EFFECT OF CONSTRUCTIVIST PEDAGOGY ON CONCEPT ATTAINMENT AND ANXIETY IN MATHEMATICS AMONG SEVENTH CLASS STUDENTS

THESIS

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बाबासाहेब भीमराव अम्बेडकर विश्वविद्यालय

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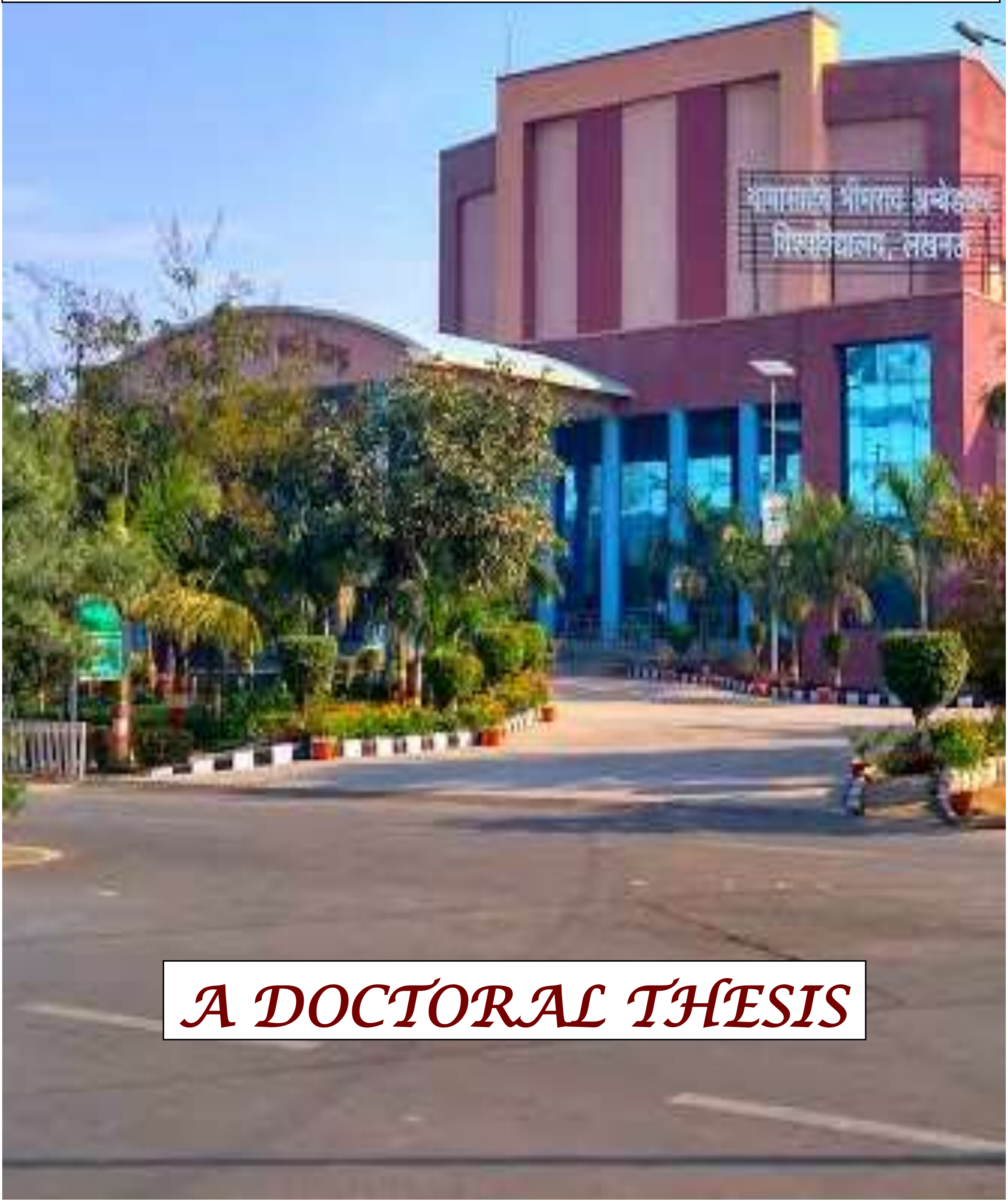

A DOCTORAL THESIS

DEDICATED TO

MY PARENTS

AND

MY HUSBAND

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Date:............. **(Neelam Suman)**

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ABBREVIATIONS

S.E.S.	Socio-Economic Status
S.E.S.S.	Socio-Economis Status Scale
C.A.T.	Concept Attainment Test
M.A.S.	Mathematical Anxiety Scale
I.Q.	Intelligent Quotient
D.V.	Difficulty Value
D.P./D.I.	Discrimination Power/Discrimination Index
C.V.R.	Content Validity Ratio
K.S.S.W.T.	Kolmogorov Smirnov and Shapiro Wilk Test
SPSS-28	Statistical Pacakge for Social Science Study- 28 Version
CA-Post	Concept Attainment Post Test
NPC	Normal Probability Curve
IQCAX	Concept Attainment Experimental Group based on I.Q.
IQCAC	Concept Attainment Control Group based on I.Q.
M.A.- Post	Mathematical Anxiety Post Test
C	Control Group
X	Experimental Group
MAX	Experimental Group of Mathematical Anxiety
MAC	Control Group of Mathematical Anxiety

IQCAXH	Concept Attainment Experimental Group based on High I.Q.
IQCAXL	Concept Attainment Experimental Group based on Low I.Q.
MAXH	Mathematical Anxiety Experimental Group based on High I.Q.
MAXL	Mathematical Anxiety Experimental Group based on Low I.Q.
IQCACL	Concept Attainment Control Group based on Low I.Q.
IQCACH	Concept Attainment Control Group based on High I.Q.
MACH	Mathematical Anxiety Control Group based on High I.Q.
MACL	Mathematical Anxiety Control Group based on Low I.Q.
CAXF	Concept Attainment Experimental Group of Female Students
CAXM	Concept Attainment Experimental Group of Male Students
MAXF	Mathematical Anxiety Experimental Group of Female Students
MAXM	Mathematical Anxiety Experimental Group of Male Students
CACF	Concept Attainment Control Group of Female Students
CACM	Concept Attainment Control Group of Male Students
MACF	Mathematical Anxiety Control Group of Female Students
MACM	Mathematical Anxiety Control Group of Male Students
SESXCAH	Experimental Group of Concept Attainment based on High S.E.S.
SESXCAL	Experimental Group of Concept Attainment based on Low S.E.S.
XSESH	Experimental Group of Mathematical Anxiety based on High S.E.S.
XSESL	Experimental Group of Mathematical Anxiety based on Low S.E.S.

SESCCAH	Control Group of Concept Attainment based on High S.E.S.
SESCCAL	Control Group of Concept Attainment based on Low S.E.S.
CSESH	Control Group of Mathematical Anxiety based on High S.E.S.
CSESL	Control Group of Mathematical Anxiety based on Low S.E.S.

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CHAPTER 1
THE PROBLEM AND ITS BACKGROUND

1.1 Introduction

A child's development is a lifelong process, we are amazed regard his ability to learn and the environment around him in which he learns. These formative years are most relevant for his language learning, physical dexterity, social development, and progressive development. It is useful in his future. The child has sufficient cognitive development before going to school.

School is the main place of formal education where traditional teaching and learning take place. Teachers teach according to the material given in the textbook through the lecture method and doing some activities. It is believed that a child is a blank slate, a teacher can write whatever he wants on it or a child is an empty vessel and teacher wants to fill it, then this will complete the education of the children. This thinking has hindered the education of children.

Somewhere the traditional teaching encourages rote learning. Education develops the inherent capacities within the child, so the aim of the teacher should be to provide opportunities for children to learn, and help them in building knowledge. For this, teachers must be given good teacher training. So, they can understand the student's abilities and teach according to them therefore, as much education is needed for development, there is a need for teacher training as well.

1.2 History of Primary Teacher Education

In the Vedic and Buddhist periods, inductive methods were used to expand education mainly, while the origin of primary teacher education in the modern era has been considered since 1802. William Carey established the 'Normal Schools' for the education of primary teachers. The Calcutta school society was established in 1819, the main purpose of its was to train teachers by the Bell Lanchesterian System, classes were started by the Native Education Society and the Elphinstone Institution for the teaching training for primary teachers. At the same time, the proclamation letter of Wood's Dispatch' was issued in 1854.

The government strengthened the system of teaching training for newly established schools and courses at the same time in 1856, the Government Normal Schools were converted into a training college. Training College opened in 1881. The various types of suggestions have been made for Indian Teacher Training Education by Hunter Commission (1882), Government of India Resolution on Education policy (1904), Calcutta University Commission or 'Saddler Commission' (1917-19), Radhakrishnan Commission (1948-49), and National Education Policy (1986).

1.3 NCF-2005

NCF 2005 has given importance to the way of child's learning. The NCF emphasized building knowledge and focused that what the child is learning is more important than knowing how the child is learning. The curriculum of education should be based on this. The NCF-2005 states that "the child builds knowledge". The curriculum and textbooks should be able to help the child to organize classroom experiences in their nature and surroundings.

If children organize the experiences of the class, then they should get the opportunity to create knowledge. In traditional education, knowledge is considered subjective, whereas, in constructivism, an individual subject considers knowledge. Constructivism is flexible according to the beliefs of the learner and existing society. It creates knowledge according to the learning context.

It is also necessary for the teacher to have knowledge of the subject matter as well as knowledge of teaching methods. The teaching method inspires motivation in learning. The teacher should develop knowledge and understanding of the students by awakening their sensation while doing teaching work.

Rousseau explores the theory of learning by doing, Maria Montessori emphasized self-learning, and Frobel made learning through the play-way method on the basis of his educational system. In the modern era, John Dewey has given learning theory based on Learning by experience. The Secondary Education Commission said in the report that "No matter how we made good and scientific the curriculum unless good teaching method is used by good teachers, all is meaningless."

NCF-2005 assumed that the teachers as transferors of knowledge. There should be diversity and challenges in learning. All children are motivated to learn by nature, drawing skills, developing the capacity of abstract thinking are the most important aspects of the process of learning.

All children are motivated to learn by nature. Developing skills and the ability to think abstractly are the most important aspects of the process of learning. Children learn according to their individual difference and from others through their own experiences by making, using, reading, dissolving, asking, listening, thinking, and meditating. They express their knowledge through activities and writing. Hence, all kinds of opportunities should provide to the students in their developmental path.

According to NCF-2005 knowledge should be linked to outside the life. The school should be enhancing the quality of education. The education system should be free from rhetoric. The child builds knowledge so the teacher should organize the educational classroom according to the nature and environment of the children. All the children get opportunities and try to understand the world around them through the process so that teaching aids should be used in such a way that the child can use them as objects. In the educational world, there are so many opportunities to stay healthy and grow. Organize the experiences of children in such a way that they must get the opportunity to create knowledge. The activities allow the teacher to focus on each child. All children will benefit from these activities. The teacher should use this type of teaching method so that the student not only repeats the given topic but is also interested in thinking by giving them an opportunity to try the learned subject matter. For example, if we convey the contents of the banking system through text or pictures. If we go to the bank with students and discuss with them about the bank, it can help the students in building knowledge related to the banking system.

Such education will be interesting and effective. Children learn from direct experiences which incorporated into their life. In the process of learning, they build their knowledge. Children should be allowed to ask questions so that they can establish a connection with the world. They should be encouraged to respond and express their experiences in their own words. These are small but very important tasks for developing the understanding of the concept in the cognition of children.

Constructivism has become popular in the world of education with the National Curriculum Framework of Education in 2005. Constructivism applies equally to both learning theory and epistemology. These experiences are reflected in the understanding of the learner. The learner learns by doing certain activities like talking with their own peers and building an understanding based on the learned knowledge and then building a concept related to that knowledge. In this way knowledge is created by the learner himself, it is called constructivism.

1.4 NCFTE – 2009

The NCFTE has been designed keeping in mind the above policies which explain the different types of arrangements on teacher education. Despite all the efforts, there was no significant positive change found in the level of primary education. Even with the enactment of the Right to Education Act on 1st April 2010, there was no satisfactory improvement in the enrollment situation in primary schools. NCFTE is committed in 2009 under the chairmanship of Mohammad Akhtar Siddiqui. Under which the following recommendations have been made to reduce the shortage of creative and reflective teachers in primary education:

1. **Improvement in Primary Teacher Education**: To improve primary teacher education, it is necessary to develop the professionality of teachers, for this emphasis has been laid on practice and skills.

2. **Increase the Qualification and Training in the Entrance for Teacher Training**: NCFTE recommended a four-year integrated degree program like a bachelor of elementary education at the University of Delhi.

3. **Elementary Teacher of Knowledge Education:** Primary teachers should be aware of pedagogy so that they can understand the psycho-social status and needs of the student. After that, it is easy for the students to teach. Teachers can apply the specific teaching method according to the growth, memory, knowledge, physical qualities of the child.

The National Curriculum Framework is as comprehensive as the structure of a subject. Teachers should have depth knowledge and understanding of the subject and use it as instructions in teaching. These instructions are related to the use of the concept of education to apply teaching-learning methods in teaching.

1.5 NCFTE- 2009 Draft

NCFTE discussion-2006 and Draft of Discussion-2009 made after a study of National Education Commission (1964-66), NPE-1968, Chattopadhyay Committee

Recommendations (1983-85), National Curriculum Framework (NCF-2005), National Curriculum Framework for Secondary Education (NCFSE-2000).

NCFTE is envisaged to reshape teacher education. The following points are the main in the planned frame of NCFTE-2009 regarding teacher education:

1. Involving the teacher in a socio-political framework to which he/she can connect the students with education, the teacher engages the student in the social structure of the learner so that the student can relate to education.
2. Involving the teacher in the real relevance of the student.
3. To bring the curriculum of teacher education closer to the concept, knowledge and learning style of the student.
4. Raising teachers above gender, caste, poverty, regionalism and community.
5. To prepare the learner for self-regulated thinking and mutual learning.
6. Teachers should be trained so that their knowledge can be reflected in the learning of the students.

Thus, as per NCFTE-2009, the teacher should keep the following points in mind regarding the learner:

1. To take care of the student without any gender discrimination.
2. Loving children like parents.
3. Provide meaningful knowledge in a diverse classroom with the atmosphere of fearlessness and joy.
4. Listen patiently to each statement and argument carefully.
5. To provide the necessary support for innovation in education.
6. Knowledge should be imparted to the student by ensuring practical participation of the student using drama, project, dialogue, discussion, observation, experiment, and other activities.

Thus, we see that in NCFTE-2009 education was influenced by play, drama, project, experiment, and observation, etc. which has been emphasized to make a qualitative and fearless environment in the classroom. All these techniques are contained in constructivism, which will be effective only when we teach after knowing the level of prior knowledge of the student then setting the appropriate method according to it. Now the Government of India also believes that permanent, intense, and highest learning is possible with the help of constructivism.

The child learns from the gained experience himself and the experience collects the information from his surroundings. This is an example of constructivism. This is an idea that encouraged academics from all over the world. Constructivism emphasizes the use of knowledge, belief, and skills in the learning experience. It presents the understanding of new knowledge which grows through the combination of old learning with new information and readiness to learn. Individuals choose the subject to accept new ideas then select a suitable unit of experience to establish these new ideas in their previously established ideas.

In the constructivist classroom, a teacher presents problems to the students. The teacher supervises and directs them in the right direction and promotes thinking in a new way. The constructivist classes have unpredictable twists because students have the freedom to make decisions. The process promotes the creation of knowledge, which is prevalent in the modern education world.

The term constructivism derives from the idea of individualism. With this idea, the learner interacts with the environment and constructs knowledge. A person lives and develops his learning in the social and cultural perspective. The creation of knowledge is inherent in him.

Construction of Knowledge

Learning - Three types of approach

Reception | **Transmission** | **Construction**

Fig. 1.1: Construction of Knowledge

The concept of construction of knowledge is completely different from the concept of Reception and Transmission. In the Construction of learning, students build knowledge of any concept through their conversation, exploration, open questions, and relationships. According to construction here learning means "Making Personal Thinking". Children create new knowledge through cooperation with each other.

If a child is seen developing from infancy to childhood, he acts only by understanding the environment around him. In this stage, language, physical ability, and social understanding develop in him. Evolution also takes place, which he also uses in his life. He acquires a large part of knowledge before going to school. The child tries to understand the environment around him through information and experiences. Constructivism has encouraged this type of learning. It emphasizes the importance of knowledge, belief, and skill. The person who understands the importance of skill then accepts new knowledge, new information, and readiness to learn based on his prior knowledge. He selects new ideas himself and uses them in new circumstances.

1.6 Constructivism

Constructivist ideology believed that learning depends on needs, instinct, growth, beliefs, and relationships. It depends on one's ideology. According to the ideology, the learner is the creator of his knowledge himself. He gains knowledge through his own experiences and interactions with others. The learner uses his foreknowledge to construct new knowledge and analyze its meaning himself. According to the constructivist ideology:

1. The learner is inclusive;
2. The learner is the supervisor.
3. The learner shapes ideas.
4. Refers to them.
5. The learner creates the meaning himself.

i) How to Create Knowledge

Knowledge or information is stored in the brain, but the experience of learning is not stored exactly in the brain. In the sequence of what we learned and what we remember, it is different properly. The reason for this is the learned fact is interpreted by us; this interpretation is based on our foreknowledge. In this way, interpretation makes sense, increases experience, and creates new knowledge.

The created knowledge is preserved systematically in the brain, in this way, the structures of the created knowledge are stored in an organized way are called schemas. The new experience is constantly added to the schema by the creation of knowledge. This implies that knowledge is being assimilated. To assimilate knowledge, one has to modify ideas oneself, that is the process of adjustment and creation of knowledge.

ii) The Constructivist Views of Learning

Constructivists Piaget, Vygotsky, and Novak did not agree with the prevalent process of construction of knowledge, they all consider the basic characteristics of constructivism, these are like this:

1. Learning is not a process of accepting information or facts through passivity, but a process in which meaning is explored, and the problem is solved.
2. New learning is based on foreknowledge. Pre-knowledge helps to understanding new information.
3. In the process of learning, old concepts are reconstituted and implemented.
4. Learning from social interaction is encouraged.
5. Meaningful learning takes place only from the activity of real learning.

When a person shares or exchanges his thoughts (Ideas) with others, then he adds the knowledge found from the other person to his previous knowledge. Freire (1994) says that - "Knowledge is not received as a gift and neither can any person's property." By identifying their problem, they tried to solve it. This implies that they create knowledge from whatever they learn.

iii) How to Children Create Knowledge

Jean Piaget (Switzerland) and L. S. Vygotsky (Russia), psychologists worked on it prominently. How children learn will need to know in the following steps -

1. To first observe an event or action.
2. Formulate hypotheses based on observation.
3. Testing hypothesis.
4. exploring results after hypothesis testing.
5. Identifying the results after testing the hypothesis.

6. To generalize.
7. Finally, find the principles.

The two main persons who first studied the ways of learning of children were Jean Piaget (Switzerland) and L. S. Vygotsky (Russia). They created a hypothesis by observing children and examining how children learn. In this process, they wrote the entire theory of constructivism.

1.6.1 Piaget's Constructivist Approach

Jean Piaget (1880–1986) discovered important theories for cognitive development. Piaget was a philosopher, biologist, psychologist, and educationist. According to him, the process of knowledge development in children is scientific. Piaget firstly noted that the child is not a small replica of elders, but he interprets the world differently. It cannot be said that the elders know more than the children, but their knowledge is structured differently. Piaget said that children learn words and interpret the words differently in their different stages. Piaget had nominated the children **"small scientists"**. They create knowledge and understanding through the process of expansion and creation of ideas. The perspective of constructivist learning Piaget given the following principles:

i) Schema
ii) Assimilation
iii) Accommodation
iv) Equilibrium

i) Schema

Children learn through exposure to concrete experiences again and again. They make conceptual images for the understanding in their own mind or we can say, make a learning scheme. for example: when the child is born, then he/she drinks milk. As the child grows up, he seeks another scheme of nutrition. In this way, his experience creates schemas for changed old methods of learning. Organized patterns of behavior that can be easily skipped are called schemas. Like: Every day a child collects some books in his bag, wears shoes first, sits on the stool, then wears socks, and then wears shoes.

This organized behavior is called a schema. According to the schema "In different contexts repeatedly apply the same condition, the action which is broadened and improved is called the schema." The child's schema is the way to perform his action, not the result of his actions. It can be said that the schema of two persons of the same background can be different. Therefore, the cognitive representation of an activity or object is called a schema.

Definition of Schema

The schema of a concept is a sketch representation of a person's understanding of that concept and its properties and its relationship with other concepts. The schema does not remain the same for a long time in the person. The schema also changes when the understanding of the concept is changed. The schema keeps expanding with adjustments and changes in the person from time to time.

ii) Assimilation

Applying the thought process to a new situation is called assimilation. Children are not able to learn any information completely, their education is selective.

iii) Accommodation

When a new plan is changed by modifying the previous plan, this process is called assimilation. When the child assimilates the present plan with a new experience it is called accommodation. For example, in the schema of a child, all birds can fly in the sky, but the peacock will have to change that schema because the peacock, being a bird, cannot fly in the same way. For this, children have to deal with their current experiences. While struggling, they can maintain and update the schema. In this way, new experiences develop new schemas.

iv) Equilibrium

Hummel (1998) said that the process of consistency of knowledge requires integration. The child tries continuously to explain and understand the world while struggling with new experiences. It is a challenge for the child that he can adjust his schemas and expand by adjusting to new experiences.

a) **Assimilation -** The thought processes by which a scheme is applied to a new situation.

b) **Adjustment –** The thought of processes that applies a scheme to a new situation by which the old scheme is changed, it is called Adjustment.

c) **Expansion -** The expansion of the scheme as a result of the adjustment. Assimilation and adjustment always go hand in hand. When we assimilate, we act on the world based on whatever we already know. When we indulge in the adjustment process, we react concerning the world as a result of our actions and changing our previous knowledge.

(A) Teachers can Conduct Activities in the Constructivist Classroom

i) Repeating, practicing the same action for a long time.

ii) Giving opportunities to use an action on different objects in different ways will develop the process of assimilation into the scheme.

iii) Giving opportunities to children to perform several activities together will expand the schema of children.

(B) Stages of Cognitive Development

Cognitive development passes through four stages which are as follows-

i) Sensorimotor stage.

ii) Pre-operational stage.

iii) Concrete operational Stage.

iv) Formal operational Stage.

i) Sensorimotor Stage

This stage begins from birth to 2 years. In this stage, various physical activities develop in a child i. e., physically few things have to be thrown around, caught things, identify, put into the mouth, etc., by doing this kind of activity, and there is a growth of the muscles of the child.

ii) Pre-operational stage

The pre-operational stage has been considered from 2 years to 7 years. In this stage, children think about something, i.e., object, word, statue. After 4 years, children are involved in mental activities-addition, subtraction, multiplication, and division.

iii) Concrete Operational Stage

The Concrete operational stage has been considered from 7 years to 11 years. In this stage, children easily solve problems by performing mental operations based on two objects i.e., solid objects. But if the problem is in the form of a literal statement in place of things, then they cannot conclude by performing mental operations.

iv) Formal Operational Stage

The Formal Operational Stage starts from 11 years until a young age. In this stage, the thinking of the teenager becomes more flexible and effective. Now they can think about the solution to any problem imaginatively. In this stage, students become capable of abstract thinking.

(C) Educational Implications of Piaget's Theory

i) The role of children is considered active and important. The need, interests, and age levels of the children should be taken into consideration while preparing the curriculum.

ii) Cognitive development should be done by giving education to children through the play-way method.

iii) If the level of formal operational thinking is to be increased by the teenagers, then it is mandatory to give education abstractly.

1.6.2 Vygotsky's Constructivist Approach

Lev Vygotsky (1896-1934) presents the social vision of a progressive analysis of cognitive development. Russian psychologist Vygotsky observed the interaction between society and its cultural relations as an important dimension in the cognitive development of children. Like Piaget, Vygotsky (1896–1934) also believed that children construct knowledge. Cognitive development cannot be monolithic. It is in the context of language development, social development even physical development as well as socio-cultural context. Vygotsky said, a developmental approach is needed to understand the cognitive development of the child, which tested to a child from his infancy to adolescence and identifying the modification into his behavior.

Vygotsky believed that language is the tool that works as a cognitive mediator. Based on this, he also believes that the language is an important tool for cognitive development. According to his, in early childhood, the child starts to use language as a tool in the planning and problem solving of his work. Vygotsky also believed that cognitive skills are indulged in social and cultural relations.

According to Vygotsky, biological factors play very little but a basic role in human development, whereas social factors play an almost complete and important role in higher cognitive processes (such as language, memory, and abstract thinking). Unlike Piaget's theory (in which biological situation and development play a leading role in learning), according to Vygotsky's theory, learning and development go along with the mediation of the cultural and social environment. He says that the development of the child cannot be separated into social and cultural activities it is inherent in these activities.

Vygotsky believed that knowledge is situated and supportive in the external environment. It means knowledge of different individuals of the environments (e.g., objects, tools, books, human creations, etc.) and communities is different. This theory suggests that the process of knowing is better qualitatively by interacting and co-occurring with others.

Based on these claims, Vygotsky gives specific and effective ideas about learning and development therefore, he emphasizes that the nature of cognitive development is social, not cognitive in fact, as Piaget believed. Piaget's theory is cognitive constructivism, while Vygotsky's theory is social constructivism. From these words of Vygotsky, it is also more obvious - "Our development is hampered by others."

Thus, according to Vygotsky, all mental or intellectual activities first take place in the world of the external society, and through interactions, children learn the culture (ways of thinking and behaving) in their community. Vygotsky has created different social environments and favors the emphasized role of family, community, friends, and school in children's development.

i) Zone of Proximal Development, ZPD

Vygotsky defines the difference in performance between a child performed with no assistance and a child performed with the help of an adult or a more skilled partner. In other words, the area between the child who is doing and who can do is called Zone of Proximal Development (ZPD).

ii) Scaffolding

Scaffolding is a technique that changes the level of support. Children have unorganized theories while skilled assistants have systematic logical, and intelligent ideas. During teaching or in cooperative learning, a teacher or co-worker with more skills adjusts his / her counseling according to the current performance of the learner. For example, if there is a new problem in which more instructions are required, in this situation, according to the students' ability the teacher increases practices and decreases the number of instructions.

iii) Language and Thoughts

Vygotsky said that dialogue is an important tool to build the cognitive structure. Vygotsky believed that children use language not only for social communication but also for self-directed work, in planning, directing, and evaluating their behavior. For self-direction, the use of language is called internal self-language or private language. Piaget considers private language as self-centered and immature, but according to Vygotsky in early childhood, it is an important tool to propagate the child's thoughts. He explained the socio-cultural context of cognitive development. The principle of cognitive development of Piaget, in which the child learns by exploring himself and emphasizing the process of maturity, is not accepted by Vygotsky.

Vygotsky believed that social factors and language have an important place in the cognitive development of the child. He has the opinion that the child can understand the complex ideas of the elders with his older fellow child, which he might not understand alone.

According to him, cognitive development takes place in an interpersonal social situation. In this situation, the actual exiting level of the child is the Level of Actual Development, at this level they can work without any help. In the difference between these two levels of development, Vygotsky named Zone of Proximal Development (ZPD). The area of proximal development can be understood in such a way that it is a limitation of such difficult tasks that it cannot perform alone but it is possible to do if anyone (some classy people, elders, or skilled companions) support to complete the task.

Zone of Proximal Development is so important because it helps to know what children can do at their level from which teachers or parents can extend a child's cognitive development to the boundary area of biological maturity. There, the teacher and students act in the same order and the teacher is ideal for the driver, which the child follows.

In all these end-actions, the teacher acts as a scaffold for the child, in which the teacher supports through this the new work done by the child. Then students start working independently without any support slowly. Scaffolding refers to a mental structure that is provided by the teacher to the child as support while performing new tasks or new thoughts.

According to Vygotsky, language is the dominant place in cognitive development. He believed that the children use language to plan and direct their behavior, not just for communication.

1.6.3 Bruner's Constructivism

Jerome Bruner (1960) is a twentieth-century constructivist. His book, "The Process of Education", contains his views on constructivism in 1960 that advances Vygotsky's ideas. His ideas and work are influenced by Vygotsky's social constructivism, which was produced in the form of a well-known theory Scaffolding, i.e., assisting the learner in their early stages of learning, which is supported in the right amount and decreases as learning progresses. The basic hypotheses of Bruner's social constructivism are:

- Children build their new idea based on their current knowledge.
- Learning is an active process.
- The process of learning, selection, conversion of facts, decision making, hypotheses making, extracting meaning from the fact and experience is possible.

If the learner understands the basic structure, then the perception of any subject is better. For this, he valued the importance of classified learning. In this, the learner actively constructs structures and automatically identifies the principle.

Interest is the best stimulus for any type of learning. Bruner also proposed the ‘spiral curriculum’, meaning readiness for learning, in which children are given basic ideas on a concept according to their cognitive ability around which they build their perception and knowledge deeply.

(A) Bruner's Three Levels of Intelligence

Another very important contribution of Bruner is three levels of intellectual development:

i) **Enactive (Action Based, 0-1 years):** The enactive stage exists from 0 to 1 year of age of a child. It is action-based. In this stage, the child's thinking is based on physical actions and he learns by doing.

ii) **Iconic (Image-Based- 1-6 years):** The iconic stage exists from 1 to 6 years. The concept involves learning with the help of formats and images it is named "Iconic". In this stage, the brain accepts the information in the form of a sensory image and thinking which is based on listening.

iii) **Symbolic (Language-Based, above 6-7 years):** This stage exists from the age of 6 to 7 years in the child. This is the third and last stage. It is called "Symbolic". In this, the child develops the ability to think abstractly.

1.6.4 John Dewey Constructivist Approach

John Dewey (1859-1952) was a philosopher, psychologist, and great educationist whose constructivist outlook is reflected in his educational philosophy. According to him, education aims to reconstruct experiences and integrate with the environment to develop social skills. To fulfill such objectives, by acting their own and realizing these experiences that children have to interact with the environment. In this process, the child acquires knowledge, creates knowledge, and prepares himself for society.

(A) Curriculum of Education

According to John Dewey, the curriculum of education should be child and society-centered. It should be based on the interest of the child. If the curriculum is focused on the child, it means that the maximum opportunity for the creation of knowledge will be available to the children.

(B) Education Methods

Following are the different stages of education methods which John Dewey has considered to be good-

i) Problem realization

ii) Problem analysis

iii) Hypotheses Construction

iv) Hypothesis-testing

v) Result

These are the steps at which knowledge is created. According to Dewey, the process of teaching-learning should be based on the interest of the children and give them opportunities to talk. They should be given opportunities to do it themselves and find themselves.

1.6.5 Joseph Novak's Constructivist Approach

Joseph Novak's views on learning are highly influenced by Ausubel's Assimilation Theory. He proposed the creation of knowledge through **"Meaningful Learning".** In his words, "The complete learning possible through an action leading to thinking, sensation, and empowerment for promise and responsibility".

Novak argued that "Learning is an effective experience; it is an illusion of pain and anxiety, and is the happiness and enthusiasm that a person knows when he recognizes a new meaning. The creation of new knowledge is a special kind of full learning in any field." The child tries to identify the connection between his prior knowledge and new experience and facilitates the creation of new knowledge. He believes that the learner should be responsible for the creation of knowledge for his learning.

(A) Human Constructivist Model of Learning

Novak believes that in the acquisition of new knowledge, the child contributes a critical role. He has called his idea humanistic constructivism. Nowak (1993) presents the Human Constructivism Model of Learning. Human constructivism believed that in any research work or scientific work, the creation of new knowledge has to be done. There is a relation between foreknowledge and new knowledge which helps derive the meaning of knowledge created by individuals. It is a technique of making meaning that is embedded in the complex form of language that human beings have to adopt it is called human constructivism.

(B) Concept Mapping

Another important contribution of Novak's learning process is the "Concept Map". It is a method that helps in making the whole meaning of new knowledge based on finding new affiliation in the present. The concept map helps to organize the scattered thoughts of the learner in one place and establish relationships between them. It can also be used as a method of assessment by which the quality of learning can be improved and he believed that the teacher should follow this:

i) The teacher should create an environment in which the learners share their objects with others.
ii) The teachers should develop their meanings from the objects.
iii) The teacher should praise what the child is learning and also tell that understanding never ends.
iv) Learning should be interactive.

1.7 Types of Constructivism

Constructivism is known as a tool to give different perspectives with different multiple perspectives. It is believed that with the help of multiple perspectives people can understand the meaning and severity of various social, psychological, and educational problems. Ernst Von Glasersfeld (1995) said "There are many varieties of constructivism" while Burning has described three types of constructivism.

a) **Exogenous Constructivism**: In this type of Constructivism, prior ideas are reconstructed.

b) **Endogenous Constructivism**: In this kind of Constructivism abstract knowledge is developed from cognitive actions based on future predictions.

c) **Dialectical Constructivism**: Dialectical constructivism is the origin of knowledge that is dependent upon socio-cultural interaction between the learner and the environment.

After reviewing the literature related to constructivism it was found that constructivism follows:

i) Cultural Constructivism

ii) Radical Constructivism

iii) Critical Constructivism

iv) Psychological Constructivism

v) Trivial/Personal Constructivism

vi) Genetic Constructivism

vii) Developmental Constructivism

viii) Epistemological Constructivism

ix) Epistemic Constructivism

x) Metaphysical Constructivism

xi) Cybernetic/Second-Order Constructivism

xii) Transactional/Situational Constructivism

xiii) Exogenous Constructivism

xiv) Cognitive/Endogenous Constructivism

xv) Dialectical/Social Constructivism

i) Cultural Constructivism: When the construction of knowledge and reality is believed by culture then that approach is called Cultural Constructivism. It is the possibility of two independent cultures having different classifications coming together. This means that we can separate the world based on a different culture.

ii) Radical Constructivism: Von Glasersfeld introduced the preface of 'Radical Constructivism'. He believed that "knowledge is a self-organized cognitive process of the human brain. Knowledge is created by person which is based on the unique experience of the individual. It is based on many realities not on one reality" (Von Glasersfeld). Radical constructivism is described as a process of dynamic adaption towards the reliable interpretation of experience.

Maturana & Varela (1987), Von Foersrer (1984) and Von Glasersfeld (1984) expressed their views on radical constructivism that is ruled out the possibility of objective knowledge. So according to them, the entire knowledge depends on the mental structure of the knower. Knowledge is not a collection of sensations, but it is created. In this way, the observer created the world himself as an object dependent on each other. Maturang and Varela (1987) said that living beings were creators and producers themselves. They have the ability to create their own organization which is developed and organized by them. The main basis of Radical Constructivism is-

1. Significance only exists in the mind so it cannot be transferred.
2. The person makes only understanding about a person that he is a person.
3. If it is a matter of communication then there can be talk but we can only share the meaning of the conversation.

iii) **Critical Constructivism**: The social and cultural environment accepts the existence of constructivism with which to improve this environment by creating new knowledge. It connects various important aspects. Critical constructivism can also be called 'Social Knowledge Epistemology' (Taylor, 1996). It relates to the cultural perspective and plays a guiding role in cultural reform.

iv) **Psychological Constructivism**: Psychological constructivism is related to the purpose of education generally, in which the Childs interests and need is supported in his education. It is a child-centered approach that tries to naturally identify the cognitive development of the scientific study. A teacher should give various opportunities for the students to solve dilemma tasks and questions with help of their psychological development. According to psychological constructivism, development is a long-lasting permanent, natural and biological process that is the same in every person. It is an unknown approach to teaching and learning.

v) **Trivial/Personal Constructivism**: Von Glasersfeld (1984) believes that new ideas are first generated in one's mind. It is also called personal constructivism.

vi) **Genetic Constructivism**: Here genetic means, not heredity but understanding the origin of cognitive form. Genetic Constructivism believes that the work on cognition in all humans is similar. It is characterized by cognitive function. If assimilation and accommodation make up the cognitive adaptation of different objects then the cognitive types are the same in all individuals. Genetic Constructivism presents its claim through this adaptation of human social and historical needs according to his knowledge makes plans and structures. We can also say that there is no special difference between general sense and scientific understanding but it can be a structural differentiation.

vii) **Developmental Constructivism**: Developmental Constructivism believed that knowledge is the active construction of the knowing subject. It keeps trying to find the balance i.e., the cognitive system is very essential for order and stability. It expresses the objective concept of truth between mental representation and reality. Knowledge never expresses the entire reality. The known fact demands a new higher level of justice**.** Developmental Constructivism considers knowledge equivalent to conflicts, i.e., it has the ability to encapsulate the environment of the knowledge structure of any individual.

viii) **Epistemological Constructivism**: Epistemological Constructivism studies the various theories of knowledge not the principles of knowledge. Accordingly, the most important is how to reach different theories of knowing that how can be known to the unknown or mainly focuses on the functional method of knowing.

ix) **Epistemic Constructivism**: Epistemic Constructivism focuses on the nature of knowing. It places less importance on the method of knowing and more on the nature of knowing.

x) **Metaphysical Constructivism**: Metaphysical Constructivism holds that reality is not just physical and tangible but it is abstract or we can say that there is a reality beyond physicality which is called metaphysics.

xi) **Cybernetic Constructivism**: Cybernetic/Second-Order Constructivism is based on the concept of construction which is also called self-formation. Chilean (Cell-Biologists) Humberto Maturana and Francesco Varela introduced the concept of self-formation. Following are basic points of constructivism:

2) It can be identified by its extent.
3) It is analyzed by its component.
4) These constituents follow the general natural law in interaction, i.e., it is a natural system.
5) This system creates its border.
6) It is a self-productive system that uses only its components.

7) It creates the system limitation itself.

xii) **Transactional/Situational Constructivism**: It says that by participating in real-world activities to a subject matter one can gain knowledge of that subject. By using a subject matter in its context students can understand the deep meaning of that subject. Situated cognition here assumes that knowledge of most of the content is dependent which can be brought to notice through the signals produced when experienced directly. Direct experiences gained from the current problem are even more important.

xiii) **Exogenous Constructivism**: In Exogenous Constructivism, pre-formed ideas are reconstructed. It restores the truth of the world and builds knowledge. The organization of the world develops in the mental structure of a person his thought is re-practiced with the real veracity of the world and when necessary significant improvements are also made in it.

xiv) **Cognitive/ Personal/ Individual/ Endogenous Constructivism**: In cognitive constructivism personal knowledge of devotion is constructed in an attempt to balance the mental imbalances resulting from internal cognitive conflicts. The appeared external knowledge in any person is the manifestation of his inner sense. The learner creates a cognitive structure by sharing knowledge with his followers and developing a new sense in cognition is known as Cognitive Constructivism (According to Jean Piaget). The learner starts learning from birth and continues to build his/her knowledge for a lifetime. It is a continuous process that goes on throughout life.

Endogenous constructivism focuses on the creation of internal and personal knowledge. Piaget's theory has led to endogenous constructivism. The child develops his schema by examining various phenomena as he continuous to gain experience at the same pace. Cognitive/endogenous constructivism is the theory of Jean Piaget related to the cognitive development. Students update their cognitive structure by adding understanding to their prior understanding.

The age and stage according to Jean Piaget's theory that explains man's development are as follows:

1) Man creates his knowledge himself which is based on experience.
2) Experience makes schema.

3) Schema is a mental format.

4) Schema changes due to the process of assimilation and accommodation.

xv) Dialectical/Social Constructivism: When people of different communities meet each other, share experiences, compare and debate then new knowledge is received under Dialectical/Social Constructivism. The same process occurs between the teacher and the learner. The recipients of high social interaction between groups or individuals are the results of learning recipients. Information interacts with facts, adds new knowledge, purifies entire knowledge, and thus enhances knowledge.

Social constructivism is an idea of Vygotsky's theory related to sociocultural learning. The basic property of social constructivism is the mixed and abstract knowledge derived from social interaction. Thus, the cognitive transfer of social interaction is social constructivism that a person gains knowledge himself. Knowledge is created socially, although the social experiences of each person is different. This gives importance to the context and culture-based strength of learning. This knowledge originates from society. Based on social understanding, the knowledge would be created. Knowledge is created mutually (According to Make Mohan, 1997 and Derry 1999). Social constructivism in cultural and historical context gives importance to learning according to knowledge. Social relations and social interaction are facilitated by creative action. It also formulates the principle of human development which is influenced by the socio-cultural environment.

1.8 Constructivism in Education

The teacher needs instructions based on constructivist theory. Three areas are essential for the effective transmission of knowledge in education. The constructivist approach includes knowledge of general education, knowledge of content, and pedagogical knowledge of content. Constructivist pedagogy acts as a bridge between theory and practice. The following component is required for constructivism in education-

1. Learning takes place authentically in the real world.
2. This learning involves social conversation and thinking.
3. It should be relevant to the content and skills of the learner.

4. The content and skills should be related to the foreknowledge of the teacher.
5. Students should be assessed and served to inform future learning experiences.
6. The student should be motivated for self-discipline, autonomy, and self-awareness.
7. The teacher should initially be in the role of a mentor, facilitator, and not a teacher.
8. The teacher should be encouraged to present the content from different perspectives.

1.8.1 Constructive Learning Approach

The following are the major learning approaches of constructivism:

1. Learner-Centered approach.
2. Experimental Learning.
3. Concept mapping.
4. Problem-solving.
5. Investigatory approach.
6. Creative Writing.
7. Social inquiry approach.

1.8.2 7- E Constructivist Model

In constructivist approach, teaching-learning has to pass through seven stages while constructing knowledge which is known as 7-E constructivist model of learning. Here 7-E is expressed under the following constructivist ideology-

i) Elicit

ii) Engage

iii) Explore

iv) Explain

v) Elaborate

vi) Evaluate

vii) Extend

i) **Elicit**: The meaning of eliciting is "come to attention". The child sees the events around him and tries to understand. At the same time some things come to his attention they can come either by themselves or meditated by the teacher. In this phase the teacher asks open-ended questions related to his/her previous knowledge to bring attention to the student which can be used to create a mind map related to the asked fact so that the teacher tries to find the learning level of the student by asking open-ended questions.

To answer the open-ended question the student also interacts in his group which creates a common mind map. The teacher checks the mind map of students and when the misconception is understood the teacher improves it.

ii) **Engage:** In this phase the child is activated to ask questions related to attention and foreknowledge. By making the problem, children were motivated to ask questions. In this way, children become fully engaged in the activity. Children share their experiences related to the concept and ideas with friends. At the time of partnership, children understand the process, recognize the skills, and get busy to developing their knowledge.

iii) **Explore:** When the child is busy with some action, then he will learn while doing some work. The teacher should give the children to perform such actions so that the child can join the learning process while searching.

iv) **Explain**: In this stage, children explain the discovered knowledge, make understanding and identify the concept. Here children are provided opportunities to interpret, learn new skills. The teacher has to explain the formal words and definitions used for concepts, procedures, and skills.

v) **Elaborate:** This phase provides opportunities to students to build retention, understanding, extend skills. In this phase, students try to understand the depth of the concept.

vi) Evaluation: In this stage, the learner has assessed what study matter student has learned such as concepts, processes, skills, etc. In this phase, the teacher evaluates the various skills taught to the students and also removes their confusion.

vii) Extend: In this phase, the students make more generalizations of the facts learned. The child spreads and expands what he has learned. They begin to experience the facts learned in their daily life and expand the learned concept personally and add experience and create their new knowledge. In this stage, the child starts looking at the various creatures around him and tries to find the chain between them. Even in this stage, he keeps getting the guidance and instruction of the teacher.

1.8.3 Educational Implications of Constructivist Approach

(A) Role of Constructivist Teacher

The teacher's role is changed from "Transfer of Knowledge" in the constructivist class to "Facilitator in the Creation of Knowledge". Students are being given knowledge in unconnected parts through traditional teaching and students are often expected to present the same type of knowledge and remember the future in the same way as they had received. The children are not able to use their creativity in the way of presenting the received knowledge in pieces in the same way.

As a result, there is no clear perceptual understanding of that knowledge. To change the pattern of creation instead of rote knowledge the teacher has to accept that the child comes with his / her previous concept which is exist before joining the school. The teacher plays a broad role as follows-

i) Conceptual Change: No theory can be easily replaced the brain does not reject any schema for a new schema. The brain has to interpret the new knowledge in terms of old knowledge. It has to be adjusted so that it can enter into new knowledge. This is called a conceptual change. Conceptual changes can be done in the teacher classroom:

1. Ask proper questions like how and why.
2. Talking about different ways of solving problems.
3. Classifying various methods of problem-solving.
4. Explain the concept understood by students.

ii) **Learning by Heuristic Method-** In this method, children are instructed to use a lot of materials and which is given by the instructor or they can also be instructed by the students themselves.

iii) **Procedural Knowledge and Skill Learning**: Procedural learning means knowing the process of learning. Procedural learning is a continuous process. It starts from the first day of birth. To develop procedural knowledge and skills teachers should mention these points:

1. Children should be given maximum verbal instructions and opportunities to observe new processes.
2. Repeatedly given opportunities to practice the same process.
3. Procedural knowledge and learning skills are latent, can be learned only by watching the process so it is important to show the process.
4. The process should be practiced until it starts doing the process on its own.

iv) **Context-Dependent Reasoning Power-** Students can read, understand, or remember some specific facts. Consider that thinking this is a major part of constructivist pedagogy. Parkins called it "Informal Logic Power". To develop context-dependent reasoning power teachers should mention these points:

1. Talking to children about the open issue games to know their opinion like Playing is important for health and by watching TV, there is only the development of knowledge.
2. Organize a debate competition.
3. Asking how and why questions

v) **Mutual Learning-** In 1980 psychologist N. Brownie and his co-worker talked about mutual pedagogy. It transforms the classroom into a collaborative learning community. The student takes responsibility for his learning. Mutual learning is a communication between the teacher and the students to increase the metacognitive skills of the student during this process.

vi) **Teacher's Role to Established Mutual Teaching and learning**

1. In mutual teaching and learning, the teacher can divide the class into several groups of class 6 to 8 students.
2. Teachers can go around the classroom wherever guidance or help is needed.
3. The teachers teach the concept through an activity to the children.

4. Students gradually understand the concept through the activity and start doing it themselves.

- **Readiness-** The way to receive the knowledge of children is different from that of adults. Children learn in their way so there should be a focus on child-centered education. The selection and preparation of teaching methods should be done according to their developmental stage and level. The teacher should encourage the children to ask questions to create learning conditions while using them.
- **Active Learning:** Piaget says that the child is not able to easily acquire knowledge but the child learns actively by connecting with some process. Therefore, participation in learning is essential. The interest in the children is awakened and understanding developed by actively engaging them. The child can become understand the concept by connecting with the process. Therefore, Piaget says that children should be allowed to learn by doing.
- **Learning by Mistakes**: According to Piaget, education should be made logical. If children give wrong answers, the teacher should be asked to prove their answers instead of telling them their mistakes. This will give the children the necessary reasoning for their answers. Let the children learn by making mistakes instead of putting them on the wrong side.
- **Peer Interaction:** According to Vygotsky, socialization is a major part of education which consists of learning while interacting with a partner. According to Birch (1998) in this type of interaction the children present their point of view, the choice of the partner should be accepted simultaneously and the partner should be the same cognitive level.
- **Use of Real Material**- It is difficult for children to acquire abstract knowledge and they should be given opportunities to learn using real material.
- **New Concept-** Children should connect with old knowledge and tell about new knowledge so that children assimilate and integrate knowledge. For example, to teach a table of two, if they can learn how to make a table, then they can also make tables of other numbers.

- **Asking Questions-** The teacher should ask the children more and more questions during class teaching.

Role of the Learner in Constructivist Approach

In the constructivist approach, the role of the learner is as follows:

- The students formulate hypotheses by examining the question, guess, design, etc. with their ideas and discussing the results, and finding the conclusions personally. This familiar situations and concepts apply to new situations.
- The learner examines the validity of his idea. For example, multiplying three by three will bring the child to see it again and again in different ways. Like, I would also believe that multiplying 3 digits 3 times (3x3= 9) or adding 3 to 3 times (3+3+3= 9) would result in nine marks.
- The learners take responsibility for learning themselves.
- Constructivist learning process is academically flexible. It motivates participatory learning and partnerships with their participants.

1.9 History of Mathematics

Before the development of mathematics, ancient mathematical texts have appeared in various places. Plimpton C. 322 BC, Babylonian Mathematics 1900 BC, Moscow Mathematical Papyrus, Egyptian Mathematics C. 1850 BC, and Shulba Sutra in Indian Mathematics 800 BC. It is believed that all these ancient texts were related to the ‘Pythagorean Theorem’. It appears that they developed after arithmetic and geometry. Egypt introduced the concept of ‘prime number’ and ‘multiplication’.

The origin of Indian mathematics is believed to be from 900 BC to 1200 BC. The Indus Valley Civilization which divided into North India and Pakistan developed the same weight and decimal system. The streets were built, on the right angle and ratio in the present area. With this, there found evidence that various geometrical shapes and designs were used in this civilization, including cuboid, barrel, cylinder, cones, concentric, and each other cutting circles and triangle shapes.

Based on old evidence about the mathematics of Harappa, it can be believed that this civilization used the base ‘8-digit system’. Different numbers and enumeration materials have been found in the mantras of ‘Shukla Yajurveda Samhita’.

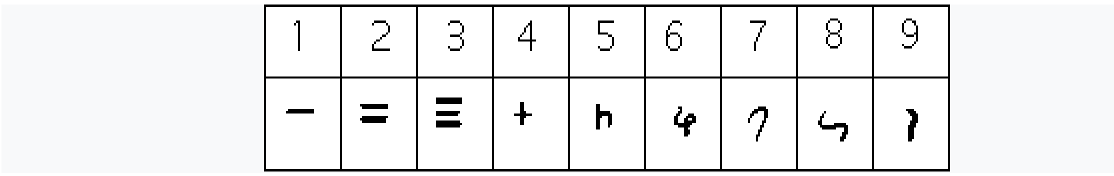

Fig. 1.1: Brahmi Numerals

In the 5th century BCE, Panini made the grammar rules of Sanskrit. His notation was like mathematical symbols. The ‘Brahmi numerals’ were produced in the 3rd century BCE. Vedic mathematics began with_the ‘Shatapatha Brahmana’ in the early Iron Age in C. 30 BC.

The value of ‘pie (π)’ has been found written up to two places of decimals. Evidence for the use of ‘irrational numbers’, ‘prime numbers’, ‘rule of three’, and ‘cube root’ has been found in the geometrics chapters described in the Shulba Sutra dated 800-500 BC. The value of the ‘square root of two’ was known by the scholars concerned with the ‘five places of decimals. Along with giving the method of ‘squaring of circles’, solving ‘linear and quadratic equations,’ gave the ‘Pythagorean Theorem’, as proof of the ‘Pythagorean triple’.

Jayana mathematicians studied mathematics between 400 BC-200 BC. They developed ‘transfinite number’, ‘set theory’, ‘logarithm’, ‘indicators’, ‘permutations’ and ‘combinations’, ‘square’ and ‘square root’. They also developed ‘finite and infinite powers. In India, the ‘Bakhshali Manuscript’ was written between 200 BCE-200 BC. In this, ‘zero (0)’, ‘negative number’, and ‘quadratic equation’ were developed and used. In India developed the prevailing mathematical numerals ‘zero (0)’ and ‘decimal (.)’. Thus, the credit for the discovery and development of various basic mathematical concepts is given to India along with various countries in the order to contribute to mathematics.

Students have been experiencing difficulty in understanding various mathematical operations since ancient times. Some students understand mathematical operations easily, but most students spend time on them. The mathematical operations are the basis of various mathematical concepts. Students of mathematics must study mathematics subjects according to the syllabus.

We know that mathematics is a core subject in our education system both at the primary and secondary levels. A single negative experience in mathematics is sufficient to create a negative attitude toward mathematics.

Everyone knows this worrying state of mathematics teaching but very few people try to find out the causes and implement ways of improving mathematics teaching. Many reasons can be related to students' failure to learn mathematics such as defective syllabus and defective teaching methodology, etc. The nature of instructions of mathematics is being altered now a day. To make this kind of mathematics instruction appreciate, lots of suggestions have been made by many mathematics educators. For this, teachers should know how students can learn mathematics and how can teach best.

The 1960s, the 1970s, and 1980s developed prevalence in scientific inquiry due to the radical paradigm shift in the academic era. Constructivism is used in Mathematical education and science education to identify the problem in the learning process. In science and mathematics education constructivist approach is used to identify and solve the upcoming learning problem. Not only this it is used to identify the simple methods of the learning process from which student learning becomes easy and short time taken in comparison to traditional teaching-learning method.

Usually, the student faces many problems to learn mathematics and science principles due to their high typicality level and if they understand the principle of these subjects they have to face the problems to solve the mathematical problems of these subjects. There are several numerical bases upon the situation of an event in the form of a question which the students imagine in their consciousness. Therefore, it is no easy task for every student. Few students can do this and other faces problem and take stress in their mind.

If constructivism is used for mathematical education, then mathematical learning for the student becomes relatively simple and understandable. By which mathematical concepts are marked in the brain of the students. As a result, the student receives relatively permanent learning of that mathematical concept. Thus, the use of a constructivist approach in mathematics education can lead to a joyous role in the simple and steady learning of mathematical concepts.

Thus, the famous prevalence that science and mathematics subjects are very hard to understand according to the student. Therefore, the constructivist approach is used to make it easy to understand the facts of these subjects and solve the difficulty of the learning process in the mental structure of students. According to an educational perspective, the students handle many problems to do mathematical operations. Due to mathematical typicality students faces various problems regarding mathematics so a phobia originated in students psychologically. It creates anxiety related to the mathematics subject.

1.10 Origin of Anxiety

The word anxiety is derived from Latin substantive 'angor' regarding the verb is 'ango' (to constrict). In 1972, Richardson & Suinn developed the first rating scale of mathematical anxiety. This is MARS (Mathematical Anxiety Rating Scale). They define mathematical anxiety as the feeling of apprehension and stress to do solve mathematical problems with the help of various formulas and operations. Joseph Levy-Valensi (1879-1943), a professor of psychiatry in Paris, believes that anxiety is a negative and distressing feeling of expectation. It is a cognitive aspect of worrying. The study of mathematics anxiety has begun in the 1950s at the time of Marry Fides. He explains the word 'Mathemophobia' to illustrate the phobia which is generated due to mathematical operations. Hembree, (1990) investigated through a meta-analysis and he found that mathematics-related anxiety becomes generated into the student when he presents a poor performance and obtained low academic achievement in mathematics. The anxiety belongs to a negative attitude regarding the subject and is generated in the problem-solving process in mathematics. Mark H. Ashcraft, (2002) states that mathematical anxiety is "A feeling of tension, apprehension, or fear that interfaces with performance."

Some great contributors who have given a suitable direction to the mathematical anxiety in research are as follows: (Young-Loveridge, 2010), (Hunter & Anthony, 2011), (Whyte 2009, Miller &Bischel 2004), (Freiberg, 2005), (Zambo & Zambo, 2006), (Else-Quest, Hyde, & Hejmadi, 2008), (Dossel, 1993), (Fraser & Honeyford, 2000), (Bernstein, Coté-Bonanno, Reilly, Carver, & Doremus, 1995), (Latterell, 2005), (Gurganus, 2007), (Higgins & Parson, 2009), (Neill, Fisher, & Dingle, 2010), (Young-Loveridge, Taylor, Sharma, &Hāwera, 2006), (Shields, 2005), (Watson, 2000), (Walshaw & Anthony, 2008), (Wolodko, Willson, & Johnson, 2003), (Middleton & Jansen, 2011).

Mathematics is a subject that many children like very much, while some students remain in awe of this subject. You will have told your child many times to generate interest in this subject. It is a scoring subject and after a little hard work, you can easily get full marks in this subject. Due to excessive pressure on children regarding this subject, they start getting tense. After a short time, they start to hate this subject. According to a recent study, now they are also being victims of mathematical anxiety because of the increasing hatred for mathematics in students.

A study conducted by the Center for Neuroscience in Education revealed that most children are suffering from stress due to mathematics. In this study, the parents and teachers of the children were cited as the cause of their stress. The sample of the research contains 1000 Italian children and 1700 children living in London. After doing these studies well, the researchers concluded that girls are more prone to mathematical anxiety than boys studying in primary and secondary school. The study also revealed that children already find the difficult subject, due to which they feel stressed. In addition to fear of getting low marks in this subject, they do not overcome this stress.

Denise says that it is true mathematical anxiety can occur in every child for a different reason. We have discovered some reasons that are the same for both primary and secondary children. The conclusion of this research is that the children have complained that this subject is taught in their school in different ways. Due to this, they often get confused, while the secondary school children said that due to poor relationships with parents and friends, they are stressed, apart from studying with every student of the class.

It is surprising that children who are strong in Mathematics also feel stress in many situations of mathematical learning, but those children who are good in Mathematics, their parents give importance to their marks always. The tension starts to increase in the situation that they are unable to perform in the field in the future when they are better. According to the researchers, this growing trend is very distressing. According to them, the children get caught in this kind of maze from where it is very difficult for them to break the maze in the future. According to them due to mathematical anxiety, children do not perform well and then they suffer from stress due to achieving fewer marks in mathematics.

In this study, researchers have also emphasized some important options to solve this problem. They said that to get rid of these problem first school teachers must accept that children also suffer from mathematics anxiety. Mathematical anxiety impacts their performance directly. Apart from this, teachers should create necessary changes in their teaching style according to child psychology. Researchers hope that if these solutions are implemented the situation can be improved soon. They also acknowledged that the present situation is very worrying.

Mathematics is a subject that can be difficult for some to understand and can be a game for others. It's not as easy as a puzzle. Mathematics is not the only subject from which students are always stressed but it is the easiest subject as it can neither be memorized nor studied. This is a practice subject but there are some tricks that can be followed if the phobia of mathematics can be overcome.

1. **Learn to Clear Basic Concepts –** Clear your basic concept about mathematics and try to make it stronger. If needed take help from previous-classes books to clear your doubts because, without a better base or basic concept clearing, you cannot handle mathematics phobia.

2. **Self-Study is Most Important -** You cleared the concept of mathematics class or coaching, but if you did not solve many questions at the home then you may forget it. Therefore, self-study and revision are very important.

3. **Mathematics cannot learn without Practice –** Mathematics completely depends on practice. Even if one's basic concepts are cleared, students cannot learn mathematics without practice. For Mathematics they have to practice daily to clear mathematical concepts.

4. **Tables are Important to Remember-** The basic technique to mastering mathematics is that you should remember the tables from 2 to 20. The tables are very helpful to addition, subtraction, multiplication, and division.

5. **Learn Fast and Easy ways to Calculate-** Fast and easy ways to calculate will have to be learned. For this, resort to Abacus or Vedic Mathematics. If you want to do fast calculations, then you have to learn tricks to fast calculations.

6. **Connect Daily Needs to Mathematics-** If you start looking the needs of daily life by connecting to mathematics then the fear of mathematic will disappear. Like you organize a party at home and for that, you have to calculate the account.

7. **Create your Mathematics Bank-** Just like the English word bank, you should make a formula bank of mathematics. You will often need to memorize many formulas. Many times it happens that if many formulas are not read for a few days then they get out of the mind.

1.11 Concept Attainment

(A) Concept

The world 'concept' originated from 'concepts'. It is a 'Latin word' that means 'to be understood' or 'acquired'. Bourne & Dodd says that the concept is the rule according to which certain objects and events can be divided into classes based on some characteristics. We can add different concepts in our daily life like day, night, humans, animals, and birds, etc. According to Hunt, the concept of learning is the use of different names all the names that we use in our language are the concepts.

(B) Definition of concept

"A concept may be regarded as a kind of selective attention system in a mental organization of a person which links previous experience and current states with stimulus object."

-Vinacke (1957)

(C) Dimension of Concept

The concept has the following dimensions-

1. **Relevant Dimension**- Such dimensions based on which the learner accesses the concept are called the relevant or critical dimension.
2. **Irrelevant Dimension**- The dimensions which are not used during the construction of the concept are ignored. The dimensions which are not effective in the concept construction are called irrelevant dimensions.

(D) Characteristics of Concept

1. The concept is based on the past experience of a living being.
2. The concept is based on the sensory experience of man.
3. The concept is the result of the expansion and combination of different kinds of sensations and emotions.
4. Prior experience used by humans under new circumstances is a concept.

5. A concept is a selective mechanism that establishes a relationship between multiple sensations.

(E) Types of Concepts

i) Simple Concept: When a stimulus is placed in a class based on a definite or predetermined feature, it is called a simple concept, like a cow, cat, fish, etc. only one feature is taken in their classification.

ii) Conjunctive Concept: The stimuli in which the two or more relevant dimensions are present are examples of the conjunctive concepts. Out of this when two or more characteristics are in the object or person they become the impetus of that theory. When an object or event is defined based on two or more traits and properties then it is called a conjunctive concept.

iii) Disjunctive Concept: For a stimulus to be true, it is necessary to have one or more relevant dimensions. When an object with multiple attributes is placed in a class due to a single feature, it is called a Disjunctive Concept.

"In disjunctive concept, any one of the several properties put to an object in the class of an object."

-Morgan, King & Robinson (1981)

When an object with multiple features is placed in a class due to a single feature, it is called a disjunctive concept.

iv) Relational Concept: The relational concept is identified as the basis of the relationship of attributes such as cards that have more lines than shapes in a variety of design tasks. They are called relational concepts. In daily life we use it lighter, taller, shorter, etc. Munn (1956) told that there are two types of relational concepts that are concrete and abstract.

v) Biconditional Concept: Biconditional Concepts are restricted from two conditions i.e. the concept which has two characteristics in the stimulus, the same principle is placed under the concept it is called biconditional concepts.

(F) Component of Concept

In the current educational scenario the structure of knowledge has four main components:

1. Attribute

2. Example

3. Definition

4. Hierarchical Relation

(G) Elements of Concept: The concept consists of five elements-

i) Name
ii) Example
iii) Attribute
iv) Attribute Value
v) Rule

The systematic well-organized elements and components of concepts create a theory and principle that gives the new direction of human knowledge.

(H) Concept Attainment

To provide a new direction of knowledge to humans, it is necessary to spread it through education so that the child can understand the necessary concepts. Cognitively understanding the theory in a particular situation, presenting examples related to the concepts, and identifying the positive and negative examples related to this concept is concept attainment.

Jerome S. Bruner, Jacqueline J. Goodnow, and Late George A. Austin introduced the concept attainment firstly in their book "A Study of Thinking (1956)". It stated that Bruner used the multidisciplinary approach to find out how the brain works during various activities. According to Joyce & Weil (1967), the concept of attainment is related to inductive thinking. It emphasizes the decision-making and classification process to understand the concept.

"A concept is the network of inferences that are or may be set into play by an act of categorization." **-Bruner, Goodnow & Austin (1956)**

(I) Factors of Concept Attainment: There are the following factors of concept attainment

i) The definition of work.

ii) Specific work-related examples.

iii) Validation procedure of task.

iv) Categorization of the task.

v) Restrictions of work.

In addition to strategic planning according to Brunner et. al. (1956) the following facts are necessary for achieving the concept:

1) Concept is achieved when the number of relevant examples is small.
2) It is necessary to examine the way of concept acquisition along with precise examples related to the concept.
3) Concept and memorization should not be stressful while imagining the concept.

Concept acquisition approaches try to make the concepts clearer and deeper through the presentation of positive and negative examples. This helps the learner to develop a comprehensive understanding of the concept. Concept acquisition is a creative approach to teaching-learning. This instructional model is originated from the research of Jerome Bruner. Students are able to understand achievement based on their prior knowledge through a process of inversion and comparison. In this process the students get the following opportunities:

i) Distinguish between relevant and irrelevant information.
ii) Monitoring, Hypothesis and Classification.
iii) Addition of new concepts gained from prior information.
iv) Inductive thinking.

"Competition fosters a win-lose situation where better students receive rewards and recognition and those with mediocre or lower achievers reap none" (Johnson & Johnson, 2000). Therefore, teachers are expected to go beyond the traditional teaching approach and come up with new innovative teaching practices especially for teaching mathematics but children can reach the stage of cognition only when they discover themselves. Concept attainment is a unique plan to enhance self-realization for a creative approach, self-direction through creating dynamic classroom environments. NCF (2005) and NCFTE (2009) also suggest that various resources should be given to the school in the process of knowledge creation and creative approaches. In the process, we all should try to reduce anxiety levels among students make them independent thinkers and knowledgeable.

1.12 Noteworthy Contribution in the field of Proposed Research

1.12.1 Constructivist Approach

Constructivism consists of the verb “to construct” which is derived from the Latin word ‘Construere’ which means “to arrange” or “give structure”. The concept of constructivism is very ancient. It started from the time of Lao Tzu, Buddha, Heraclitus, Socrates, Saint Augustine, Aristotle, and Plato, etc. Philosopher John Lock taught that without experience a man cannot be knowledgeable. Kant said that logical analysis of action and object increases knowledge. Human creates new knowledge from these experiences. Although, the credit for the creation of the main principles of the constructivism approach goes to Jean Piaget and Henrich Pestalozzi.

Vico, Kant, Schopenhauer, and Vaihinger worked to make this ideology even more advanced. Vico explained the role of relaxation and fancy imagination in the human knowledge acquiring process. Vaihinger (1876) said that the primary purpose of the brain and mental process is not to know the whole mirror reality, but to make oneself livable under different circumstances of life.

The origin of constructivism has mainly come from Piaget’s theory of genetic epistemology. In which he analyzed the development of the human’s brain and explained his cognitive process. Russia’s psychologist Lev Vygotsky (1896-1934) presented the concept of social constructivism. In which he explored firstly about ZPD (Zone of Proximal Development). When a child performs without any help and when the same child performs the same performance with the help of someone, then the difference between those two performances is called ZPD.

Jerome Bruner divides intellectual development into three stages Enactive, Iconic and Symbolic. In the Enactive stage, the child plays with the material object and learns its effects. In the second stage Iconic, the child learns with the help of format and pictures and in the third stage Symbolic, the child develops the capacity for abstract thinking now he starts understanding the signs.

Bruner conceptualized ‘Discovery Learning’. In this, the learner actively constructs structures and discovers the principles himself. John Dewey said that the curriculum should be student and society-centered. It should also be based on the student’s interest there should be maximum opportunities for knowledge creation. Joseph Nowak spoke about building knowledge through meaningful learning. He gave 'Human Constructivist Model of Learning' and the principle of 'Concept Mapping'. Giambattista Vico explored the knowledge related to common sense. Ernst Von Glasersfeld introduced the concept of Radical Constructivism. Kenneth J. Gergen (1982, 1985) rejected exogenous and endogenous epistemology and stated that it is possible to evaluate pedagogical actions through knowledge-related dialogue. The theorists who have made a significant contribution to the development of constructivist theory are Ernst Von Glasersfeld, Giambattista Vico, Immanuel Kant, John Dewey, Jerome Seymour Bruner, Kenneth J. Gergen.

Scholars who made their significant contributions are as follows: Machlup (1962), Cooper (1993), Einstein (1938), George Barkeley, Mahoney (1995), Vaihinger (1876), Lipman (1991), Stever (1989), Swamy (1987), McMohan (1997), Holt & Willard Holt (2000), Flavel (1963), Soloman (1987), Cobern (1993), Millar (1989), Maiullar (2000), Liu & Matthews (2005), Tomasello (1993), Jackson (1968), Wood (1988), Billig (1987), Edwards & Potter (1992), Mayerson (1994), Kozulin (1998), Yacket (1995), Watzawick (1984), Simon (1994), Jonassen (1991), Merril (1997), Crowther (1999), Steffe (1990), Resnick (1983), Spencer (2000), Fabricus (1983), Richarson (1997), Hanckbarth (1996).

1.12.2 Mathematical Concept Attainment

The world 'concept' originated from 'concepts'. It is a 'Latin word' that means 'to be understood' or 'acquired'. Bourne & Dodd says that the concept is the rule according to which certain objects and events can be divided into classes based on some characteristics.

Concept attainment, also known as concept learning and category learning, is mainly based on the work of American psychologist Jerome Seymour Bruner, who was born on October 1, 1915. Jerome S. Bruner, Jacqueline J. Goodnow, and Late George A. Austin explained the concept attainment in their book "A Study of Thinking (1956)". The principle of concept attainment originated mainly from the research work of Jerome S. Bruner. He developed the instructional model of concept attainment which is called Concept Attainment Model (CAM).

Leo Postman, D. Wood, G. Ross, C.C. Goodman, Hilda Taba, B. Joyce and M. Weil, M.C. Durkin, M.D. Merrill and R.D. Tennyson have also given their valuable contributions in the field of "Concept Attainment".

Various scholars on the concept attainment made valuable contributions through research work they were B. Joshua Tenenbaum (1999), Haygood & Bourne (1965), Neisser Weene (1962), Hunt Hovland (1960), Conat & Trabasso (1964), Hulse, Deese, Egeth (1980), Heidbreder (1946), Archer (1956), Russel (1956), Pichkin & Blanchard (1964), Weiss (1953), Smoke (1933), Morgan, King & Robinson (1981), Munn (1956), Johnson (1972), Ossgood (1953), Goss (1960), Vinacks (1957), Rathus (1984), Dood.

1.12.3 Mathematical Anxiety

The word anxiety derives from the 'Latin substantive' 'angor' and the corresponding verb 'ango (to constrict)'. A cognate word is 'angustus (narrow)'. These words derive from an 'Indo-European root' that has produced 'Angst' in 'modern German'. Anxiety is also called a future threat. In 1621, Robert Burton wrote "The Anatomy of Melancholy" which is a survey of encyclopedic literature explained by Allen W. Horwitz. The work of Burton was generally in the context of depression and anxiety. He presented the first medical nosology in his creation 'Boisser de Sauvages' (1706-1767) in which he described panophobia as related to anxiety, which means panic terror. Mark H. Ashcraft (2002) defines mathematics anxiety as "a feeling of tension, apprehension, or fear that interferes with mathematics performance".

Hippocrates, Virgil Aeneid, George Miller, Sigmund Freud, Emil Kraepelin (1856), Pierre Janet (1859) have contributed to analyzing the concept of anxiety. There have been studies on mathematics anxiety since 1950. In which Mary Fides Gough described the most prominent term 'Mathemaphobic', it expressed as a relative fear of mathematical experience. Richardson & Suinn built the first Mathematics Anxiety Rating Scale (MARS, 1972).

In 1990, Hembree conducted a Meta-analysis of 151 students that related to mathematical anxiety and concluded that mathematical anxiety is a negative attitude towards mathematics. This arises due to weak performance in mathematics exams. He said that mathematical anxiety is directly related to mathematics avoidance. Fennema & Sherman created a mathematical attitude scale which is called 'FSMAS (Fennema-Sherman- Mathematical Attitude-Scale)'.

Thus, various scholars contributed their contribution to the conceptual development of mathematical anxiety in which some are important. They were Sian Beilock, Trezise, Reeve Beller, Gafni, Kail & Zolner (2005), Rowlands & Barber (2002), Latruner (2002), Kawakami, Steele, Cifa, Phills, Dovidio (2008), Johns, Schmader, Martens, Margaret Murray, Francis Galton. Hembree (1990), Richardson and Suinn (1992), Hembree, R. (1990), Schar, M. H.; Kirk, E. P. (2001), Beilock, S. L., & Willingham, D. T. (2014), Scarpello, Gary (2007) have given valuable contribution in the field of mathematical anxiety.

1.13 Rationale of the Study

The above review of the literature reveals that a good amount of work has been done at the national and international levels. The research work has been accomplished mainly on problem-solving skills, students' creative thinking, knowledge construction, retention, and students' attitudes towards mathematics, constructionist learning theory; group work during visual art activities, effective learning environment, primary science curriculum, and constructivist based geometric teaching material of eighth class. Researches also have done on primary pre-service teachers' perspectives on constructivism, constructivist profile, instructional practices, scholastic achievement, and constructivist learning environment, concept map network, and social constructivist strategy, constructivist approach towards teaching-learning, learning strategy in biology, science process skills, and Science attitude. researchers conducted on the nature of science, teaching in social science, etc. at different levels of education.

If analyze the positive impact of constructivism on education NCF-2005 and NCFTE-2009 emphasized the effective use of constructivism for children's education and training of teachers by the government of India. The positive effect of constructivism today can be known through research with subjects like Biology, Mathematics, Science, English, Social Science, and Geography, etc.

Research work has also been done with various variables on constructivism in mathematics which are mathematics teachers' beliefs, learning, and nature of mathematics, mathematics teaching practice, mathematics academic achievement. Without engaging constructivism in the field of mathematical education, research work has been done on the following variables like- achievement in mathematical pattern, mathematical anxiety, mathematical beliefs, mathematical task, mathematical courses, mathematical exams, mathematics self-efficacy, mistake handling learning and integration of mathematical course.

The researcher did not find any research on constructivism and mathematical anxiety, whereas the researcher believes that if constructivism is used in teaching mathematics, then with its help, mathematical anxiety of students can be reduced or eliminated. Learning mathematics will become easier if the student understands the essential facts related to mathematics. It can also be said that if the student can understand the concept of mathematics then the mathematical anxiety arising out of it can be reduced.

It was known from the review of related literature that the research work on mathematical concept attainment is not accomplished with the effect of constructivism. Due to this, the researcher wants to conduct a study based on this. Research related to the concept attainment model has come to light but concept attainment has been included in very minimum research as a variable. There is no study found about constructivism with concept attainment all over.

The researcher looked at the student's anxiety, fear, and nervousness-related attitude. Mathematical anxiety will be reduced when the student's mathematical concept attainment is increased. The researcher has taken the help of constructivism therefore; the researcher wants to do research work to reduce mathematical anxiety by increasing mathematical concept attainment.

There is a scarcity of such type of research work in India that aims to construct instructional material based on constructivism in mathematics. There are limited research works that find the level of anxiety towards mathematics through constructivism. Therefore, a study titled "Effect of Constructivist Pedagogy on Concept Attainment and Anxiety in Mathematics among Seventh Class Students" has been taken by the researcher. The present study is based on the assumption that constructivist pedagogy will improve students' mathematical concept attainment and will reduce anxiety towards mathematics.

1.14 Statement of the Problem

Mathematics is more difficult for children than any other subject because they have problems understanding the symbols and formulas used in it. It requires more time and attention in mathematics. We all know that if we learn facts without understanding we easily forget it and in this situation, we do not understand our world. When interest is created in a subject, attention is born. Interest arises when the facts related to the subject are understood. When we try to learn without understanding the facts, we start forgetting them. According to the mechanism of our understanding of subject matter and theory etc. it must be related to our prior knowledge. If we are willing to understand and we don't forget the learned facts too quickly then this kind of knowledge gets added to the experience of the individual. This creates permanent knowledge of the person. Grouped learning and dynamic classroom environment is very important for building knowledge of the individual. In this regard, the constructivist plays a joyful role in understanding the concept of mathematics in mathematics education which is updated by gaining daily experience.

In the construction of knowledge, group learning and a dynamic classroom environment are very important. In this connection, the constructivist approach in mathematics education can play a joyous role to learn mathematical concepts. When students learn mathematical concepts easily, then their mathematical anxiety starts to decrease. When children easily understand mathematical concepts, formulas, and facts then they become interested in practicing mathematics. Students solve repeatedly various questions on the basis of learned formulas. Due to which their practice of that formula becomes good and they get permanent learning. This increases their understanding of the concept. Due to their deep understanding of the mathematical concept, their fear of mathematics gradually ends. We can say that when the student’s concept attainment ability increases then his mathematical anxiety decreases.

Therefore, the researcher is interested to investigate which one of these teaching strategies (constructivist approach and conventional approach) will increase mathematical concept attainment ability and will reduce mathematical anxiety levels in the students. Hence, the researcher has chosen the topic entitled- Effect of Constructivist Pedagogy on Concept Attainment and Anxiety in Mathematics among Seventh Class Students.

1.15 Operational Definition of the Terms

i) **Constructivism:** Constructivism is a child-centered and child-activity-based learning approach in which the child is the originator of his knowledge based upon his foreknowledge and past experiences.

ii) **Constructivist Pedagogy:** When we use a constructivist approach in the teaching-learning process to enhance the learning of students, it is called constructivist pedagogy.

iii) **Concept Attainment:** Concept Attainment is an indirect instructional strategy that uses a structured inquiry process.

iv) **Effect:** It refers to the outcome of a particular treatment given to the subjects which produce a significant change in a student's academic achievement or behavior. Here, effect means the responses which are shown by the students when they receive instruction by the Constructivism approach and Traditional teaching method.

v) **Traditional Teaching Method:** In this study, the traditional teaching method has been taken as the traditional face-to-face classroom teaching, the teacher is active and students are almost passive in the teaching-learning process.

vi) **Mathematical Anxiety:** Mathematical Anxiety is a negative emotional reaction to mathematics that can be debilitated by using effective teaching methods. It is directly connected with mathematics avoidance.

1.16 Research Questions

- What are the effects of constructivist pedagogy on concept attainment in mathematics of seventh class students?
- What are the effects of constructivist pedagogy on anxiety in mathematics of seventh class students?
- How are concept attainment and anxiety in the mathematics of class seventh students affected by intelligence quotient (I.Q.), socio-economic status (S.E.S), and gender in the experimental and control group?
- What are the views of teachers and students about constructivist pedagogy?

Keeping the aforesaid issues in the mind and exploring the effect of the constructivist pedagogy on the concept attainment and anxiety in the mathematics of seventh class students, the researcher has proposed this problem for the intensive and detailed study.

1.17 Objectives of the Study

1.17.1 Main Objectives

1. To study the effect of constructivist pedagogy on concept attainment in mathematics among seventh class students.
2. To study the effect of constructivist pedagogy on anxiety in mathematics among seventh class students.
3. To study the effect of constructivist pedagogy on concept attainment in mathematics among seventh class students on the basis of intelligence quotient.
4. To study the effect of a constructivist pedagogy on anxiety in mathematics among seventh class students on the basis of intelligence quotient.
5. To compare concept attainment in mathematics between experimental and controlled group students on the basis of intelligence quotient.
6. To compare anxiety in mathematics between experimental and controlled group students on the basis of intelligence quotient.
7. To study the effect of constructivist pedagogy on concept attainment in mathematics among seventh class students with respect to their gender.
8. To study the effect of a constructivist pedagogy on anxiety in mathematics among seventh class students with respect to their gender.
9. To compare concept attainment in mathematics between experimental and controlled group students with respect to their gender.
10. To compare anxiety in mathematics between experimental and controlled group students with respect to their gender.
11. To study the effect of constructivist pedagogy on concept attainment in mathematics among seventh class students on the basis of socio-economic status.
12. To study the effect of a constructivist pedagogy on anxiety in mathematics among seventh class students on the basis of socio-economic status.
13. To compare concept attainment in mathematics between experimental and controlled group students on the basis of socio-economic status.
14. To compare anxiety in mathematics between experimental and controlled group students on the basis of socio-economic status.

15. To explore the opinion of teachers and students about the constructivist approach.

1.17.2 Auxiliary Objectives

1. To develop the instructional material based on the constructivist approach for some specific topics in mathematics for seventh class students.
2. Construction and standardization of a tool on concept attainment to measure the understanding of some selected concepts in mathematics for seventh class students.
3. Construction and standardization of a tool on anxiety to measure the level of anxiety in mathematics for seventh class students.
4. To construct an opinionnaire to explore the student's opinion about the constructivist pedagogy.
5. To construct an opinionnaire to explore the teacher's opinion about the constructivist pedagogy.

1.18 Research Hypotheses

1. There is a significant difference in mathematical concept attainment between experimental and control group students.
2. There is a significant difference in mathematical anxiety between experimental and control group students.
3. There is a significant difference in mathematical concept attainment of experimental group students on the basis of Intelligence Quotient (I.Q.).
4. There is a significant difference in mathematical anxiety of experimental group students on the basis of Intelligence Quotient (I.Q.).
5. There is a significant difference in mathematical concept attainment between experimental and control group students on the basis of Intelligence Quotient (I.Q.).
6. There is a significant difference in mathematical anxiety between experimental and control group students on the basis of Intelligence Quotient (I.Q.).
7. There is a significant difference in mathematical concept attainment of experimental group students with respect to their gender.
8. There is a significant difference in mathematical anxiety of experimental group students with respect to their gender.

9. There is a significant difference in mathematical concept attainment between experimental and control group students with respect to their gender.
10. There is a significant difference in mathematical anxiety between experimental and control group students with respect to their gender.
11. There is a significant difference in mathematical concept attainment of experimental group students on the basis of Socio-Economic Status (S.E.S).
12. There is a significant difference in mathematical anxiety of experimental group students on the basis of Socio-Economic Status (S.E.S).
13. There is a significant difference in mathematical concept attainment between experimental and control group students on the basis of Socio-Economic Status (S.E.S).
14. There is a significant difference in mathematical anxiety between experimental and control group students on the basis of Socio-Economic Status (S.E.S).

1.19 Significance of the Study

Mathematics as an academic discipline can confuse and frustrate the learners and increase anxiety toward mathematics. Mathematics is a difficult topic for a student. As knowledge of mathematics, in general, is relatively less connected to the knowledge acquired in their social environment. So that students experienced the burden to understand it and try to rote it to solve the question. Even if the mathematical operations and the calculation are wrong, the entire answer becomes wrong. If such type of situation arises in the examination then students receive low marks. That is even if the student has a good skill or ability to solve questions using appropriate formulas and methods but if the calculation is wrong then his marks become less similar to the students who have the less mathematical ability.

Such a situation arises when the students are lacking in the practice of solving the question due to which the dilemma of solving the questions and not being correct in the exam. The students get nervous about this situation. This situation is similar in both able and less able students of mathematics. For this situation both the understanding and practice of mathematics are responsible.

So, teachers should go beyond the conventional teaching method and should use innovative teaching practices in the classroom and should create an environment in which students can share their ideas and learn with their previous knowledge. As NCF (2005) recommended that curriculum and teaching methodology are the main reason behind the students' failure to learn some specific subjects like mathematics and science. It also suggests that teaching methodology should be constructive based which helps the students to make knowledge builders or creators.

According to NCFTE-2009, the use of drama, games, and experiments, etc., ensures the students' active participation in teaching so that these uses are necessary to make the education effective. NCFTE-2009 states that the atmosphere of the classroom should be fearless and joyful in which the role of the teacher will be that of a facilitator. NCFTE-2009 also focused on using the construction methods in teacher training.

Quite often the students lose interest because of the lack of fun and develop a negative attitude towards mathematics. So, most students leave it in higher classes but students can learn mathematics effectively when they have opportunities to construct their own knowledge with the help of their own experiences. The present study has attempted to eliminate or reduce students' mathematical fear by using the constructivist approach in mathematics teaching so that students can easily understand mathematical facts.

Studying the review of related literature, the researcher finds that the constructivist method plays a positive role in teaching-learning. The constructivist learning method facilitates students in mathematics learning so that they can learn mathematics easily. The learning will be permanent due to active participation. Students get more and permanent learning in less time with different activities and constructivist method increase their mathematical conceptual learning. Through the reviews, it has been found that the constructivist method is very beneficial to eliminate the fear of not understanding mathematics in order to enhance the learning of mathematics. Therefore, two tools have been created and standardized by the researcher in the presented study which follows:

1. Concept Attainment Test.
2. Mathematical Anxiety Scale.

Here are wealth of publications that explain how a constructivist classroom should be designed and how this technI.Q.ue should be applied. The studies of Lindfors (1984), Von Glasersfeld, E. (1989), Von Glasersfeld, E. (1993), Kim, Jong Suk (1997), Kim, Jong Suk (2002), Young, R. and Collin, A. (2003), Jong Suk Kim (2005), Kim, J.K (2005), Youl-Kwan Sung (2007) Srinivas Kadem (2013), Durmus, yelizTemli (July 2016), Csizmadia, Andrew et.al.(2019) on the effectiveness of constructivist approach highlighted that constructivist enhances students' achievement, social and communication skills and develop the positive attitude towards different subjects but no study has been conducted on the variables such as concept attainment and anxiety in mathematics. Therefore, the researcher has chosen this topic for research.

1.20 Delimitation of the Study

The following are the delimitation of the study-

1. Present study is restricted to the selected school of Lucknow city.
2. The study is restricted to the students of the school affiliated with the U.P Board.
3. The study is restricted only to seventh class students.
4. The study is restricted only to Mathematics teaching.
5. The content is limited only to some specific topics of the entire mathematics syllabus of seventh class.

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CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 Introduction

Researchers needs to know what kind of research work has been done so far so that they can make their research meaningful, non-repetitive and useful before proceeding in the direction of research. Researcher study various researches which done previously. Through this, they try to know which type of researches have been done and which were not. They try to know those areas through the review of related literature where research is needed.

In the study the researcher first studied the research work related to constructivism to know the positive effect of the use of drama, games, poetry, puzzles, etc., in education. Constructivism is an active process of self-learning through own ideas, mindset, and previous experiences. In the process of self-learning the learner constructs his own trick and technique to solve the problem and create new knowledge which is right according to his viewpoint. The researcher studied the research done earlier in Indian and foreign context. These are related to the use of a constructivist approach with various variables.

Junior high school students fear not passing and getting low marks in certain subjects like science and mathematics than all other classes. The researcher believes that constructivist approaches can be useful to reduce the anxiety of mathematics if the constructivist approach is applied meaningfully in classrooms. Keeping in view the importance of constructivism in mathematical education, the researcher also studied research activities related to mathematics.

The researcher is of the opinion that if the student understands mathematics well, then he will not panic, his mathematical fatigue will also be less because fatigue comes from doing the work which does not feel like and we run away from the work which we have to do. Do not want. The researcher is of the view that learning can be good if the concepts are understood well. Children will not be afraid of mathematics if they understand the concepts of mathematics properly, so the researcher examined various research work related to concept acquisition and anxiety in mathematics as well as constructivist-related studies. In this way, the researcher studied the research work done in the past with different subjects in Indian and foreign research related to constructivist approach which in short is as follows-

2.2 Review of Related Literature in the Indian Context

2.3 Review of Related Literature in Foreign Context

The researcher divided the reviews of Indian and foreign researches into the following parts:

2.2.1. Review of Indian Previous Research Works on Constructive Approach and Constructivist Pedagogy

2.2.2. Review of Indian Previous Research Works on Concept Attainment

2.2.3. Review of Indian Previous Research Works on Mathematical Anxiety

2.3.1. Review of Foreign Previous Research Works on Constructive Approach and Constructivist Pedagogy

2.3.2. Review of Foreign Previous Research Works on Concept Attainment

2.3.3. Review of Foreign Previous Research Works on Mathematical Anxiety

2.4. Summary of Review of Related Literature.

The main fact reveals from the studied research were as follows:

2.2 Review of Related Literature in the Indian Context

2.2.1 Review of Indian Previous Research Works on Constructivist Approach and Constructivist Pedagogy

Hari Prasad Upadhyay (2001) conducted a study on "Effect of Constructivism on Mathematics Achievement of Grade V Students in Nepal". The purpose of the study was to use the constructivist approach in Mathematics teaching in Nepal. Grade V mathematics students of Nepal were the population of the study. Pre-test post-test quasi-experimental control group design was used in the experimental study. To proceed with the study selected 4 schools. Out of which 2 schools were public and the other two schools were private. The experimental group of the study considered 2 schools out of which one was government and the other one was private similarly made the control group of the study. In the study control group considered 93 students and the experimental groups contained 87 students as samples of the study. The teaching was conducted in three stages i.e., an introduction, analysis of the group, and precise reflection. The study used both techniques quantitative (frequency, tabulation, graph, and chart) and qualitative (observation, written test, and semi-structured interview). There were taken five months in the experiment of the study included pre-test, post-test, non-equivalent control group methods. The researcher used ANCOVA to find the outcomes of the obtained data and bar diagram to the symbolic representation of the obtained outcomes. The result of the study found that that the constructivist method was more useful to improve and enhance the learning of the students compared to the traditional method.

R. Nagalakshmi (2011) conducted a study on 'Effectiveness of Constructivist Approach on Students in Science, Science-related Attitude, Science Process Skills and Perception of Nature of Science at the Secondary Level.' The quasi-experimental design was used in the study. The students of the class seventh of Tamil Nādu state were considered as the population of the study. By using a purposive sampling technique selected two schools Vidya Bharti Matriculation School and Brooke Matriculation School located at Salem of Tamilnadu state. By using random sampling selected 68 students from the above two schools whereas the experimental group had 36 students out of which 21were boys and 15 girls. The control group selected a total of 32 students out of which 16 were boys and 16 were girls. There were several tools and tests used in the study Raven's Progressive matrices, to find the mental perception used nature of science test, science process skill test, the test of science-related attitude, a science opinion survey, reaction scale, and semi-structured interview. The content analysis, item analysis, test-retest reliability, t-test, product-moment correlation, and ANCOVA were used to analyze the collected data.

The result of the study explored that the constructivist approach made easy learning and enhanced learning. It increased the student's achievement in science, upgraded the science-related attitude, science process skills, and perception of the nature of science at the secondary level.

Ranu Mandal (2013) researched on a topic 'A Study of Constructivism Approaches towards Teaching-Learning in the Secondary Schools of Shantiniketan, West Bengal'. The study was experimental and descriptive. The first part of the study was to conduct pre-test and post-test by using a pre-experimental design and the second part used the descriptive survey method. All secondary school students and teachers belonged to West Bengal were the population of the study. There were 1769 secondary school students, 11 schools, and 112 teachers of Shantiniketan, West Bengal. The sample of the study was selected by random sampling method. The investigator developed an achievement test for 25 marks of grade 9th and 10th students and constructed a questionnaire that included 20 items with yes & no options. The study used descriptive statistical analysis such as mean, median, mode, standard deviation, skewness, kurtosis, frequency distribution to analyze the obtained data. For the testing of null hypothesis used t-test and ANOVA. The result of the study described that the constructive approach played a vital role to enhanced and upgraded learning among secondary level students.

R. Ramanath (2013) conducted a study on the topic 'Effectiveness of constructivism based learning strategies in biology for enhancing science process skills'. The general objective of the study was to analyze the efficacy of a constructivist-based learning strategy (CBLS) to upgrade science process skills of secondary-level students. The study used a simple group experimental design. The research considered constructivist-based learning strategy as an independent variable while science process skill was the dependent variable and the two demographic variables were gender and student area.

The Class 9 textbooks were published by the Tamil Nadu Textbook Corporation belonging to the Tamil Nadu State Board, considered the population of the study. Out of the population 40 students of class 9th were selected from S.M.S.V. Ghanta Secondary School, Karaikudi using purposive sample. The group of these 40 students was a homogeneous experimental group. Five instruments were used namely Constructivism-Based Learning Strategy (CBLS), Test of Science Process Skills (TSPS-I), (TSPS-II), (TSPS-III), Learner Participatory Scale (LPS). Mean difference for descriptive analysis, t-test for difference analysis, Pearson's product-moment correlation technique for correlation analysis, and content analysis for development of CBLS were used.

The results of the study showed that students using a constructivist-based learning strategy (CBLS) learned the concept easily and were interested in learning. But the main finding was that girl students learned more through a constructivist-based learning strategy (CBLS) which is based on a constructive approach.

Ravula Krishnaiah (2013) conducted a study on 'Constructivism and its Approach of Teaching Social Science at Secondary Level - A Critical Survey in Telangana Region'. Social science teachers and secondary level students from the Telangana region were the study population. 100 secondary school social science teachers were selected by random sampling. There were 50 male and 50 female teachers in the sample out of which 50 had teaching experience of less than 5 years and the remaining 50 had 5 years experience. The sample included 50 teachers working in government schools and the remaining 50 teachers working in private schools. The selected 50 teachers were teachers working in urban areas. 300 students at the secondary school level were selected as the study sample using the random sampling technique. There were 150 male and 150 female students in the sample. Out of which 150 students were studying in government colleges and 150 students were studying in privately managed schools. Out of 300 students at the secondary school level, 150 students were selected in urban areas and 150 students were studying in rural areas. The researcher developed two questionnaires and one was the interview schedule for data collection. The first questionnaire consists of 60 items designed to find out the opinion of social science teachers on the use of constructivist approach in classroom teaching. The second questionnaire consisted of 30 items designed to ascertain the opinion of secondary school students using a constructivist approach by their social science teachers. The researcher developed an observation schedule (rating scale) consisting of 49 items for social science teachers to observe classroom instruction. The dependent variables of the study were classroom management, teaching-learning activities, assessment, constructivist social science teaching-learning, and constructivist social science content. The independent variables studied were teaching experience, school location, gender, management orientation on the constructivist approach, and race. The independent variables related to secondary school students were gender, race, school management and school locality. The statistical techniques of the study were means, frequency, standard deviation, object analysis, and t-test. The split-half (odd-even) method and the Spearman-Brown prediction were used to test the reliability of the above questionnaire. The validity of the content analysis method used to define the validity of the questionnaire and observation schedule. F-ratio, simple percentage and bar diagram were used to analyze the data.

The study concluded that the constructivist approach was found to be more effective for male teachers than female teachers. This was more effective for a junior teacher than a senior secondary school teacher. Private teachers were found to have higher perception abilities as compared to government teachers, and similarly, urban teachers had higher perception abilities than rural teachers.

Ganiger Bharti (2014) investigated a study on ‘Development and Implementation of ICT aided Constructivist Learning Approach for the Professional Development of Pre-service Teachers’. The quasi-experimental design (non-equivalent pre-test post-test control group design) and pre-experimental design were used in the study. The secondary, science pre-service teachers of Karnataka state (2011-2012) and the students of 9^{th} grade of the state were the populations of the study. 35 pre-service teachers of the University College of education, Dharwad which was considered as the experimental group of the study. The 30 science pre-service teachers of Dr. Kamla Balika College of education, Kumta were selected through purposive sampling which considered the control group of the study. The 437 students of class 9^{th} who belonged from all six practicing schools of University College of education selected through cluster sampling.

The researcher used a self-made questionnaire reaction scale for data collection, observation, and semi-structured interview was also constructed by the researcher himself. To check the reliability of the questionnaire used the test-retest method. The pre-service teachers developed the achievement test. A focused group discussion with pre-service teachers was organized by the researcher. A rubric was made and used by the researcher to observe the lesson plan of pre-service teachers. It was based on ICTACLA (Information and Communication Technology Aided Constructivist Learning Approach) also made by the researcher. The data was collected through a reaction scale and analyzed by using the chi-square test, frequency, percentage count. The data collected by the achievement test was analyzed by using mean, standard deviation, and t-test. Similarly, the data collected by semi-structured interview focused group discussion, pre-service teacher’s diary, and researcher’s diary was analyzed by using content analysis. The data was collected through a questionnaire analyzed by using the chi-square test.

The findings of the study explored that the constructivist approach proved very effective for the more professional development of the pre-service teachers.

Hence the achievements of pre-service teachers were increased by using constructivist approach at the expected level of learning.

Mahesha S. J. (2014) conducted a study on the topic "effect of social constructivist strategies on achievement in Geography and group cohesiveness among secondary school students." The main objective of this research study was to study the effect of constructivist methods on the educational achievement of the subject of geography and to know the dependent variables related to the study. In the study presented, 120 students of class 8 of Mysore city had selected by random method. Two instruments had used in this study. One was the Geography Achievement Test and the other was the Group Cohesiveness Scale. T-test, two-way ANOVA, Pearson Product Moment Correlation had been used for the given analysis. The findings of the research mentioned that the educational achievement of the geography of the student had increased by using the constructive methods.

Dharmindarjeet Kaur (2015) researched a study on "Effect of Constructivist Teaching Approach on Scholastic Achievement of Elementary School Students in Mathematics". The study had been used as a pre-test, post-test, randomized matched subject control group experimental design and the sample of 120 students belonged to two government schools. The booth schools were selected through purposive sampling and students had been selected according to age, social and environmental status, academic achievement in Mathematics in class-VI, and the intelligence scores themselves. Out of which 60 students had treated as experimental group and provided the treatment on the basis of a lesson plan which was prepared after adopting the constructivist approach and next remains 60 students who had treated as a control group of the study. The tool has found internal consistency of 0.75 and it was used to study the pre-test and post-test. To analysis the data ANCOVA (analysis of covariance) was used in the factorial design in order to inspect the effect of teaching, techniques, and intelligence. There were also used f-ratio and the t-test to find out the significant difference between means of different groups on mathematics achievement. The outcomes of the study were that students were obtained higher scholastic achievement in mathematics when were taught by the constructivist method. It explored that the constructivist method was more useful than the traditional method to improve and enhance the teaching-learning activity.

2.2.2 Review of Indian Previous Research Works on Concept Attainment

Shyamsunder Bhairagya (2006) researched 'A Study on the Relative Effectiveness of Concept Attainment Model and Advanced Organizer Model in teaching Economics'. All the students of a higher secondary school affiliated with W.B.C.H.S.E. who have chosen economics as an elective subject were the population of the study. The 120 students were selected by random sampling method from the population was the sample of the study. The independent variables of the study were models of teaching (two instructional models concept attainment model, CAM and advanced organizer model, AOM), students' attitudes towards economics, and students' intelligence. The dependent variables of the study were knowledge, understanding, and application. The entry-level test in economics (ELTE), attitude towards economics scale (ATES), and raven's advanced progressive matrices test of intelligence (RAPMT), instructional materials based on concept attainment model (CAM), and advanced organizer model (AOM) and criterion reference test, these all were important tools used by researcher for data collection. ANOVA, 2×2×3 factorial design, f-ratio, and mean were used to analyze the collected data. The findings of the study explored that advance organizer model (AOM) proved more effective in comparison to concept attainment model (CAM) to enhance the cognitive learning of students. The students have a 15.4% rate of forgetting in the advanced organizer model (AOM) and 5.6% in concept attainment model (CAM). The positive attitudes towards economics played a positive role in the cognitive learning of students.

Kiran Dammani (2011) conducted a study on 'Comparison of Concept Mapping Strategy, Concept Attainment Model and Conventional Method in terms of understanding of English Grammar Concepts of Class 9th Students of M. P. Board'. The population of the study was all students of the 9th standard of session 2009-10 who belonged to different higher secondary schools affiliated to the Madhya Pradesh board of secondary education, Bhopal, and established in Indore city. At that time there found 471 high schools in Indore city. Out of 471 high schools, 3 schools selected by using the purposive sampling method. There were selected 180 students by using a random sampling method from these three schools. Out of which 86 were females and 94 were males. The age of the students were existed between 14 to 17 years. The non-equivalent control group design was used in the study. The test of understanding of English grammar concepts, reaction towards concept mapping strategy, and reaction towards concept attainment model these three tools developed by the researcher himself. The verbal test of creative thinking (Baquer Mehdi), non-verbal intelligence test of the age group of 13 to 17 years (Imtisungba, A.O.), introversion and extroversion inventory (P.F. Aziz and R. Agnihotri, 1973) was used to collect the data. One-way ANOVA, two-way ANCOVA, mean, standard deviation, CV, and percentage were used to analyze the collected data.

The findings of the study that the concept mapping strategy was found more effective in comparison to concept attainment model and traditional methods for understanding English grammar concepts when groups were matched. Creativity was independent to the understanding of English grammar concepts. It implied that to increase the level of understanding of English grammar concepts the creativity of students were be non-effective. The concept attainment model was found more effective to understand the English grammar concepts in females than males.

Anusmita Swain (2012) conducted a study on 'Comparison of Concept Mapping Strategy, Concept Attainment Model and Conventional Method in terms of understanding of English Grammar Concepts of Class 9th Students of M. P. Board'. The population of the study was all students of the 9th standard of session 2009-10 who belonged to different higher secondary schools affiliated to the Madhya Pradesh board of secondary education, Bhopal, and established in Indore city. At that time there found 471 high schools in Indore city. Out of 471 high schools, 3 schools selected by using the purposive sampling method. There were selected 180 students by using a random sampling method from these three schools. Out of which 86 were females and 94 were males. The age of the students were existed between 14 to 17 years. The non-equivalent control group design was used in the study. The test of understanding of English grammar concepts, reaction towards concept mapping strategy, and reaction towards concept attainment model these three tools developed by the researcher himself. The verbal test of creative thinking (Baquer Mehdi), non-verbal intelligence test of the age group of 13 to 17 years (Imtisungba, A.O.), introversion and extroversion inventory (P.F. Aziz and R. Agnihotri, 1973) were used to collect the data. One-way ANOVA, two-way ANCOVA, mean, standard deviation, CV, and percentage were used to analyze the collected data.

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Nirupama (2013) conducted research on the topic of 'An Experimental Study on CAI and Conventional Method in Attaining and Retaining the Mathematical Concepts'. The undergraduate females belonged to Rajasthan were the population of the study. The 100 undergraduate females were selected from Bansthali Vidyapeeth, Rajasthan by a purposive sampling method. The mode of instruction was the independent variable of the study. It had two components that instruction through CAI and instruction through the conventional method. The dependent variables of the study were attainment scores and retention scores. The confounding variable of the study were grade level, intelligence, prior knowledge about the subject, contamination effect, test administrator, and computer laboratory environment. There were various tools used to collect the data which were computer-assisted instructional material (CAIM) and planned lessons based on matrix algebra, ravens' standard progressive matrices, matrix algebra test, calculus attainment test, numerical analysis test, mathematical concept test, parallel matrix algebra test, parallel calculus attainment test, parallel numerical analysis test. The SPSS was used to analyze the collected data. The mean, standard deviation, variance, parallel t-test, coefficient of correlation, and independent-sample t-test were statistical techniques used to analyze the collected data.

The findings of the study described that the learning enhanced up to 88%by using CAI of the experimental group and the learning enhanced up to 83% of the control group to attain all mathematical concepts. The learning enhanced up to 83% by using CAI of the experimental group and 78% for the conventional method of the control group to retain all specific mathematical concepts. The instructional material enhanced learning at a satisfactory level but the experimental group gained more percentage in comparison to the control group. Therefore, it was cleared that CAI proved more useful to attaining and retaining all specific mathematical concepts.

Jasdeep Kamal Kaur (2015) conducted a study on 'Effect of Interaction Analysis and Concept Attainment Model on teaching skills on teacher trainers'. The population of the study was all the trainees' teachers studying in education and belonging to the college of education of Punjab. The Ludhiana district was selected by random sampling through the lottery system. The three B. Ed colleges were selected from the district for experimental groups A-1, A-2 & A-3 respectively of the study. The study used a pre-test post-test equivalent group design. The tools of the study were the mental ability test for college adults (1976, Jalota), observation schedule included five skills of teaching (1976, Passi) and Investigator has developed two modules which were based on Flanders interaction analysis category system (1970) and another one was Burner's concept attainment model (1956) tool which one was made by the researcher. The study contained one dependent variable teaching skills of trainees' teachers who chosen social studies as an optional subject for teaching and two independent variables interaction analysis and concept attainment model. To analysis the data, researcher used means, standard deviation, and standard error of mean, t-test, and ANOVA.

The result of the study concluded that the concept attainment model and Flanders interaction analysis category system were found useful to upgrade and enhance the learning and teaching skills of trainees' teachers than the conventional method of teaching. According to the statistical analysis of the data, it found that the Flanders interaction analysis category system was more effective in comparison to the concept attainment model for the emergence of teaching skills of trainees' teachers.

2.2.3 Review of Indian Previous Research Works on Mathematical Anxiety

P.S. Parmar (1993) conducted research on the topic entitled 'A Comparative Study of the Mathematical Concept and Mathematical Achievement of the Pupils of Grade 8th in the Context of Caste, Intelligence, Anxiety, Need for Achievement and Certain Demographic Variables'. The population of the study was all students of grade 8th belonged from the Mehsana district. There were the 1980 students selected by using a random sampling method from the population, out of which 1035 were boys and were 945 girls. The independent variable of the study were caste, intelligence, anxiety, sex, need for achievement, family, and birth order whereas the dependent variable of the study were the mathematical concept and mathematical achievement. The investigator chose a 2×2×2×2 factorial design to done his experiment. The statistical techniques mean, frequency, median, standard deviation, quartile range, coefficient of correlation were used in the study. To find the validity of the test researcher used content validity and scatter diagram and to find out the reliability of the test researcher used test-retest and split-half method. The test based on the conceptual understanding of mathematics was constructed by the researcher. There were various tools used in the study named Desai (Bhatt Group Test of Intelligence standardized by K.G. Desai & C.L. Bhatt), Boxell's Test of School Anxiety, Need for Achievement Test by Smith's and the bio-data proforma of the public constructed by the researcher.

The findings of the study represented that a highly intelligent student scored better in mathematics than a low intelligent student. The non-backward class student achieved more scores than a backward class student. According to the findings of the study the need for achievement contributed 42% to learning the mathematical concept, intelligence contributed 43.06% to achieving the mathematical scores. The caste and gender contributed 13.24% to achieve the mathematical achievement and caste, anxiety & gender did not contribute to mathematical achievement.

Satya Prakash (2000) conducted research on the topic 'A Study of Mathematical Creativity and Achievement of Elementary School Students in Relation to Problem-Solving Ability, Anxiety, and Socio-Demographic Variables.' The 8th-grade students of the government and private senior secondary schools in Chandigarh were the population of the study. The sample contained 400 students from these above-mentioned schools that were selected by using a random sampling method. The descriptive survey method was used in the study. The problem-solving ability test, environmental factor scale, and achievement test in mathematics these three tools constructed by the researcher. Some standardized tools like the comprehensive anxiety scale (1970, Sinha), the Socio-economic status scale (1980, Kulshreshtha), and the test for creative thinking in mathematics (1989, Moghe) were used for data collection. The bi-variate coefficient of correlation, mean, standard deviation and t-test were used to analyze the collected data.

The findings of the study showed that the problem-solving ability of elementary school students developed with the development of their mathematical creativity and mathematical achievement. It was clear that mathematical creativity, mathematical anxiety, and mathematical achievement were independent from each other. The school environment played a vital role in the development of problem-solving ability and mathematical creativity of the type of flexibility, fluency originality. In the study, the relationship between socio-economic- status, mathematical creativity, and mathematical achievement were also accepted. In the study, the researcher found the positive relationship between socio-demographic variables, mathematical creativity, and mathematical achievement.

Vasant V. Shastri (2011) conducted research on the topic 'Evaluation of Yoga Pranayama and Vedic Mathematics Method in the Management of Math Anxiety and Cognitive Skills in School Children'. The population of the study considered the students of grade 8th, 9th, 10th, and 12th belonged to Sri Sai Angles Institution Chikka Mangaluru, Karnataka, India. The sample of the study was 243 students selected from these classes by using a random sampling method for study III. The 168 students were selected by a random sampling method for the main study-II and the other 40 students were selected by a random sampling method for study–I (pilot study). The mathematical anxiety rating scale revised (MARS-R, Plake et. al., 1982), Children's cognitive assessment questionnaire (CCAQ Zatz et. al., 1983), computerized STROOP 2011 version (Draine, 1998), digit span test computerized version forward and backward (Drain, 1998), mindfulness attention awareness scale, MAAS (Brown et. al., 2003), non-physical aggression scale from the Pittsburgh youth study (Loeber et. al., 1998), emotion regulation questionnaire (Gross et. al., 2003) were the tools of the study. The one-way ANOVA, t-test, Kruskal Wallis test with Bonferroni corrections Mann Whitney U test were used to analyze the data.

The findings of the study showed that the mathematical anxiety of the students reduced rapidly by using the yoga pranayama and Vedic math method. These were also useful to enhance the learning of the students. There was a very positive effect of increased yoga pranayama on the cognitive skills of children. They gained more concentration and attentiveness for learning through yoga and pranayama.

Jitender Dhull (2012) conducted a research on 'A Comparative Study of the Academic Achievement in Science in the relation to Intelligence, Academic Anxiety and Reading Interest of the 10th Class Students in Government and Private Schools of Haryana.' The population of the study was all students of grade 10th stream of education studying in government and private schools belonging to Rohtak. The sample of the study contained 400 students selected from random sampling from the government and private schools of Sonepat, Rohtak. There were four tools used by the investigator's academic anxiety scale (Dr. A.K.P. Sinha & Dr. I.M.K. Sinha), general intelligence test (Dr. S.M. Mohsin), achievement test in science, and reading interest inventory developed by the researcher. The intelligence, academic anxiety and reading interest were independent variables of the study and achievement tests in science were the dependent variables of the study. The data was collected through the normative survey method. There were used mean, standard deviation, t-test, and Karl Pearson product-moment correlation.

The findings of the study showed that the academic anxiety of the 10th class students in government and private schools found the same. The private school students of class-10th had more academic anxiety than government school students of class-10th because they obtained better guidance and infrastructure which created pressure to do achieve high scores in examinations in comparison to government school students. The infrastructure and academic environment created pressure within the private school students therefore their anxiety became increased up to a higher level than government school students. According to the findings of the study, female students had high reading interest than male students. The reading interest was found directly proportional to achievement in science.

Satwant Kaur (2013) conducted a study on the topic ‘Effect of Computer-Based Instruction on Achievement in Mathematics in Relation to Mathematics Self-efficacy and Mathematics Anxiety’. The population of the study was the students of class 9th of district Mohali, Jalandhar. The sample of the study was selected by a random sampling technique from the senior secondary school of Jalandhar which is affiliated to the Punjab school board, Mohali. Therefore, the number of samples was 216 students of class 9th. The study used a 2×2×3 factorial design for analyzing the data. There were various tools used in the study named the General mental ability test (Jalota, 1972), mathematics anxiety scale (2011, Karime & Venkatesan). Some tools made by the researcher himself named a criterion-referenced test in mathematics, an achievement test in mathematics, computer-based instructional material in mathematics, instructional material in mathematics based on traditional methods of teaching, and a mathematics self-efficacy scale. After data collection through the above-mentioned test, the researcher used mean, standard deviation, skewness, kurtosis, a three-way ANOVA (2×2×3), t-test, f-ratio for statistical analysis of obtained data.

The findings of the study showed that the group taught through computer-based instructional method obtained higher achievement than the group taught through traditional methods. The students who had higher mathematics self-efficacy obtained high academic achievement in comparison to those students who had low mathematics self-efficacy.

Archana Singh (2014) researched on 'A Study of the Relationships between Anxiety and Creativity among Intermediate Students'. The intermediate students of Allahabad, U.P. were the population of the study. First, researcher chosen the schools by using a random sampling method then selected the students of class 12th from these schools randomly. The sample size was 300. The mean, standard deviation, correlation, regression were used for statistical analysis of the data with the help of the SPSS 19.00 window version. The independent variables of the study were gender, family background, age, and academic profile whereas the dependent variables were anxiety and creativity of the ex-post-facto study. The data was collected with the help of a questionnaire based on anxiety and creativity-related questions. The reliability of the test was measured by using the test-retest and split-half methods. To measure the creativity, the researcher used a test battery named 'Thinking creatively with words' (Dr. Bakar Mehdi, 1981) and to measure the anxiety by using Sinha Anxiety Scale (Dr. Sinha).

The findings of the study showed that there was a 0.146 correlation found between anxiety and creativity. The flexibility and fluency were positively correlated with anxiety but originality made a negative correlation with flexibility and creativity. According to the growth of age, the relationship between anxiety and creativity became weak.

Meena Thakur (2014) conducted a study on 'Self-efficacy, Mathematical Attitude, and Anxiety as Correlates of Creativity among Secondary School Students'. The population of the study was the secondary school of Himachal Pradesh. To conduct the study used the descriptive method of the research. On the basis of the high literacy rate selected 12 districts in the state and further selected 3 districts out of

12 by using a random sampling method. There were 42 schools selected from Hamirpur and Solan district and 1110 number of the sample selected from the above-mentioned schools by using a cluster sampling technique. The research tools of the study were creative ability in the mathematics test (CAMT, D.S.Balka, 1974), Hindi self-efficacy scale (1998, Shonali Sud, Matthias Jerusalem & Ralf Schwarzer), How I feel about mathematics (Mann, based on mathematical attitude scale MAS by Fennema-Sherman, 1976) and Hindi version of cattle's self-analysis form (1970, S.D. Kapoor). Researcher used mean, median, mode, standard deviation, variance, skewness, kurtosis, range 3-way ANOVA, t-test to analyze the collected data. The researcher made a 2×2×2 factorial design (gender × mathematical attitude × mathematical anxiety).

The result of the study explored that the creative ability in the mathematics of girls was higher than boys; the low anxious secondary school students had a higher creative ability in mathematics than high anxious secondary school students. According to the result, the students who had high self-efficacy were more favorable towards creativity. The boys represented a higher mathematical attitude than girls therefore gender and mathematical attitude were dependent on each other. In the low self-efficacy group, the boys who had a more mathematical attitude had more mean creativity. The researcher found no significant difference between the mean creativity scores of secondary school students. The self-efficacy played the role of facilitator for only girls group, not boys and mathematical anxiety was not important for creativity but it acted as a facilitator for boys group, not girls.

Anjana (2018) conducted a study on the topic 'Mathematical Achievement concerning Problem-Solving Ability, Mathematical Attitude, and Anxiety of Secondary School Students.' The problem-solving ability, mathematical attitude, and mathematical anxiety were the independent variable of the study. The dependent variable was mathematical achievement. The population of the study considered all the students who were studying in government and private secondary schools affiliated to HBSE (Hariyana Board of Secondary Education), Bhiwani. There were four divisions of Haryana state that Rohtak division, Ambala division, Hisar division, Gurgaon division. The researcher contained 200 samples from each division of Haryana. So, a total of 800 samples were collected by the stratified random sampling method in the study. To collect the data the researcher used several tools that

Mathematical Achievement Test (2011, Ali Imam & Tahira Khatoon), problem-solving ability Test (2011, L.N. Dubey), mathematical attitude scale (1984, P.S. Yadav), and mathematical anxiety scale (2012, Sadia Mehmood and Tahira Khatoon). To analyze the collected data, mean, standard deviation, range, percentage, Q-Q plot, product-moment correlation, multiple regression equation, and t-test were used by the researcher.

The findings of the study showed that private secondary schools had high mathematical achievement than the mathematical achievement of those students who belonged to government schools. Male students had high academic achievement than females, rural and urban students obtained similar academic achievement almost. The students of private secondary schools had the high problem-solving ability and high mathematical attitude in comparison to government secondary schools' students. The government secondary school students have high mathematical anxiety in comparison to private secondary school students. The male students had high problem-solving abilities than female students whereas male and female students were found similar mathematical anxiety and mathematical attitude. According to the findings of the study urban and rural secondary school students had similar problem-solving abilities, mathematical attitudes, and mathematical anxiety.

Priti Kalsia (2018) conducted a study entitled 'Effect of Inquiry-Based Learning Approach on Achievement and Attitude towards the Mathematics of 9th Graders in relation to their Mathematical Anxiety'. The dependent variables of the study were achievement and attitude towards mathematics. The independent variables were the environment, Instruction, task, and subject variables. The teaching strategy considered as an independent variable. The scholastic achievement, social-economic status, the physical environment of the school, the effect of time, the practice of test effect, and the effect of intelligence were considered as the extraneous variable of the study and the intervening variables were fatigue, boredom, interest, health, and hunger. The researcher used a mixed type group test of intelligence (MGTI, 2008 By Mehrotra), Mathematics Anxiety Scale (2012 by Sharma & Sansanswal), Mathematics Attitude Scale (2016 by Singh & Jaidka), and conventional teaching strategy for data collection. The researcher made an achievement test and instructional package for an inquiry-based learning approach. The population of the study was all

9th-grade students of mathematics of Punjab and teachers who were taught mathematics to 9th-grade students in the senior secondary school of Punjab.

The researcher collected two types of samples one was the schools' sample and the other was the students' sample and find out two government colleges. By using a random sampling method, the researcher selected 210 students of grade 9th from these two above-mentioned colleges. The randomized group pre-test post-test design was used in the study. To analysis the data, researcher used a factorial design to obtain the scores of achievement in mathematics. Researcher used mean, standard deviation, skewness, kurtosis, and ANOVA (2×2), F-ratio, t-test to analyze the data. The findings of the study showed that the students who were taught by the inquiry-based learning approach obtained about double academic achievements in comparison to the academic achievement of those students of grade 9th who's taught by the traditional teaching method. The students who had low mathematical anxiety obtained more academic achievement in comparison to the obtained score of academic achievement of those students who had high mathematical anxiety.

Surendra Yadav (2018) researched a study on 'Achievement in Mathematics in relation to Mathematics Anxiety and Self-efficacy among Secondary School Students.' The students of the 9th grade of central government school by CBSE in Varanasi city considered as the population of the study. The numbers of sample were 374 students of 9th standard who were selected by random sampling technique. The descriptive survey method was used in the study. The researcher used self-constructed tools. There were mathematics achievement test (MAT), mathematics anxiety scale, mathematics self-efficacy assessment scale were used. Mathematics anxiety and mathematics self-efficacy were the independent variables of the study. Mathematical achievement was the dependent variable of the study. The researcher divided into mathematical achievement and self-efficacy in their various components. The components of mathematical achievement were set theory, algebra, trigonometry, coordinate geometry, calculus, and statistics. The components of mathematical self-efficacy were general beliefs to solve the mathematical problems and cognitive strategies, emotional strategies, selection strategies, motivational strategies. The researcher included demographic variables gender, category of students and parent's occupation, and age group in his study. To analyze the collected data, researcher used mean, median, standard deviation, skewness, kurtosis, multiple regression analysis, t-test, one-way ANOVA, and post ANOVA test.

The findings of the study showed that mathematics anxiety and mathematics self-efficacy both reflected an equal level of importance to predict mathematical achievement. There was a positive correlation between mathematical self-efficacy and mathematical achievement but mathematics anxiety had a negative correlation with mathematical achievement.

2.3 Review of Related Literature in Foreign Context

2.3.1 Review of Foreign Previous Research Works on Constructivist Pedagogy and Constructivism

Jong Suk Kim (2005) conducted a study on the topic 'The Effect of Constructivist Teaching Approach on Student Academic Achievement, Self-concept and Learning Strategies'. The main aim of the study was to identify the effect of teaching while using a constructivist learning approach on academic achievement, self-concept, and learning strategies of the students. The population of the study was 6th-grade students of Chungnam National University Korea. There were 76 students of 6th grade selected from the above-mentioned population through random sampling, out of which 38 students for the control group and 38 students for the experimental group. Researcher used various tools to proceed to the study that the mathematics test used by teachers contained 40 items, a survey related to classroom experiments, learning strategy inventory, self-concept inventory included 15 items. The non-equivalent control group pre-test post-test design was used in the research. The Cronbach alpha or the coefficient of alpha, Likert scale, test-retest reliability, coefficient of correlation, mean, standard deviation, and t-test were used to analyze the collected data.

The findings of the study showed that the post-test scores of the experimental group obtained 75.65% and the control group obtained the 64.65% scores related to the academic achievement of students. The constructivist approach was more effective for stable and easy learning of mathematical concepts and it was not effective for self-concept enhancement and strategy related to the students learning. According to the findings of the study, the constructivist approach had a minimum effect on motivation to learn academic tasks, anxiety related to the academic learning process, and self-monitoring.

Rafia Zareen et. al., (2014) conducted a study on the topic 'Higher Secondary Biology Instruction in Pakistan in Constructivist Perspectives'. The important purpose of the study was to find out the higher secondary Biology instructions on the basis of the constructivism approach in Pakistan. The biology teachers of higher secondary schools or colleges of Pakistan were the population of the present study. There were 200 Biology teachers, 1000 Biology students who selected through random sampling technique from 100 institutions from the five districts of Punjab. The 20 higher secondary schools were selected randomly from every five districts. Therefore, 2 teachers and 10 students were selected by random sampling method after that the researcher selected the actual sample for the data collection. Therefore, multi-stage sampling was used to find out the sample of the research. The researcher developed a questionnaire for both the above-mentioned teachers and students in the descriptive survey study. The Chi-square test mainly used for the statistical analysis.

The findings of the study showed that constructive understanding was stable in the cognition of learners. Teachers should be assisted to their students for a more stable understanding which was possible through constructivism. According to the result of the study, the students of the higher secondary Biology stream found positive attitude with the help of their teachers in their different tasks related to the constructivist perspective.

Fereshte Heydari Aydisheh et. al., (2015) conducted a study on 'Effectiveness of Constructivist Teaching Method on Students' Mathematics Academic Achievement'. The main purpose of the study was to explore the effect of the constructivism approach in mathematics teaching on the mathematics academic achievement of the students. The statistical population contained 364, 3rd-grade girls students from high schools of Maindoab, Iran. There were 70 girls students of 3rd grade who belonged from 6 schools. Therefore, one school was selected by using the multistage random sampling method and 2 classes chosen randomly whereas one was experimental and the other was the control group. The sample of the experimental group was 35 students and the control group was 35 students. The quasi-experimental research design with the control group was used to proceed with the research. The researcher prepared a questionnaire that contained 30 questions based on the academic achievement principles of Bloom’s cognitive domain was considered the tool of the study. Cronbach’s Alpha, mean, standard deviation, t-test, distribution tables with the diagram were used to analyze the collected data.

The result of the study exposed that the academic achievement of the students was increased and learning was stable while using the constructivist method in the mathematical classroom. The constructivist approach affected positively the understanding, analysis, application, and evaluation of the students’ cognition.

Polat Ahmad et. al., (2015) conducted a study on the topic ‘The Constructivist Approach? I have heard about it but I have never seen it: An Example of Exploratory Sequential Mixed Design Study’. The study investigated the quality of education on the basis of students' views who attending social studies subject in the education department and to explore the problems of education in the present scenario and try to find out the solutions to these problems according to the tricks and ways which were given by the students. To find the views of prospective teachers use ‘education quality scale faculties of education, EQSFE’. The students of the faculty of education were the population of the study. There was two-phase cluster sampling used to get a sample of the study. In the qualitative study of the group, the 6 participants and 1670 students were the samples of the study collected by cluster sampling method. The researcher used exploratory sequential mixed methods and semi-structured interviews to collect the data. To analyze the data, the researcher used the Barlet test, content analysis, standard deviation, p-value, confirmatory factor analysis, explanatory factor analysis, Cronbach alpha reliability. By using these methods, the researcher determined the group of the qualitative study. The findings of the study related to the physical, social & cultural environment. The students preferred the use of behaviorism in the place of constructivism. The result of the study reflected that qualitative data indicated that the data may be generalized and their different major factors became revolutionary for different faculties of higher education.

Izwita Devi et. al., (2016) conducted a study on ‘The Development of Geometric Teaching Materials Based on Constructivism to improve the Students’ Mathematics Reasoning Ability through Cooperative Learning Jigsaw at the Class 8th of SMP Negeri 3 Padangsidimpuan’. The aim of the research was to know the effect of constructivism-based geometric learning material on the mathematics reasoning ability of class 8th students of SMP Negeri 3 Padangsidimpuan. The researcher developed and modified the 4D developmental models. The research was conducted to follow many steps to define the steps, designing step, developing step and disseminating step. The population of the study was the 8th-grade students of SMP Negeri 3 Padangsidimpuan. The instruments were used in the study that validity sheets and questionnaires, related to teaching material, tests and observation sheets related to the effectiveness of teaching material, and enhancement of teaching ability tests. The product-moment correlation, coefficient of reliability, mean, and percentage were used for the statistical analysis of the research. There were used criterion validity to define the validity of geometry teaching material. The findings of the study showed that the mathematical reasoning ability of class 8th students increased to the medium category by using constructivist-based geometric learning material.

Ozturk, Faruk (2016) conducted a study on the topic "The Development of Science Concept in Turkey and Effects of Constructivism on 2004 Primary Science Curriculum". The important aim of the study was to test the development of the concept of science in Turkey. According to the study, the historical background of the science concept was developed in Turkey in two stages. The first stage ottoman state and republican era, in the positivism time the prevalent objectives of the national science curriculum. The second was the stage considered in the beginning periods from 2004 when the ramification of postmodern epistemology could be seen with the emergence of the latest elementary curriculum, which is based on the constructivist approach. The document of the program of the year 1913, 1924, 1926, 1930, and 2004 was used to the representation of the science curriculum. The analysis represented the effect of positivism observed as far as the 2004 program. Hereby there was not any difference in the basic paradigm related to the scientific understanding up till the 2004 program. These programs provided a break from the conventional to the constructivist approach.

Savas Basturk (2016) conducted a study on 'Primary Pre-service Teachers' Perspective on Constructivism and Its Implementation in the Schools.' The main purpose of the study was to find out the view of the pre-service teachers to implementation of constructivism approach in the schools. The population of the study involved primary pre-service teachers belonging to the department of primary schools' teacher of education related to the faculty of education of the state university of North Turkey. The twelve pre-service teachers of grades 2, 3, 4 were selected on a voluntary based which was the sample of the study. The semi-structured interview was conducted by the researcher with twelve primary pre-service teachers of 2, 3, 4 grades. The four pre-service teachers were selected through purposive sampling from every grade to participate in the interview. The researcher conducted the interview again for about 20 minutes. Recording of the interview was saved in written form by the researcher for later analysis. There were used content analysis and descriptive methods were for examining their responses. There were used frequency and inter-coder reliability for the open-ended questions in the interview. There were used miles and Huber man's (23 formula) to know the perspective of the teachers.

The findings of the study showed that the knowledge of pre-service teachers about constructivism was very simple and limited. They had the positive view of constructivism for enhancing and updating the teaching-learning approach. They felt a lack of experience, confidence, and major hesitations about implementing constructivism in classroom teaching. They also thought that the lesson plans and practices were not sufficient for the constructivist teacher in the faculty of education.

Sustana Roy Chaudhary (2016) researched on the topic 'A study on the effect of the constructivist approach on the achievement in mathematics of 9th-grade students'. The main purpose of the research is to find out the effect of constructivism on the mathematics achievement of the class 9th students. The population of the study was mathematics students of 9th grade belonging to Tinsukia, Assam. The sample of the study was 60 students selected from Govt. higher senior secondary school affiliated to S.E.B.A. Assam by purposive sampling. From these 60 students, 30 students were selected through random sampling for the experimental group and remain, 30 students were considered for the control group of the study. The non-equivalent pre-test post-test design was used in the study. Before the experiment, the researcher operated MAT pre-test to ensure the similarity of the experimental and control group. An achievement test in mathematics contains 35 items and instructional material was developed by the researcher in the study. To analyze the collected data, the researcher used percentages, SD, t-test, mean.

The findings of the study showed that the constructivist approach enhanced and upgraded mathematics learning. The constructivist approach provided stable learning in mathematics which affected equally for boys and girls. According to the findings of the study, constructivism enhanced the understanding and application ability of the student in comparison to other cognitive abilities like knowledge and skills.

Yeliz Temli Durmus (July 2016) conducted a study on "Effective Learning Environment Characteristics as a requirement of Constructivist Curricula: Teachers' Needs and School Principals". The purpose of this study was to explore the views of elementary school teachers and principals on the physical learning environment whereas the teachers wanted to implement the constructivist approach. It was a qualitative study. Hereby elementary school teachers and school administrators were the populations of the study. The researcher consisted of 48 teachers of elementary school and 6 administrators for samples of the study which had to work in Usak, Turkey. Semi-structured interviews were used for data collection. The data was analyzed through coding-based content analysis. There were 7 participants out of which 5 teachers and 2 administrators. These participants were analyzed by three researchers and one author. There were standard deviation, mean, and percentage used as statistical techniques. The findings of the study showed that the teachers recommended special classrooms to imply constructivism in the classroom which became suitable for constructivist teaching-learning. Similarly in the English language classroom, the teachers demanded a separate classroom with useful audio-visual aids. In Turkish classrooms, participants demanded audio-visual aids, study materials, internet connection, computer, projector, disposable materials, bulletin boards, science and technology classes and these laboratories, mathematics classes, and their material, mathematics classes with smart boards.

Fufa E. Meleta, & Weizhong Zhang (2017) conducted a study on 'Comparative Study on the Senior Secondary School Mathematics Curricula Development in Ethiopia and Australia'. The main objective of the research was to find the difference between the process of the development of the mathematics curriculum of the various Intermediate colleges by using comparing methods in the two countries Ethiopia and Australia. This was qualitative research whichever used document analysis and semi-structured interviews as a research method of the study. The sample was collected from the website of the federal democratic republic of Ethiopia related to the ministry of education and the website of the curriculum of

Australia. The investigation depended upon four themes that were developing the curriculum, implementation, monitoring, and evaluation. The result of the study analyzed that the difference in the development of the mathematics curriculum of Intermediate College emphasizes on the basis of international research outcomes and temporal matter in Mathematics education. Suppose as the base of curriculum development. The fundamentals of content standard organization, a trial took of the curriculum before its implementation on all over schools, inspection, and evaluation technique. Though, there were some similarities in the mathematics curriculum of Ethiopia and Australia and the assessment of needs and use of the constructivist approach in both countries were similar.

Molly Van Niekerk et. al., (2017) conducted research on the topic 'Value-based Leadership Approach – A way for Principals to Review the Value of Values in Schools.' The main purpose of the research was to know that how a principal made and maintained the moral and value-based environment in their schools. The qualitative research was grounded based on social constructivism. The school's principal of South Africa was the population of the study. The 9 schools' principals were selected by using the purposive sampling method for data collection. A semi-structured audio-recorded interview was conducted with the 9 principals.

The findings of the study were that every principal had a person's own different views on values. They advertised perfectly the value of morality and defined their range also in their institution. They presented that the principals connected with the values globally as a leader. The schools' principal made and maintained a level of values that were shared by this principal and all members of the institute.

Qais Faryadi (2017) conducted a study on 'Effectiveness of Facebook in English language learning – A case study'. The main objective of the study was to find out the importance and advantage of Facebook to learn the English language. The undergraduate students of the University of Sains Islam Malaysia (USIM) were the population of the study. The 900 students were selected through random sampling from the above-mentioned population. The study used the triangulation method to collect the data. There were various tools used for data collection like- pre-test post-test, the field observation of students, observation of inventors, and the perceptions and opinions of participants. The dependent variable of the study was comprehension skills of the learner, motivation, satisfaction, students test score, and critical thinking. The dependent variable of the study was Facebook.

The findings of the study were based on interviews, questionnaires, and pre-test post-test. According to the result, Facebook improved English language proficiency. The student who used Facebook that was the control group of the study performed 88.8% passed and the students who didn't use Facebook performed 60.00% passed. So the use of Facebook to create a constructivist classroom can be more effective. These findings of the study will be useful to create the paradigm of constructivism.

Nahil M. Aljaberi et. al., (2018) investigated the topic 'In-service Mathematics Teachers believe about Teaching, Learning, and Nature of Mathematics and their Mathematics Teaching Practices.' The main purpose of the study was to know the viewpoints of in-service mathematics teachers with respect to learning, teaching, nature of mathematics, and practice of mathematics teaching. The mathematical teachers of primary and upper primary private schools in Amman-Jordan of the session 2016-17 were considered as the population of the study. The 101 teachers were selected from 11 schools through appropriate sampling methods. The two tools used for data collection 'The mathematics beliefs scale and the mathematics teaching practices scale' made by the researcher. The reliability coefficient or Cronbach's alpha was used as the statistical technique of the study.

The findings of the study showed that the mathematics teachers' beliefs regarding teaching-learning about mathematics subjects were very inclined with respect to constructivism. According to the conclusion, there was found a lack of constructivism in teaching training. It was found that the experience and academic level did not affect the teaching and learning in mathematics of the teachers. There was found a significant correlation between beliefs and teaching practices represented in the class by the teacher.

Nkhensani Thuketana et. al., (Nov 2018) conducted a study on 'Group Work during Visual Art Activities to Reduce Indecisiveness'. The purpose of the study was to investigate how did group work accelerated the ability of decisive behavior and self-confidence in students. The population of the study was the students of 5th grade of pre-primary schools and the sample was the group of 5th-grade students in the private pre-primary schools. The sample was 5 students, who were targeted to fulfill the aim of the investigation. Observation and recordings had used as techniques and purposive sampling was used. The research had a qualitative approach in the multiple case studies. The researcher emphasized 4 learners out of which 3 had expressed indecisive behavior. The one learner had presented the decisive behavior at the time of the making of visual art. The activities of these learners have been observed and recorded by the researcher in a co-operative group of art activities. According to the result of the research, the four indecisive learners had improved and adopted confidence further decisiveness all over time. The result followed the Vygotsky theory that the capable learners may be scaffold to the incapable learners to adapt their complete potential.

Ozlem Ates (2018) conducted a study on 'Consistency between Constructivist Profiles and Instructional Practices of Prospective Physics Teachers'. The prospective physics teachers of Turkey were the population of the study. There were 11 prospective physics teachers selected through purposive sampling considered as the sample of the study. The lesson plans, semi-structured interviews, and observation notes were used for data collection. The constructivist 5-E learning model-based questions were contained in the interview. The 11 physics students of 5th grade of the secondary science department and mathematics education of university, west of turkey as considered the sample of the study. To the analysis of the interview, the data collected from the participants were divided into the three categories traditional, transition, and constructivist belonging to the four dimensions beginning of the lesson, learning environment, assessment, and learning process. These dimensions were observed through a checklist that contained 24 items based upon the constructivist 5-E learning model. The researcher made the second checklist to examine the teaching qualifications of the participants.

The findings of the study represented that 7 participants had transitional, three had constructivist and four had traditional views. There were no participants who used the constructivist teaching style. The result of the observation and interview was that the 6 participants expressed their views into practice whereas about half the number of the participants could not express their views about practice.

Andrew Csizmadia, et. al., (Jan 2019) researched a study on the topic 'Integrating the Constructionist Learning Theory with Computational Thinking

Classroom Activities'. The main aim of this study was to identify a new mapping tool that might use to review the classroom activities with respect to constructivist learning and computational thinking. The population of the study contained students under age from 5 to 18 years. The number of samples was 25 students. The Constructionist scale was used as a tool of the study. To create the constructivist environment used lesson plans, games, and online study techniques. The study consisted of a small number of activities i.e., n = 21, which were analyzed by the mapping tool. Used inter-reliability test and Mann-Whitney test to compare the lesson plans and online activities of the students, the Kruskal Wallis with Bonferroni correction pairwise test and Wilcoxon signed-rank test used to analyze the data. The pre result of the research showed that various findings the first was that learner autonomy did not play a vital role in defining the problem and developing their own knowledge and the Second was the computational thinking or the concept of computer science-related to the learner's autonomy. The research facilitated had provisional authentication which could be seen as it is. The learning conditions were related to the level of constructionists in the learning context alternatively.

2.3.2 Review of Foreign Previous Research Works on Concept Attainment

Mehmat Erdogan (2012) investigated the topic on 'Environmental Education in High School 9^{th}-12^{th} Grade Biology Course Curricula started to be Implemented in 2007'. The aim of the study was to analyze the environmental education of the 9^{th}-12^{th} grade biology course curriculum which was implemented in 2007. There were 9^{th}-12^{th} grade biology course curricula analyzed by using the content analysis method. The analyzed sources of the research received from the board of education (TTKB, 2011a, 2011b, 2011c, 2011d). The content of 9^{th}, 10^{th}, 11^{th}, and 12^{th} grade biology related curricula of 2007 were analyzed by content analysis.

The findings of the study explored that the concept attainment of biology curricula was slightly related to affective and psychomotor domains but deeply related to the cognitive domain.

Izaak Hendrik Wenno (2016) conducted research on 'Comparative Study between Drill Skill and Concept Attainment Model towards Physics Learning Achievement'. The main aim of the study was to find a more effective teaching technique by comparing methods within the drill skill and concept attainment model. The population of the study contained all the students of the 8th grade of state junior high school of Ambon. The 60 samples were collected by random sampling method from the 8th A and 8th B class. Each grade has 30 samples considered two groups respectively. The first group of 8th A class of 30 students was taught by the drill skill model and the second group of 8th B class of 30 students was taught by the concept attainment model. The quasi-experimental design was applied in the research. There were used frequency, mean, standard deviations, t-test to analyze the collected data.

The conclusion of the study was based on students learning achievement represented that the drill skill model was better than the concept attainment model. The students learn more through drills and practice in comparison to concept attainment. The first group taught by drill skill model obtained 76.7% average value of learning achievements and the second group taught by concept attainment model obtained 46.7 % average value of learning achievements.

Jiesi Guo (2016) conducted research on the topic ‘The Probing the Unique Contribution of Self-concept Task Values and their Interaction Using Contributions of Multiple Values Facet and Multiple Academic Outcomes’. The main aim of the study was to investigate the unique contribution of four factors of beliefs and self-concept on academic achievements, behavioral engagement in mathematics, and self-reported effort. The population of the study contained the 9th-grade students of German. The sample of the study contained the 1978 students of 9th grade of high school selected by multiple random sampling methods from 82 classes in 25 academic schools in the state of Badan-Wurttemberg in 2012 in German. The motivational beliefs of students were measured by using the 4-point Likert-type scale. To analyze the data, researcher used confirmatory factor analysis (CFAs) and SEMs, chi-square, CFI (Comparative Fit Index), TLI (Tucker Lewis Index), RMSEA (Root Mean Square Error Approximation).

The findings of the study showed that the self-concept played important role in the prediction of achievement while the value of the beliefs was very predictive for the self-reported effort. The self-concept and belief value played the same importance as predictors of the engagement of the teacher. The achievement was highly connected with four factors of beliefs while effort was more connected with the attainment value. The current interactions between value beliefs and self-concept were predicted the three outcomes synergistically.

Olugbenga I.G.E. (2019) conducted study on 'Using Action Learning Concept Mapping and Value Clarification to improve Student Attainment in ICT Concept in Social Studies: The case of Rural Ecologies'. The main purpose of the study was to improve the students' concept attainment of ICT concepts in social science by using active learning, concept mapping, and value clarification method. The population of the study contained secondary schools students in 4 rural learning areas in Akoko, Nigeria. There were 170 students selected by using purposive sampling from the 8th intact classes of these secondary schools. There were 7 tools used in the research named action teaching, teaching guide, concept mapping teaching guide, value clarification teaching guide, social teaching guide, conventional lecture guide, and social studies test for rural ecologies, academic ability test, and research assistants' evaluation sheet. The quasi-experimental control group design was used in the present study. There was the 4x2x3 factorial matrix used for 4 treatments named action-learning, traditional lecturer method, concept mapping, and value clarification. To analyze the data, the researcher used ANCOVA, squared, mean, standard deviation as a statistical technique with the help of SPSS 25.0.

The findings of the study showed that the concept mapping instructional strategy proved the most suitable teaching technique to teach the concept related to ICT in social studies in rural learning ecologies. The treatment of concept mapping instructional strategy was found very sensitive for academic abilities and gender.

2.3.3 Review of Foreign Previous Researches on Mathematical Anxiety

Guney Haciomeroglu (2013) conducted research on 'Mathematics Anxiety and Mathematical Beliefs: What is the Relationship in Elementary Pre-Service Teachers?' The population of the study was considered as all the teachers of elementary education programs. There were 301 pre-service teachers enrolled in the elementary pre-service teachers' education program out of which 200 were female and 101 were male pre-service teachers. The sample included 135 pre-service teachers of the 4th year and 166 pre-service teachers of the 3rd year. The mathematics anxiety rating scale-short version (MARS-SV Suinn & Wintson, 2003) was used to measure the mathematics anxiety of the sample. It contained 30 items on 5 points Likert scale. MARS-SV constituted 5 dimensions test, course, application, computation, and social anxiety. Mathematical beliefs instrument (MBI, Peterson, Fennema Carpenter and Loef, 1989) used to measure the mathematical beliefs. The study used inferential and descriptive analysis. To analyze the data, the researcher used mean, standard deviation, t-test, one-way ANOVA and to compare the mean of MBI scores used Turkey HSD Test (Honestly Significant Difference).

The findings of the study expressed that the pre-service teachers were very confident in general concerning their abilities in mathematics teaching. The teachers had low mathematical beliefs related to teaching organization. They had no confidence regarding their belief in the teaching organization. They had some mathematics anxiety. There was found a significant negative relationship between mathematical anxiety and mathematical beliefs.

Aksu Zeki (2016) conducted a study on the topic 'Mathematics Self-efficacy and Mistake Handling Learning as predictors of Mathematical Anxiety'. The main aim of the study was to examine the relationship between Mathematical self-efficacy and mistake handling learning for the prediction of Mathematical Anxiety. The population of the study contained all 7th-grade students between the age of 12 to 14. The sample of the study constituted 320 students by random sampling method, out of which 166 were girls and 154 were boys. The data was collected with the help of the self-efficacy scale (2003, Tasdemir), mistake handling scale (2011, Heinze, Ufer, Rach & Reiss), and Mathematics Anxiety scale (1988, Ikegulu). There were used Pearson product-moment correlation method, multiple linear regression, mean and standard deviation to analyze the collected data.

The findings of the study identified a positive relationship between mistake handling learning, mathematical anxiety, and mathematical self-efficacy. The capacity of mistake handling in learning and self-efficacy might constitute that suppose a predictor of mathematical anxiety. There was the main fact found by using multiple regression analysis that the mathematical self-efficacy and mistake handling learning given a significant description of mathematical anxiety.

Elena Moreno Garcia (2018) conducted study on 'Among the Mathematics Task, Math Courses and Math Exams: How the Level of Students Anxiety Toward

Mathematics in a Private High School in Mexico?’. The purpose of the study was to identify the latest structure of variables that explained the level of anxiety towards the mathematics of high school students. It depended on the interaction i.e., the tasks, courses, and math exams of students. The population of the study was all high school students who belonged to Veracruz, located in the central area of Mexico. The sample of the research was 183 students of high schools selected by convenience sampling out of which 89 were from 1st semester, 27 were from 3rd semester, and 67 were from 5th semester. Out of 183 students, 72 were male and 111 female students, Out of which 144 students had lived together with both parents, 35 were lived alone or with one parent and 4 were lived with another family member. To collect the data used RMARS mathematical anxiety score scale of Richardson & Suinn (1972) was modified by Alexander Martray (1989) for measuring the mathematical anxiety of students. The scale had three-dimensional anxiety that exam anxiety (math test), task anxiety (math task), and anxiety towards courses (math courses). It contains 25 items. The study was descriptive and exploratory cross-sectional. It was empirical research. It was used a non-experimental design because the independent variable was not manipulated to change effects. To analyze the collected data used RMARS to identify the socio-demographic variables, exploratory factor analysis and Cronbach alpha index, Kaiser-Mayer-Olkin (KMO) test, and Barlett test.

The findings of the study showed that the three-factor scale original design made by Richardson & Suinn (1972) modified by Alexander Martray (1989) was not valid for Latin content students in the case of Mexico. The findings explored that the obtained model was tri-dimensional which was in contrast to the Penta-dimensional model for undergraduate students in the economic administrative area. By the way, the model of Alexander Martray (1989) was a three-factor model that also contrasts the obtained model in the study. The components of the obtained four-dimensional model of mathematical anxiety expressed anxiety when preparing for a mathematics test, anxiety when solving math problems, anxiety towards mathematics books, and anxiety when attending an exam related to the mathematics subject.

Akbayer Kamil (2019) conducted a study on ‘An Investigation about High School Students’ Mathematics Anxiety Level according to Gender’. The main aim of the study was to examine the level of mathematical anxiety of high school students towards mathematical lessons according to gender. The population constituted all 9th-grade students was belonging to Van, Turkey. The sample of the research constituted total of 89 students of 9th grade out of which 29 were females and 60 were males belonging from different high schools enrolled in Van Province Centre of the session 2017-18. The mathematical anxiety scale made by the researcher contained 27 items, used for data collection. Collected data was analyzed by using frequency, percentage, and t-test.

The findings of the study explored that the students of high schools had minimum mathematical anxiety levels but there was no significant difference found between male and female students' mathematical anxiety.

Colleen M. Ganley (2019) conducted study on the topic 'Construct Validation of the Math Anxiety Scale for Teachers'. The population of the study contained 399 elementary school teachers selected through a random sampling method out of which 297 teachers belonged to lower elementary schools (class 1st and 2nd) and 102 teachers belonged to upper elementary schools (class 3rd, 4th, and 5th). MAST (Mathematical Anxiety Scale of Teachers) was used to measure mathematical knowledge of teaching, it consisted of 19 items, and early elementary mathematics (K-TEEM, version 2016) included 32 items. There were used mean, standard deviations, skewness, kurtosis for statistical analysis of the collected data.

The findings of the study expressed that the mathematical anxiety was higher among elementary school teachers in comparison to upper elementary school teachers. The teachers who had higher mathematical anxiety had lack of knowledge of mathematics, various superstitions, and unreliable traditional belief about mathematics teaching-learning.

Milka Elena Escalera Chavez et. al., (Sept 11, 2019) conducted a study on the topic 'Anxiety towards Mathematics and Educational Level: A Study on Means Differences'. The main purpose of the investigation was to examine the degree of anxiety at different educational levels related to mathematics. The population of the study contained the different levels of primary, upper primary, secondary, senior secondary, and higher education students of Tuxtepic, Oaxaca. The sample of the study constituted 226 students by multistage sampling method. The sample was non-probabilistic. The questionnaire prepared by Munoz and Mato (2007) used for data collection had 24 items with five factors anxiety towards evaluation, anxiety towards the comprehension of mathematical problems, anxiety towards daily life mathematics situations. The Cronbach alpha reliability quotient and median, MANOVA's test of statistical power were used as statistical techniques.

The findings of the study explored that there was found different mathematical anxiety at the various educational levels. The mathematical anxiety was higher among upper primary, secondary, senior secondary, and higher education students but there was no perceptible anxiety found in elementary school students towards mathematics.

2.4 Summary of Review of Related Literature

The researcher studied the researches based on the constructivist approach firstly. Therefore, some important facts were revealed which are as follows-

2.4.1 Summary of Review of Related Literature in Indian Context

i) Constructivist Approach Review

Hari Prasad Upadhyay (2001), Dharmindarjeet Kaur (2015), R. Nagalakshmi (2011), Ravula Krishnaiah (2013), Anusmita Swain (2012), R. Ramanath (2013), Mahesh S. (2014) investigated in their studies that if teachers use constructive approach in the learning of Science, English, Mathematics, Geography, Biology and Social Science, etc. subjects then the academic achievement of students is increased definitely. Meenakshi Sharma (2018) stated that concept mapping makes a positive impact if it is used in constructive learning. G. Bharti (2014) believed that the ICT-aided constructive learning approach is very helpful in training for the professional development of pre-service teachers.

ii) Concept Attainment Review

In the important researches regarding concept attainment the stakeholders explained the important points of their results. Kiran Dammani (2011) pointed out that concept mapping strategy was more effective than concept attainment and traditional teaching strategy. Shyamsunder Bhairagya (2006) summarized that the rate of forgetting on Advance Organizing Model was 15.4% and 5.6 % in Concept Attainment Model. Nirupama (2013) found that CAI was more useful for retaining and attaining mathematical concepts.

iii) Mathematical Anxiety Review

About mathematical research work, Priti Kalsia (2018) proved that students attained double academic achievement through inquiry-based learning along with this she also said that when mathematical anxiety become decreased then academic achievement increased. The study of Anjana (2018) implied that high problem-solving ability and high mathematical attitude presented those students who have low mathematical anxiety. Meena Thakur (2014) found that those students who have high self-efficacy such students have more creativity and in reference to girl's self-efficacy was being a facilitator. She has also found that mathematical anxiety was not important for creativity. Surendra Yadav (2018) described that mathematical anxiety and mathematical creativity were equally important to predicted mathematical achievement. There was found a positive correlation between mathematical self-efficacy and mathematical achievement, but mathematical anxiety exposed a negative correlation with mathematical achievement and mathematical self-efficacy.

- There were no reviews found regarding Constructivism with Concept Attainment.
- There were no reviews found regarding Constructivism with Mathematical Anxiety.

2.4.2 Summary of Review of Related Literature in Foreign Context

i) Review on Constructivist Approach

Temili Durmus (2016) investigated that to apply constructivism in classroom teaching the teachers demanded various facilities which were suitable for the constructivist classroom. The research of Izwita Devi et. al., (2016) indicated that mathematical reasoning ability increased by using constructivist-based geometric learning material. Savas Basturk's (2016) study explained that the teacher has not a clear basic concept of constructivism, but they have positive view about this approach. Nahil Aljaberi et. al., (2018) found a lack of constructivism in teaching practices. Qais Faryadi (2017) found that Facebook increases the academic achievement of students. The findings were useful to create the constructivist paradigm.

ii) Review on Concept Attainment

Izzak Hendrik et. al., (2015) found that drill skill model was better than Concept Attainment Model. Mehmat (2012) investigated that Concept Attainment of biology curricula was slightly related to the affective and psychomotor domains.

iv) Reviews on Mathematical Anxiety

Zeki Aksu (2016) said that mistake handling learning has a positive correlation with mathematical anxiety and mathematical self-efficacy. Milka Elena Chavez (Sept 11, 2019) believed that mathematical anxiety was higher among upper primary, secondary and intermediate students but primary students have no anxiety about mathematics. Haciomeroglu Guney (2013) found a negative correlation between mathematical anxiety and mathematical belief. M. Colleen (2019) found that the primary school teachers have high mathematical anxiety in comparison to upper-primary school teachers.

- There were no reviews found regarding Constructivism with Concept Attainment.
- There were no reviews found regarding Constructivism with Mathematical Anxiety.

There was no one study found on constructivism along with mathematical anxiety and constructivism along with concept attainment. The researcher found a huge gap in the research regarding this. No researches were conducted about concept attainment and mathematical anxiety with constructivism. Therefore, researcher thought that the effect of constructivist pedagogy on concept attainment and mathematical anxiety is very relevant topic and thought that the findings of the study will be fruitful in the field of research. Researcher thought that the findings of the present study may be helpful to fill the gap in the field of research.

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CHAPTER 3

METHOD AND PROCEDURE OF THE STUDY

3.1 Introduction

Knowledge and education are complementary to each other both are inferior without each other. When knowledge began to be spread through education, research was also needed to find solutions to the problem created in it. Research conducted in the field of education is done to broaden the standard of education and find solutions to problems arising in the area of education, which is educational research.

The investigator first identified the research problem then presented tentative solutions to the problems as hypotheses. The description of previous research was presented in the review of related literature in chapter second. The main challenges of the research are tool formation, data collection, and data analysis, and the use of various statistical methods required to know the result. By adopting the right procedure, the researcher tries to fulfill the educational objectives of her research.

So, after the identification of the research problem and represented the brief description of previous researches related to it, there is a need to explain the method and process of research presented by the researcher. Therefore, the present chapter describes the tools and techniques of data collection, method, and procedure of the study which are as follows:

3.2 Research Method
3.3 Research Design of the Study
3.4 Population of the Study
3.5 Sample and Sampling Technique of the Study
3.6 Variables of the Study
3.7 Tools of the Study
3.8 Procedure of the Experiment
3.9 Statistical Techniques.

3.2 Research Method

Experimental method is used in the present study. The experiment was conducted into two parts.

1. **Main Experiment:** Treatment through teaching module based on constructivist pedagogy for experimental group students.
2. **Subsidiary Experiment:** Training program on effectiveness of constructivist pedagogy for school teachers.

3.3 Research Design of the Study

The researcher prepared an experimental plan and used it accordingly to fulfill the research objectives. The researcher used the "Non-Equivalent Post-Test-Only Control Group design". The samples of the students of class seventh selected for the study are divided into two groups. One group was the experimental group and another was the control group. 40 students were selected for the research purpose, out of which 20 students were selected for the experimental group and 20 students were selected for the control group.

X T O C O **QUASI- EXPERIMENTAL DESIGN**	X= Experimental Group C= Control Group T= Treatment O= Observations

Fig. 3.1: Non-Equivalent Post-Test Only Control Group Design

3.4 Population of the Study

The students of class seventh of U.P. Board of Lucknow city are the population of the present study.

3.5 Sample and Sampling Technique

- **Sample**

The sample of the present study is forty students of class seventh of Upper Primary School Mukarimnagar, Lucknow city.

- **Sampling Technique**

In the present study, the researcher used purposive sampling to identify the school and used simple random sampling to select the students.

- **School Sample Selection**: The researcher selected Upper Primary School Mukarimnagar, Lucknow by using purposive sampling. Since the principal of that school permitted the researcher for the experiment.
- **Students Sample Selection**: There were 47 students of class seventh in the permitted school. The researcher used a lottery system in random sampling to select the students.

3.6 Variables of the Study

Table 3.1: Variables of the study

A.	**Independent Variables**	a)	Constructivist Approach			
		b)	Conventional Teaching Method			
B.	**Dependent Variables**	a)	Concept Attainment			
		b)	Anxiety in Mathematics			
C.	**Controlled Variables**					
1.	Teacher Characteristics					
	a)	Gender	b)	Experience	c)	Training
2.	Learner Characteristics					
	a)	Gender	b)	Intelligence Level	c)	S.E.S
	d)	Age				
3.	Classroom Environment					
4.	Teaching Materials					
5.	Teaching Hours					
6.	Grade seventh					
D.	**Intervening Variables**					
	a)	Fatigue	b)	Monotony	c)	Interest in the subject matter
	d)	Teacher competence	e)	Length of the Study Material		
	f)	Parental Guidance	g)	Extra-Coaching		

3.7 Tools of the Study

In the present study, the researcher used the following tools which are given below -

1. Group Test of General Mental Ability (Hindi modified 72) by Dr. Shyamswaroop Jalota.
2. Socio-Economic Status Scale (S.E.SS) by Dr. Sunil Kumar Upadhyay.
3. Concept Attainment Test (CAT) constructed by researcher and supervisor.
4. Concept Attainment Test (CAT) by Dr. Anuradha Joshi and Dr. Ratnamala Arya.
5. Mathematical Anxiety Scale (MAS) constructed by researcher and supervisor.
6. Mathematical Anxiety Scale (MAS-I) by Dr. Ayatollah Karimi.
7. Students' Opinionnaire constructed by researcher and supervisor.
8. Teacher's Opinionnaire constructed by researcher and supervisor.
9. Development of the instructional material based on constructivist pedagogy by researcher and supervisor.
10. Determination of the traditional teaching material by researcher and supervisor.

3.7.1 Intelligence Test

The researcher used 'Group Test of General Mental Ability (Hindi modified 72), which is developed by Dr. Shyamswaroop Jalota to find the intelligence quotient (I.Q.) of class seventh students.

3.7.2 Socio-Economic Status Scale (SESS)

This tool is developed by Dr. Sunil Kumar Upadhyay to determine the Socio-Economic Status of the students. The scale has a total of 31 items divided into 5 parts:

i) Personal Information
ii) Family
iii) Education
iv) Income
v) Other (Cultural and Material Possessions)

The test-retest reliability was found to be 0.78. The validity of the scale was 0.74. No time limit was given for completing the test but students normally took 25-30 minutes to complete the scale.

3.7.2.1 Rationale of Intelligence Test and Socio-Economic Status Scale

Dr. Shyamswaroop Jalota's I.Q. test and Socio-Economic Status scale developed by Dr. Sunil Kumar Upadhyay have been used to match subjects in the control group and experimental group on the basis of I.Q. and Socio-Economic Status. Thus, it can be said that the experimental group and the control group will be equal with reference to the I.Q. and Socio-Economic Status of the students. The purpose of using I.Q. test and Socio-Economic Status Scale is to eliminate the effect of I.Q. and socio-economic status on concept attainment and mathematical anxiety of class seventh students. By removing the effects of intelligence quotient and socio-economic status, the researcher has tried to know the effect of constructivist pedagogy on concept attainment and anxiety in mathematics of students.

3.7.3 Development and Standardization of Concept Attainment Test

The steps of development and standardization of the 'Concept Attainment Test' are as follows:

i) Initial/ First draft

ii) Pre-Tryout/Expert Opinion

iii) Final Tryout/ Pilot Study

iv) Scoring and Item analysis regarding the Pilot Study

v) Evaluation of Concept Attainment Test

vi) Reliability

vii) Validity

viii) Norms

ix) Final Draft

x) Rationale of the 'Concept Attainment Test'

3.7.3.1 Initial/First Draft

The ‘Concept Attainment Test’ is a test that measures the mathematical concept attainment ability of the students of class seventh. This tool is divided into four sections and each section contains 10 items. Therefore, the total number of items in this tool is 40. The details are as follows-

i) **Concept Attainment Test Part-1**: Part-I consists of 10 items in column 'A' and column 'B', in column 'A' four examples are given, in column 'B' four concepts are given. The student has to tick the box against the theory given in column 'B'.

ii) **Concept Attainment Test Part-2:** There is a total of 10 items in Part-II in which it is mandatory to answer all the questions. Each item has a total of five options out of which four are related to a concept while the student has to tick the box in front of it identifying one option not related to that concept.

iii) **Concept Attainment Test Part-3:** This section also has 10 items. It is mandatory to answer all of them in which definition is given there are four options related to this definition choosing the correct option related to the definition the student has to tick in the related box.

iv) **Concept Attainment Test Part-4:** Concept Acquisition Test Part-4 consists of 10 items in which each item is given some fact or blank space related to a concept, which is based on a theory. Three principals are given in column 'B', the student has to identify the concept and tick the inbox in front of him.

3.7.3.2 Pre –Tryout Stage

The researcher administered some copies of the test to a few students to detect the omissions or mistakes if any, to examine whether the directions to items are actually being followed by students, to examine whether the time allowed is sufficient, etc. and researcher also collected the opinion of 09 experts from the University of Lucknow, Khwaja Moinuddin Chishti University, and Integral University, Lucknow to know their views and suggestions about the test.

3.7.3.3 Final Tryout/Pilot Study of Concept Attainment Test

The research is based on the class seventh student so the researcher has given priority to tool standardization. The researcher obtained the list of upper primary schools of Lucknow from the B.S.A. Office, Lucknow, and obtained the list of colleges (in which seventh class existed) from the D.I.O.S. office, Lucknow and selected 5 upper primary schools and 5 colleges by using a lottery system of random sampling. 51 students were selected from 5 upper primary schools through a lottery system of random sampling, out of which 25 boys and 26 girls. Similarly, 50 students were selected from 5 colleges by using a lottery system of random sampling, out of which 25 boys and 25 girls. The researcher applied the Concept Attainment Test for the first time on the 101 students of class seventh of all the selected government schools/colleges of Lucknow city.

Table 3.2: Sample for Pilot Study of Concept Attainment Test

Educational Institution	No. of School/College	No. of Boys	No. of Girls	Total no. of Students
Upper Primary Schools	5	25	26	51
Colleges	5	25	25	50
Total	10	50	51	101

3.7.3.4 Scoring and Item Analysis Regarding Pilot Study of Concept Attainment Test

i) Scoring

The researcher has collected data from a total of 101 students of class seventh of Lucknow. For each correct answer, the student was assigned 1 mark and for each wrong answer, zero mark was assigned. Thus, the scoring of the collected data was accomplished.

ii) Item Analysis

The process of analyzing the psychometric characteristics of questions numerically is called item analysis. Any statement is accepted or rejected on the basis of this procedure. The following two technical characteristics have under the item analysis process-

1. Difficulty Value
2. Discrimination Power of Index

1. **Difficulty Value:** It refers to the difficulty of items, this means that if more students answer correctly on a question, then that question will be easy similarly if fewer students are able to answer correctly then that question will be difficult. Difficulty value refers to the proportion of students answering a question correctly. After scoring the collected data, the researcher arranges these scores in descending order with the score obtained per item separately. Now makes two groups- upper group and lower group. The upper group considers the top 27% students (N_U) and 27% of students from bottom to top consider the lower group (N_L). Formula to Calculate Difficulty Value of each item:

$$\text{D.V.} = \left[\frac{R_U + R_L}{N_U + N_L}\right] \times 100$$

*To express in percentage D.V. is multiplied by 100

R_U = Number of all right responses of the upper group of students as per item

R_L = Number of all right responses of the lower group of students as per item

N_U = Number of top 27% students (the upper group)

N_L = Number of 27% students from bottom to top (the lower group)

- A low difficulty value means that fewer students have given the correct answer to the question so the question is difficult.
- A high difficulty value means that more students have given a correct answer to the question so the question is easy.

A question with a difficulty value (D.V.) of 50% is considered good but it may not be possible always. So, the researcher considered a question to have a difficulty level between 40%-60%. If the D.V. of any question is between 40%-60% then it can be selected otherwise rejected.

2. **Discrimination Power or Discrimination Index**- Discrimination power is also called item validity, the ability of items that can distinguish between less qualified and more qualified students is called discrimination power. Generally, the questions have up to 0.30 and above discrimination power is good.

$$\text{DP/DI} = \frac{R_U}{N_U} - \frac{R_L}{N_L}$$

R_U = Number of all right responses of the upper group of students as per item

R_L = Number of all right responses of the lower group of students as per item

N_U = Number of top 27% students from the upper group

N_L = Number of 27% students from bottom to top from the lower group.

In item analysis, the item whose difficulty value (D.V.) was 40%-60% and the value of discrimination index/power is up to 0.30 or more, were selected, and all other items were rejected. The item analysis of the obtained score on the 'Concept Attainment Test' was done as per the above-mentioned standards with a total of 40 items out of which 36 items were selected while 4 items were rejected.

Table 3.3: Item Analysis of Concept Attainment Test

Final Tryout/Pilot Study

Item Number	Difficulty Value	Discrimination Power/Index	Decision
1	18.519	0.2963	REJECT
2	18.519	0.1481	REJECT
3	45.926	0.5185	SELECT
4	46.296	0.7037	SELECT
5	40.741	0.5926	SELECT
6	38.889	0.3333	REJECT
7	48.889	0.3333	SELECT
8	46.296	0.5556	SELECT
9	50	0.5556	SELECT
10	58.889	0.7778	SELECT
11	42.593	0.6296	SELECT
12	44.444	0.5185	SELECT
13	48.889	0.6296	SELECT
14	47.037	0.5185	SELECT
15	42.593	0.6296	SELECT
16	46.2963	0.62963	SELECT

17	43.333	0.3704	SELECT
18	40.741	0.5926	SELECT
19	53.704	0.3333	SELECT
20	40.741	0.3704	SELECT
21	48.889	0.7037	SELECT
22	40.741	0.6667	SELECT
23	47.037	0.5926	SELECT
24	37.037	0.2222	REJECT
25	48.889	0.5556	SELECT
26	42.593	0.5556	SELECT
27	42.593	0.7778	SELECT
28	46.296	0.7037	SELECT
29	51.852	0.3704	SELECT
30	62.963	0.3704	SELECT
31	47.037	0.6667	SELECT
32	53.704	0.7037	SELECT
33	40.741	0.7407	SELECT
34	70.074	0.4444	SELECT
35	53.704	0.4815	SELECT
36	68.519	0.4815	SELECT
37	57.407	0.5556	SELECT
38	62.963	0.3704	SELECT
39	59.259	0.5926	SELECT
40	64.815	0.5556	SELECT
Total Items= 40		Selected Items= 36	
		Rejected Items= 4(Item no. 1,2,6 & 24)	

Therefore, out of 40 items, 36 items were selected and 04 items were rejected on the basis of Discrimination Index and Difficulty Value.

3.7.3.5 Evaluation of Concept Attainment Test

The researcher collected data from 205 students of Lucknow city, by using the stratified random sampling on the Concept Attainment Test to determine the validity, reliability, and norms of the self-made concept attainment test. The researcher collected data on the format of the Concept Attainment Test from 205 students of class seventh of Lucknow city, in which 5 schools were selected by the slip system of the random sampling from the available list of upper primary schools and 5 government-aided Inter Colleges (in which class seventh students exist) were selected by the lottery system of random sampling. There are 103 students of class 7th who were selected by stratified disproportionate random sampling from the schools, out of which 50 were boys and 53 were girls. Similarly, 102 students of class 7th of Lucknow city were selected from the Government Inter Colleges by disproportionate random sampling out of which 47 were boys and 55 were girls.

Table 3.4: Sample to Establish Reliability, Validity and Norms of Concept Attainment Test

Educational Institution	No. of School/College	No. of Boys	No. of Girls	Total no. of Students
Upper Primary Schools	5	50	53	103
Colleges	5	47	55	102
TOTAL	10	97	108	205

3.7.3.6 Reliability of Concept Attainment Test

i) Split-half Reliability

The reliability of the 'Concept Attainment Test' is defined by Split-half reliability and odd-even reliability of the raw scores by using the Spearman-Brown Prophecy Coefficient of correlation.

Spearman-Brown Coefficient

$$r_{SB} = \frac{2r}{1+r}$$

r_{SB}= Spearman-Brown Coefficient

r=Pearson product moment correlation between the two sets of raw scores

The Pearson product-moment correlation between first-half and second-half scores of the scale was found 0.7274 and Spearman-Brown Prophecy Coefficient was found 0.8419. Therefore, the split-half reliability of the scale is 0.8419. Similarly, the Pearson correlation between odd-even scores of the scale was found 0.8629 and Spearman-Brown Prophecy Coefficient was found 0.9264. Therefore, the odd-even reliability of the scale is 0.9264. These both reliabilities are significant for df=203 at 0.01 level of significance.

v) Cronbach's Alpha Reliability Coefficient

The researcher had computed the variance of items first to find the Cronbach's Alpha Reliability Coefficient**.**

Table 3.5: The Variance of Items for Cronbach's Alpha Coefficient

ITEM No.	VARIANCE	ITEM No.	VARIANCE	ITEM No.	VARIANCE	ITEM No.	VARIANCE
1.	0.1657	**10.**	0.2486	**19.**	0.2278	**28.**	0.2345
2.	0.24	**11.**	0.2468	**20.**	0.2383	**29.**	0.2292
3.	0.2379	**12.**	0.2216	**21.**	0.2473	**30.**	0.2499
4.	0.2427	**13.**	0.2427	**22.**	0.2409	**31.**	0.2486
5.	0.2462	**14.**	0.2248	**23.**	0.2449	**32.**	0.2495
6.	0.2499	**15.**	0.239	**24.**	0.2427	**33.**	0.2486
7.	0.22	**16.**	0.2379	**25.**	0.24	**34.**	0.2492
8.	0.239	**17.**	0.2332	**26.**	0.2492	**35.**	0.2498
9.	0.2379	**18.**	0.2379	**27.**	0.2379	**36.**	0.2452
						$\sum s_y^2$= 8.5871	

$\boxed{\alpha = (\frac{k}{k-1})(1 - \frac{\sum s_y^2}{s_x^2})}$	K=36	$\sum s_y^2$= 8.5871	s_x^2= 99.78299
α= Cronbach's alpha coefficient k = no. of item $\sum s_y^2$ = sum of items variance s_x^2 = variance of the total score	$\alpha = \left(\frac{36}{36-1}\right)\left(1 - \frac{8.5871}{99.78299}\right)$ $= 0.939532$		
	α= 0.939532		

Table 3.6: Computation of Cronbach's Alpha

The Cronbach's Alpha reliability coefficient value was found 0.939532 which shows the higher internal consistency between the selected items of the scale.

Table 3.7: Reliability of the Concept Attainment Test (CAT)

<table>
<tr><th colspan="2">Reliability</th><th>Obtained Value</th></tr>
<tr><td rowspan="2">Split-Half Reliability</td><td>First-half/Second-half Reliability Coefficient</td><td>0.8419</td></tr>
<tr><td>Odd-Even Reliability Coefficient</td><td>0.9264</td></tr>
<tr><td colspan="2">Cronbach's Alpha Reliability Coefficient</td><td>0.939532</td></tr>
</table>

3.7.3.7 Validity

The validity of the Concept Attainment Test (CAT) was established by the following methods:

i) **Face Validity:** The researcher collected the opinion of 09 experts from the University of Lucknow, Khwaja Moinuddin Chishti University, and Integral University, Lucknow to know their views and suggestions to judge the face validity of the Concept Attainment Test.

ii) **Content Validity:** The researcher calculated the content validity of the scale on the basis of rating judged by subject matter experts. Each item was assessed/measured by 'essential' and 'useful, but not essential' to the performance of the item. The researcher measured the content validity with the help of a formula developed by C.H. Lawshe (1975).

Table No. 3.8: Computation of Content Validity of Concept Attainment Test (CAT)

Item	n_e	CVR	Item	n_e	CVR
1	9	1	**19**	9	1
2	9	1	**20**	9	1
3	8	0.777778	**21**	9	1
4	7	0.555556	**22**	9	1
5	7	0.555556	**23**	9	1
6	8	0.777778	**24**	7	0.555556
7	8	0.777778	**25**	9	0.777778
8	9	1	**26**	9	1
9	9	1	**27**	9	1
10	7	0.555556	**28**	8	0.777778
11	8	0.777778	**29**	9	1
12	9	1	**30**	9	1
13	9	1	**31**	8	0.777778
14	9	1	**32**	9	1
15	9	1	**33**	8	0.777778
16	8	0.777778	**34**	8	0.777778
17	9	1	**35**	9	1
18	9	1	**36**	9	1
Total Content Validity of the Scale (Mean of CVR) = 0.888889					

Content Validity

$$\boxed{CVR = (n_e - N/2)/(N/2)}$$

Where:

CVR= Content Validity Ratio

n_e= Number of Subject Matter Expert Raters indicating 'essential'

N= Total number of Subject Matter Expert Raters

The mean of the content validity ratio was found 0.888889, which is indicator of overall content validity of the scale.

iii) Concurrent Validity: The concurrent validity of the test was computed by correlating 205 students' scores of the self-made Concept Attainment Test with 205 students' scores of the 'Concept Attainment Test' by Dr. Auradha Joshi & Ratanmala Arya. The correlation between the raw scores of the self-made Concept Attainment Test and the 'Concept Attainment Test' by Dr. Auradha Joshi & Ratanmala Arya was found 0.8126, which is significant for df=203 at 0.01 level of significance. Therefore, 0.8126 is the validity of the self-made Concept Attainment Test.

3.7.3.8 Norms: The norms of the Concept Attainment Test were made on the basis of percentile by using the 205 scores.

Table 3.9: Norms of the Concept Attainment Test

Percentile	Raw Scores	Level of Concept Attainment
$P_{81} - P_{100}$	31-36	Very High Concept Attainment
$P_{56} - P_{80}$	24-30	High Concept Attainment
$P_{41} - P_{55}$	18-23	Average Concept Attainment
$P_{16} - P_{40}$	11-17	Low Concept Attainment
$P_{1} - P_{15}$	0-10	Very Low Concept Attainment

3.7.3.9 Final Draft

The final draft of the "Concept Attainment Test" is attached in appendices of the research.

3.7.3.10 Rationale of Concept Attainment Test

The concept attainment test is constructed by the researcher with the help of a readymade concept attainment test which is developed by Dr. Anuradha Joshi and Dr. Ratnamala Arya. The test measures the ability of class seventh students to attain mathematics concepts. It has been developed to measure the concept attainment ability of class seventh students.

3.7.4 Development and Standardization of Mathematical Anxiety Scale

The steps of development and standardization of the 'Mathematical Anxiety Scale' are as follows:

1. Initial/ First draft
2. Pre- Tryout/Expert Opinion
3. Final Tryout/ Pilot Study
4. Scoring and Analysis regarding the Pilot Study
5. Evaluation of Mathematical Anxiety Scale
6. Reliability
7. Validity
8. Norms
9. Final Draft
10. Rationale of the 'Mathematical Anxiety Scale'.

3.7.4.1 Initial Draft

The mathematical Anxiety Scale has also been constructed to know about the anxiety and fatigue etc. of the students of class seventh and their concern about mathematics subject. The student had to write his/her name, class, age, and school on it. The scale has 50 items each of which five options are given as 'Strongly Agree', 'Agree', 'Undecided', 'Disagree' and 'Strongly Disagree'. Students were directed to give a response by putting a tick mark in front of each statement in the given preferable options on the basis of his/her choice.

3.7.4.2 Pre-Tryout Stage/Expert's Opinion

The researcher administered some copies of the test to few students to detect the omissions or mistakes if any, to examine whether the directions to items are being followed by students, to examine whether the time allowed is sufficient, etc. and researcher also collected the opinion of 09 experts from the University of Lucknow, Khwaja Moinuddin Chishti Language University, Lucknow and Integral University, Lucknow to know their views and suggestions about the scale.

3.7.4.3 Final Tryout/ Pilot Study

The mathematical anxiety scale was applied on 169 students selected by stratified random sampling technique of class seventh of upper primary schools and aided inter colleges of Lucknow city. Five Upper Primary schools (U.P.S.) were selected from the list of upper primary schools which was received from BSA Office Lucknow and five colleges were selected from the list of aided inter colleges which was received from the D.I.O.S. Office Lucknow by lottery system of random sampling. Total 84 students were selected by random sampling from Five Upper Primary schools in which 49 were boys and 35 were girls. Similarly, total 85 students were selected by random sampling from the 5 aided inter colleges in which 48 were boys and 37 were girls.

Table 3.10: Sample for Pilot Study of Mathematical Anxiety Scale

Educational Institution	No. of School/College	No. of Boys	No. of Girls	Total no. of Students
Upper Primary Schools	5	49	35	84
Colleges	5	48	37	85
TOTAL	10	97	72	169

3.7.4.4 Scoring for Final Tryout

i) Likert Scale

The method of summative rating was exposed by Rensis Likert in 1932. It measures traits on various points i.e., 3-point 5-point, and 7-point. The researcher used five-point Likert scale to construct and standardize the Mathematical Anxiety Scale, which has five options to express the response that is 'Strongly Agree', 'Agree', 'Undecided', 'Disagree' and 'Strongly Disagree'. The responses were calculated on all these options by giving them 4, 3, 2, 1, 0 marks respectively and it was reversed in the case of negative statements respectively. Similarly, the scoring of the whole data on the final draft of the scale was completed.

The t-test was computed between the upper and lower group. The selection and rejection of the items were accomplished on the basis of obtaining the t-value on the df =167 at the 0.01 significance level.

Here:

M_H= Mean of the raw scores of the higher group

N_H = Number of top 27% students from the higher group

$S.D._H$= Standard deviation of the raw scores of the upper group

M_L= Mean of the raw scores of the lower group

N_L = Number of 27% students from bottom to top from the lower group.

$S.D._L$= Standard deviation of the raw scores of the upper group

Df = 167

Table 3.11: Selection/Rejection of Items on Likert Scale

Statement No.	Higher Group $N_H = 46$		Lower Group $N_L = 46$		t	Significance at Level 0.01	Select/Reject Items
	M_H	$S.D._H$	M_L	$S.D._L$			
1	2.2173	0.4170	0.5438	0.5036	12.331	S	Select
2	2.2826	0.7502	0.2826	0.4552	11.2528	S	Select
3	2.9130	1.0070	0.5217	0.5472	10.4333	S	Select
4	3.5217	0.5472	0.2608	0.4439	22.3117	S	Select
5	3.1086	0.3787	0.2826	0.5016	21.7695	S	Select
6	2.6520	0.4815	0.5434	0.5036	14.5174	S	Select
7	2.9782	0.1474	0.2826	0.6884	21.8732	S	Select
8	2.9565	0.2061	0.3043	0.5914	22.5529	S	Select
9	3.3913	0.5765	0.5217	0.5050	17.9947	S	Select
10	2.8043	0.6870	0.3043	0.4652	14.7157	S	Select
11	3.7173	0.5016	1.1087	0.5261	17.2142	S	Select
12	3.7173	0.4552	0.2173	0.4170	27.2142	S	Select
13	3.8478	0.3631	0.8478	0.3631	28.0139	S	Select
14	3.7173	0.5016	0.2173	0.8409	17.6798	S	Select
15	3.8695	0.3405	2.0652	0.4423	15.3626	S	Select
16	2.9565	0.7875	0.1739	0.3832	16.1193	S	Select
17	2.8478	0.7591	0.4130	0.4978	13.1374	S	Select
18	3.0869	0.9387	0.5217	0.5050	12.0507	S	Select
19	2.5714	0.8879	0.5434	0.5036	9.6420	S	Select
20	3.9565	0.2061	1.0217	0.8816	18.2976	S	Select
21	3.7391	0.4439	1.1304	0.5416	17.9457	S	Select
22	2.5217	0.8625	0.3695	0.4880	10.808	S	Select
23	3.7826	0.4170	1.1304	0.5419	18.7572	S	Select
24	3.0210	0.1474	1.1956	0.6870	14.8423	S	Select
25	2.9782	0.1474	0.3260	0.8706	17.6689	S	Select
26	3.0217	0.1474	0.6956	1.0081	13.6518	S	Select
27	3.0430	0.2018	0.8260	0.3822	25.5156	S	Select
28	2.9780	0.1474	2.0434	0.2948	14.3333	S	Select
29	2.9347	0.2496	0.2608	0.8009	17.2619	S	Select

30	2.4782	0.8363	1.8695	1.9844	1.4635	NS	Reject
31	3.9782	0.1474	1.0652	0.9978	17.2412	S	Select
32	2.5217	0.8625	0.0217	0.1474	16.7882	S	Select
33	3.7173	0.5441	0.2173	0.8409	17.1375	S	Select
34	3.9130	0.2848	0.3913	1.1446	16.7091	S	Select
35	3.2173	0.4170	0.7826	0.4170	19.7990	S	Select
36	3.9130	0.2848	0.3478	0.9937	18.9119	S	Select
37	3.2826	0.4552	0.1739	0.8247	16.4723	S	Select
38	2.9347	0.2496	0.2391	0.9233	15.5859	S	Select
39	3.0217	0.1474	0.9130	0.7839	15.3563	S	Select
40	3.2391	0.4312	0.0869	0.5877	20.9387	S	Select
41	3.9130	0.2848	0.5652	0.7195	22.6039	S	Select
42	3.9347	0.2496	0.4782	0.5050	31.0637	S	Select
43	3.9130	0.3544	0.2861	1.0032	18.1314	S	Select
44	3.8478	0.3616	0.3043	1.0081	17.5253	S	Select
45	3.8260	0.3832	0.1956	0.8331	20.2422	S	Select
46	3.8695	0.3405	0.9347	0.8538	16.6663	S	Select
47	3.9782	0.1474	1.0434	0.9178	18.6841	S	Select
48	3.9565	0.2061	1.3260	0.8179	17.4196	S	Select
49	3.9347	0.3267	1.1956	0.7489	17.2710	S	Select
50	3.8478	0.3631	1.0652	0.4423	23.4301	S	Select
Selected Items						49 Items	
Rejected Items						1 Item (Item no. 30)	

Therefore, out of 50 items, 49 items were selected and 1 item was rejected on the basis of the t-value 2.60 at df 167 at 0.01 level of significance.

3.7.4.5 Evaluation of Mathematical Anxiety Scale

The researcher collected data from 202 students of the class seventh on the scale by using stratified random sampling, in which 5 Upper Primary Schools were selected from the list of upper primary schools, by the lottery system of random sampling and the 5 aided Inter Colleges were selected from the list of aided Inter College, Lucknow by lottery system of random sampling. 102 students of class seventh were selected by the simple random sampling from the 5 upper primary schools in which 52 were boys and 50 were girls. Similarly, a total of 100 students of class seventh were selected by simple random sampling from the 5 aided inter colleges in which 50 were boys and 50 were girls. Sample of 202 students was used for stabilizing the reliability, validity, and norms of the Mathematical Anxiety Scale.

Table 3.12: Sample Used for Reliability, Validity and Norms of 'Mathematical Anxiety Scale

Educational Institution	No. of School/College	No. of Boys	No. of Girls	Total no. of Students
Upper Primary Schools	5	52	50	102
Colleges	5	50	50	100
TOTAL	10	102	100	202

3.7.4.6 Reliability

i) Split-half Reliability

The reliability of the 'Mathematical Anxiety Scale' was evaluated by using Split-half reliability and odd-even reliability of the test scores using Spearman-Brown Prophecy Coefficient of correlation.

Spearman-Brown Coefficient

$$r_{SB} = \frac{2r}{1+r}$$

r_{SB}= Spearman-Brown Coefficient

r=Pearson product moment correlation between the split-half test-scores or the odd-even test scores of the scale.

The Pearson correlation between split-half scores of the scale was found 0.8217 and Spearman-Brown Prophecy Coefficient was found 0.957. Therefore, the split-half reliability of the scale was 0.957. Similarly, the Pearson product-moment correlation between odd-even scores of the scale was found 0.9089 and Spearman-Brown Prophecy Coefficient was found 0.9523. Therefore, the odd-even reliability of the scale was 0.9523. These both reliabilities are significant for df=200 at 0.01 level of significance.

ii) Cronbach's Alpha Reliability Coefficient

Table 3.13: The Variance of Items of 'Mathematical Anxiety Scale'

ITEM No.	VARIANCE	ITEM No.	VARIANCE	ITEM No.	VARIANCE	ITEM No.	VARIANCE	ITEM No.	VARIANCE
1.	0.2153	**11.**	0.2485	**21.**	0.2374	**31.**	0.2436	**41.**	0.2323
2.	0.2323	**12.**	0.2454	**22.**	0.2272	**32.**	0.2445	**42.**	0.2436
3.	0.2216	**13.**	0.2307	**23.**	0.2393	**33.**	0.2445	**43.**	0.2107
4.	0.1981	**14.**	0.2367	**24.**	0.2338	**34.**	0.2480	**44.**	0.2480
5.	0.1897	**15.**	0.2456	**25.**	0.2454	**35.**	0.2323	**45.**	0.2474
6.	0.2034	**16.**	0.2008	**26.**	0.2153	**36.**	0.2436	**46.**	0.2480
7.	0.2468	**17.**	0.2436	**27.**	0.2480	**37.**	0.2426	**47.**	0.2289
8.	0.2436	**18.**	0.2475	**28.**	0.2454	**38.**	0.2426	**48.**	0.2254
9.	0.2499	**19**	0.2290	**29.**	0.2323	**39.**	0.2338	**49.**	0.2235
10.	0.2153	**20.**	0.2461	**30.**	0.2393	**40.**	0.2445	$\sum s_y^2$= 11.49	

Table 3.14: Computation of Cronbach's Alpha Reliability Coefficient of 'Mathematical Anxiety Scale

$\boxed{\alpha = (\frac{k}{k-1})(1 - \frac{\sum s_y^2}{s_x^2})}$	K=49	$\sum s_y^2$= 11.49	s_x^2= 129.9
	α= $(\frac{49}{49-1})(1 - \frac{11.49}{129.9})$= 0.9305		
α= Cronbach's alpha coefficient k = no. of item $\sum s_y^2$ = sum of items variance s_x^2 = variance of the total score	α= 0.9305		

The Cronbach's Alpha reliability coefficient value was found 0.9305 which defines the higher internal consistency of the scale.

Table 3.15: Reliability of 'Mathematical Anxiety Scale

Reliability	Obtained Value
Split-Half Reliability	0.957
Odd-Even Reliability	0.9523
Cronbach's Alpha Reliability Coefficient	0.9305

3.7.4.7 Validity of Mathematical Anxiety Scale

The validity of the scale is calculated by three methods.

i) **Face Validity:** The researcher collected the opinion of 09 experts from the University of Lucknow, Khwaja Moinuddin Chishti University, and Integral University, Lucknow to know their views and suggestions to determine the face validity of the mathematical anxiety scale.

ii) **Content Validity:** The researcher calculated the content validity of the scale on the basis of rating judged by subject matter experts. Each item was assessed by 'essential' and 'useful, but not essential' to the performance of the item. The researcher measured the content validity with the help of a formula developed by C.H. Lawshe (1975).

Table No. 3.16: Computation of Content Validity of Mathematical Anxiety Scale

Item	n_e	CVR	Item	n_e	CVR
1	7	0.555556	**26**	9	1
2	9	1	**27**	9	1
3	9	1	**28**	8	0.777778
4	9	1	**29**	8	0.777778
5	7	0.555556	**30**	9	1
6	8	0.777778	**31**	8	0.777778
7	9	1	**32**	8	0.777778
8	9	1	**33**	9	1
9	8	0.777778	**34**	9	1
10	8	0.777778	**35**	8	0.777778
11	8	0.777778	**36**	8	0.777778
12	9	1	**37**	9	1
13	8	0.777778	**38**	8	0.777778
14	8	0.777778	**39**	9	1
15	9	1	**40**	7	0.555556
16	7	0.555556	**41**	9	1
17	9	1	**42**	8	0.777778
18	9	1	**43**	8	0.777778
19	8	0.777778	**44**	9	1
20	8	0.777778	**45**	8	0.777778
21	7	0.555556	**46**	8	0.777778
22	9	1	**47**	9	1
23	8	0.777778	**48**	8	0.777778
24	8	0.777778	**49**	8	0.777778
25	9	1			
Total Content Validity of the Scale (Mean of CVR) = 0.85034					

Content Validity
$$\boxed{\mathbf{CVR= (n_e- N/2)/(N/2)}}$$
Where,
CVR= Content Validity Ratio
n_e= Number of Subject Matter Expert Raters indicating 'essential'
N= Total number of Subject Matter Expert Raters

The mean of the content validity ratio was found 0.85034, which is an indicator of the overall content validity of the scale.

iii) **Concurrent Validity:** The concurrent validity of the scale was measured by correlating the obtained scores on the self-made tool with the obtained scores on the 'Mathematical Anxiety Scale' developed by Dr. Ayatollah Karimi & Prof. S. Venkatesan. The researcher collected data by administrating both scales on 202 students of Lucknow city of class seventh. The correlation between the raw scores of the self-made mathematical anxiety scale and the 'Mathematical Anxiety Scale' by Dr. Ayatollah Karimi & Prof. S. Venkatesan was found 0.95528, which is concurrent validity of the scale.

3.7.4.8 Norms

The researcher collected data from 202 students to establish the norms of the Mathematical Anxiety Scale on the basis of percentile.

Table 3.17: Norms of the Mathematical Anxiety Scale

Percentile	Raw Scores	Level of Math Anxiety
$P_1 - P_{20}$	0-39	Very Low Math Anxiety
$P_{21} - P_{40}$	40-73	Low Math Anxiety
$P_{41} - P_{60}$	74-115	Average Math Anxiety
$P_{61} - P_{80}$	116-158	High Math Anxiety
$P_{81} - P_{100}$	159-200	Very High Math Anxiety

3.7.4.9 Final Draft: Final Draft of the scale was attached in the appendices of the study.

3.7.4.10 Rationale of Mathematical Anxiety Scale

The Mathematical Anxiety scale has been developed to measure the mathematical anxiety of class seventh students. This scale is constructed and standardized on the basis of the Mathematical Anxiety scale (MAS-1) by Dr. Ayatollah Karimi and Dr. S. Venkatesan. Students have mental concern about Mathematics, which arises due to lack of understanding of mathematics. Here the Mathematical Anxiety Scale was used to collect feedback from the students on almost all its facts about mathematical anxiety from students so that a possible accurate measurement of mathematical anxiety can be done. To compare the students of the equivalent experimental group and control group with each other by finding out their mathematical anxiety with the help of the scale, the researcher used this scale.

3.7.5 Development of Constructivist Pedagogy Effectiveness Students' Opinionnaire

The student's opinionnaire based on the constructivist pedagogy effectiveness was constructed by the researcher, which consists of 57 items divided into four parts which are as follows:

Table 3.18: Description of Constructivist Pedagogy Effectiveness Students' Opinionnaire

S. No.	Description	Items
1.	Constructivism	14 items
2.	Constructivism and Mathematics	19 items
3.	Constructivism and Mathematical Anxiety	11 items
4.	Constructivism and Mathematical Concept Attainment	13 items
Total Items		57

Initially, there were 65 items or statements that existed in the Constructivist Pedagogy Effectiveness Students' Opinionnaire. Some copies of the opinionnaire were given to subject experts to check/remove the language errors, suitability of items with respect to the purpose of the opinionnaire, grammatical mistakes, ambiguous statements, etc. On the basis of experts' opinion, 8 items have been dropped and the remaining 57 statements were finally selected and modified according to the opinion of experts. All items of the opinionnaire are in the form of statements and each statement has three options 'agree', 'uncertain', and 'disagree', on which the student can express their opinion.

- **Rationale of Constructivist Pedagogy Effectiveness Students' Opinionnaire**

The students' opinionnaire is developed to know the opinion of the students of the experimental group regarding the effectiveness of constructivist pedagogy.

3.7.6 Development of Constructivist Pedagogy Effectiveness Teachers' Opinionnaire

Teachers' Opinionnaire based on the effectiveness of constructivist pedagogy was constructed by researcher. It consists of 65 items, which are divided into four parts. Initially, there were 65 items or statements that existed in the Constructivist Pedagogy Effectiveness Teachers' Opinionnaire. Some copies of the opinionnaire were given to subject experts to check/remove the language errors, suitability of items with respect to the purpose of the opinionnaire, grammatical mistakes, ambiguous statements, etc. On the basis of experts' opinion, 11 items have been dropped and the remaining 54 statements were finally selected and modified according to the opinion of experts.

Table 3.19: Description of Constructivist Pedagogy Effectiveness Teachers' Opinionnaire

S. No.	Description	Items
1.	Constructivism	14 items
2.	Constructivism and Mathematics	14 items
3.	Constructivism and Mathematical Anxiety	11 items
4.	Constructivism and Mathematical Concept Attainment	15 items
Total Items		54

All items of the opinionnaire are in the form of statements and each statement has three options 'agree', 'uncertain', and 'disagree', on which the teacher can express their opinion.

- **Rationale of Constructivist Pedagogy Effectiveness Teachers' Opinionnaire**

The researcher developed this tool to take the opinion about the effectiveness of constructivist pedagogy from the teachers of that school in which the experiment was done.

3.7.7 Development of the Instructional Material based on Constructivist Pedagogy in Mathematics

3.7.7.1 Selection of Content

The researcher has developed the teaching modules on the basis of constructivist pedagogy for the selected unit of mathematics subject of class seventh for the experimental group. The teaching modules are based on the pre-determined unit (Exponent and Powers) of the class seventh books of mathematics. The name of these books are as follows:

1. NCERT Mathematics, Class 7th, edition 2019
2. R.S. Aggarwal, Mathematics, Class 7th, edition 2018
3. Sunil Kumar Tiwari, CBSE, NCERT Mathematics class 7th, edition 2020
4. Ratna Sagar, Number Magic (updated), class 7th, edition 2018
5. UP Basic Shiksha Parishad, Mathematics, Class 7th, session: 2019-20

The entire content of the selected unit (Exponent and Powers) is divided into various small segments.

3.7.7.2 Validation of Teaching Modules

Regarding the teaching module Anastasi believes that verification of content is necessary for the validity of the academic achievement test so that the content can be verified based on two main facts:

1. Does the module represent selected special skills and knowledge?
2. Is the module free from the influence of various irrelevant variables?

In order to verify the teaching module based on these criteria the researcher distributed the module to various teacher educators and teacher's trainers so that they can evaluate the following two criteria:

i) Are the teaching modules covering the entire content of the selected unit?

ii) Whether these modules are based on axioms of constructivism?

Therefore, according to the opinion obtained from the experts, the researcher made some changes in the content, sequence, clarity of language, and content representation of the modules. The validity of the teaching modules was judged with the help of opinions and suggestions of various experts.

3.7.7.3 Rationale of Instructional Material

To accomplish the research objectives, it was necessary to use constructivist pedagogy on the experimental group. Therefore, the researcher made various modules following the 7-E constructivist model by taking the selected subject matter for teaching-learning from the mathematics textbook of class seventh students. The modules were developed as instructional material to be treated as a treatment for the experimental group i.e. the selected unit of mathematics subject was taught to the students using the module. In the present research, the impact of constructivist pedagogy through this instructional material was also analyzed on the basis of their I.Q., gender, and S.E.S on students' concept attainment and mathematical anxiety.

3.7.8 Determination of Instructional Material for Traditional Teaching

3.7.8.1 Selection of the Book

The research sample was of class seventh students of a government school in Lucknow, Uttar Pradesh, therefore, the researcher selected Unit 2 (Exponent and Powers) from the book of mathematics of U.P Basic Education Council of Class seventh, session 2019-20 purposively for the traditional teaching of the control group.

3.7.8.2 Rational of traditional teaching material

The researcher selected the same unit of mathematics for the control group as well as the experimental group. This was done in order to avoid any difference between the experimental group and the control group on the basis of subject matter with respect to mathematical concepts. In this experiment, the same concept was taught in the experimental group based on the instructional material and the control group taught through traditional teaching method. Therefore, traditional learning materials were assigned to the control group required to demonstrate the treatment effect.

3.8 Procedure of the Experiment

The experiment was carried out in two main steps:

3.8.1 Sample Selection

i) School Selection:

Table 3.20: School Sample

Name of School	Total No. of Students
Upper Primary School Mukarimnagar, Lucknow	47

ii) **Students' Selection**: There were total 47 students of the seventh class in the school. Total 40 students were selected by a lottery system of the random sampling method. Further, they were distributed by randomized matched technique with the help of I.Q. test and S.E.S. test to form the equivalent groups.

Table 3.21: Students Sample

Sample for Experiment	Total No. of Students
Total No. of Subjects taken in the study	40
No. of Subjects in the experimental group	20
No. of Subjects in the control group	20

3.8.2 Conducting the Experiment

For experimentation, the researcher has given the practical layout in the following manner:

Table 3.22: Practical Layout of Non-Equivalent Post-Test Only Control Group Design

Phases	Experimental Group	Control Group
Phase-I: Preparation of Experiment	1. Coordinate with students 2. Preparing students to learn 3. Setting up constructivist environment in the classroom	1. Coordinate with students 2. Preparing students to learn 3.Creating common ideal classroom environment in the class
Phase-II: Treatment	Using a 7-E constructivist model in teaching for students	Using the conventional teaching method
	The training program was given to the teachers of that school which was selected for the experiment.	
Phase-III: Post-test	STEP-I: Concept Attainment Test STEP-II: Mathematical Anxiety Scale STEP-III: Constructivist Pedagogy Effectiveness Students' Opinionnaire STEP-IV: Constructivist Pedagogy Effectiveness Teachers' Opinionnaire	STEP-I: Concept Attainment Test STEP-II: Mathematical Anxiety Scale STEP-III: Constructivist Pedagogy Effectiveness Students' Opinionnaire
Phase-IV: Scoring and Analysis	1. Find out test scores with the help of the manual of various tests/tools. 2. The obtained data were analyzed by using various statistical methods.	1. Find out test scores with the help of the manual of various tests/tools. 2. The obtained data were analyzed by using various statistical methods required.

The experiment was completed in four phases

Phase-I: Formation of Experimental and Control Group

Phase-II: Implementation of Treatment

Phase-III: Administration of Post-test

Phase-IV: Scoring and Analysis

A. Phase-I: Formation of Experimental and Control Group

First, the researcher randomly selected 40 children from the 47 students, then matched these subjects on the basis of two extraneous variables intelligence quotient and social-economic status, which could affect the dependent variables. The students were then randomly assigned into two groups. Then by coin tossing, one group was determined as experimental and another group as the control group. In this way, the researcher prepared two randomized matched groups on the basis of S.E.S. and I.Q.

i) **Random Selection:** the researcher selected 40 students out of 47 by lottery system of random sampling.

ii) **Random Assignment:** S.E.S. and I.Q. tests were applied on the selected 40 students to divide them into experimental and control group. The students with less than 50.85 S.E.S. were considered as students of low S.E.S. and above 50.85 S.E.S. were considered as the students of high S.E.S. Similarly, those who scored 110.27 I.Q. and above were considered as students of high I.Q. and the students who scored less than 110.27 I.Q. considered as the students of low I.Q. Thus, the students' allocation in the experimental and control group was done.

Table No. 3.23: Matching of Experimental and Control Group on the basis of I.Q. and S.E.S.

	I.Q.	
S.E.S.	HIGH	LOW
HIGH	11 Students → $X_1 = 5$, $C_1 = 6$	9 Students → $X_2 = 5$, $C_2 = 4$
LOW	11 Students → $X_3 = 6$, $C_3 = 5$	9 Students → $X_4 = 4$, $C_4 = 5$

Experimental Group= $X_1 + X_2 + X_3 + X_4 = 20$ Students

Control Group= $C_1 + C_2 + C_3 + C_4 = 20$ Students

Therefore, out of 40 students, 20 students of the experimental group and 20 students of the control group have matched on the basis of S.E.S and I.Q. by the researcher. Extra seven students were allowed to sit in the control group but the researcher did not involve them in the research and also researcher did not collect the data from them.

iii) Experimental justification: After the formation of the experimental and control group, the teaching-learning process was started by establishing mutual rapport with the students. The researcher taught through the constructivist method in the experimental group. Control group students were taught through lecture method, practice and drill method, etc. After the completion of the treatment, the post-test was applied to the students of experimental and control groups. In which the 'Concept Attainment Test' and 'Mathematical Anxiety Scale' were applied to the students of both groups but 'Constructivist Pedagogy Effectiveness Students' Opinionnaire' was applied to the experimental group only.

B. Phase-II: Implementation of Experiment

The researcher taught 40 minutes per day to the experimental group students by using the constructivist pedagogical approach. On the same day, 40 minutes were taught to the control group students per day by using the conventional teaching method.

i) **Implementation of Teaching Modules:** All teaching-learning modules were completed in one and a half months. The researcher used modules as instructional materials which were developed on the basis of the constructivist pedagogical approach by using the 7-E constructivist model to conduct the experiment. To apply the 7-E constructivist model follows these steps with the experimental group:

a) Elicit

b) Engage

c) Explore

d) Explain

e) Elaborate

f) Evaluation

g) Extend

a) Elicit: Come to attention. In this first step, the researcher/teacher asks the students of the experimental group open-ended questions. So that the students can prepare mind maps related to the facts. In this, the teacher tries to know the learning level of the students. The students interact with each other to answer the questions. This creates a mind map of the student in the classroom. The teacher checks the mind map and if there is a mistake in the concept understood by the students the teacher also corrects it.

Activity: In this step, the teacher asks the students the following questions-

- Tables of 2, 3, 4, …….etc.
- Addition

- Subtraction
- Multiplication
- Division

b) **Engage**: In this phase, the experimenter/teacher activates students to ask some questions related to their attention and prior knowledge. The teacher makes an event/problem a medium and prompts them to ask questions, on which the students get fully engaged in the activity.

Activity: In this phase, the teacher gives the students pictures and flashcards of some incidents, they observe them.

c) **Explore**: When a child starts searching for a solution to the problem then they perform various actions. The teacher helps the students in through various activities.

Activity: After giving pictures, flashcards and other learning material to the students' teacher divides them into 5 different groups. Every group is given some flashcards and pictures. There are given exponent-related questions and mathematical problems on each flashcard/picture. In this process, each group interacts with their peers about the picture and flashcards received. After a specified time, each group has to describe the problem given in its own flashcard/pictures. The other groups try to explain the concept based on the description made by this group. Each group describes the problem of their flashcard/picture in front of all groups and asks questions. The questions asked by the representative students of the group are as follows:

- $10 \times 10 \times 10 \times 10 = 10^4 = 10000$
- $2 \times 2 = 2^4 = 4$
- $4 \times 4 \times 4 = 4^3 = 64$
- $5^2 \times 5^2 = 5^{2+2} = 5^4$
- $\frac{10000}{100} = \frac{10^4}{10^2} = 10^2 = 100$

d) **Explain**: In this stage, the students explain the knowledge they have discovered and reach an idea by making an understanding. Here students are given opportunities to explain and learn other various skills. In this stage, the teacher gives the opportunity to different groups to perform one at a time. They are allowed to use charts, games, and puzzles for presentation. After the presentation of all the groups, the teachers explain to the student the concept, process, and definition of the exponential, square, cube, etc. in the class.

e) **Elaborate**: In this stage, the students are given an opportunity to understand each depth of the concept like exponent, cube, and square, etc. In which the teacher explains all facts related to the concept in detail with a good example. The teacher elaborates on the following concept in detail to the students using instruction material.

- Exponents- Meaning, definition, mathematical operations, and questions in textbooks.
- Square- Meaning, definition, mathematical operations, and questions in textbooks.
- Cube- Meaning, definition, mathematical operations, and questions in textbooks.

f) **Evaluation**: In this stage, all the students learn such as concepts, skills, etc. This process is assessed by the teacher.

g) **Extend**: In this stage, the students generalize the learned facts and apply them in daily life. To learn new concept student uses the concepts taught in the classroom. So that they can learn the new concept. In which the teacher solves each problem of the students and the problem generated can become a topic of the discussion in the next class.

ii) Implementation of Traditional Teaching

The researcher taught control group students by using the conventional teaching method. The duration of each class was 40 minutes.

iii) Subsidiary Experiment: Training Programme for Teachers on Effectiveness of Constructivist Pedagogy

The researcher conducted seven days training program on the effectiveness of the constructivist pedagogy for teachers of that school which was selected for the experiment. During the training, the researcher discussed various points related to constructivist pedagogy like – meaning, concepts, and characteristics, historical background, constructivist classroom environment, limitations, merits, and researches based on constructivist pedagogy. In this training program, seven teachers have participated. After all the classes in the school were over, all the teachers were involved in a 40 minutes training program. The researcher tried to make training effective through some videos and PPT based on constructivist pedagogy.

iv) Validity of the Experiment

The experimental validity can be divided into two types-

a) Internal Validity
b) External Validity

a) Internal Validity- It is an ideal condition that the experimenter wants to insure but is almost impossible to achieve in absolute terms. The internal validity of the experiment can be insured by keeping the experiment away from the threats that affect the internal validity of the experiment. Threats of internal validity of the experiment are as follows:

- **Maturity:** To control the maturity of all the participating students in the experiment the researcher selected tests with approximately the same age and I.Q. In which approximately equal numbers of the students of the same high I.Q., low I.Q., high S.E.S, and low S.E.S were placed in the experiment and control groups.
- **Contemporary History**: To control the effect of the contemporary history of the students such as to eliminate the effect of learning from a tutor and home environment etc., the researcher placed high S.E.S and low S.E.S Students in an equal number in the experimental and control group.
- **Pretest and Statistical Regression:** No pre-testing was done in the experiment so that there was no chance to attempt the statistical regression by the students.
- **Differential selection:** To avoid the differential selection in the experiment, the researcher selected students through random selection after that the experimental and control group was formed by random assignment then matching of these groups was done on the basis of I.Q. and S.E.S.

b) External Validity: Threats of external validity of the experiment

- **Artificiality of Experiment:** To save the experiment from artificiality, the students were given the freedom to do mathematical activities according to themselves, as to ask questions with the instructor and they could be made healthy communication on the given mathematics problem among themselves.

- **Testing:** All the students were tested only once to avoid the effects of repeated testing.
- **Selection Bias:** Following a process of random selection and random assignment, the subject was matched on the basis of S.E.S and I.Q. and the experimental and control groups were made equivalent, so as not to induce selection bias in the experiment.

Thus, an attempt was made to increase the internal and external validity of the experiment using the above efforts.

C. Phase-III: Administration of Post-test

After completing the treatment, the researcher collected data from the experimental and control group by administering the following tools Mathematical Anxiety Scale, Concept Attainment test, Constructivist Pedagogy Effectiveness Students' Opinionnaire, and Constructivist Pedagogy Effectiveness Teachers' Opinionnaire.

D. Phase-IV: Scoring and Analysis

According to the obtained data, the researcher completed the scoring of various tools. To fulfill the objectives of the research, the obtained data based on these tools were analyzed by using IBM SPSS-28 version software to find out the result of the experiment.

3.9 Statistical Techniques

The various statistical techniques were used in the present study to analyze the data. There were used mainly the mean, standard deviation, Pearson correlation coefficient, Percentile, Percentage, Kolomogrov-Smirnov & Shapiro-Wilk Test (KSSW test), Levene's test, and two-tailed t-test.

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CHAPTER 4

ANALYSIS AND INTERPRETATION OF DATA

'The effect of constructivist pedagogy on concept attainment and anxiety in mathematics among seventh class students' is an experimental study with a quantitative approach. After the collection of data, it was necessary to make it meaningful. Since raw data had no meaningful information to answer any research questions, so it was very necessary that data should be analyzed and interpreted. In the present study, the researcher analyzed the data by using appropriate statistics to keep in mind all objectives of the study. The interpretation of data was accomplished according to the need and nature of the study. In the present study, all the assumptions of applied statistics to test the null hypothesis were verified by the researcher before its use.

4 (A) Analysis and Interpretation of Data on the Basis of I.Q

4.1 OBJECTIVE: To study the effect of constructivist pedagogy on concept attainment in mathematics among seventh-class students

$\boldsymbol{H_0^1}$: There is no significant difference in mathematical concept attainment between experimental and control group students.

To find out the effect of constructivist pedagogy on the concept attainment in mathematics of class seventh students, the t-test was used.

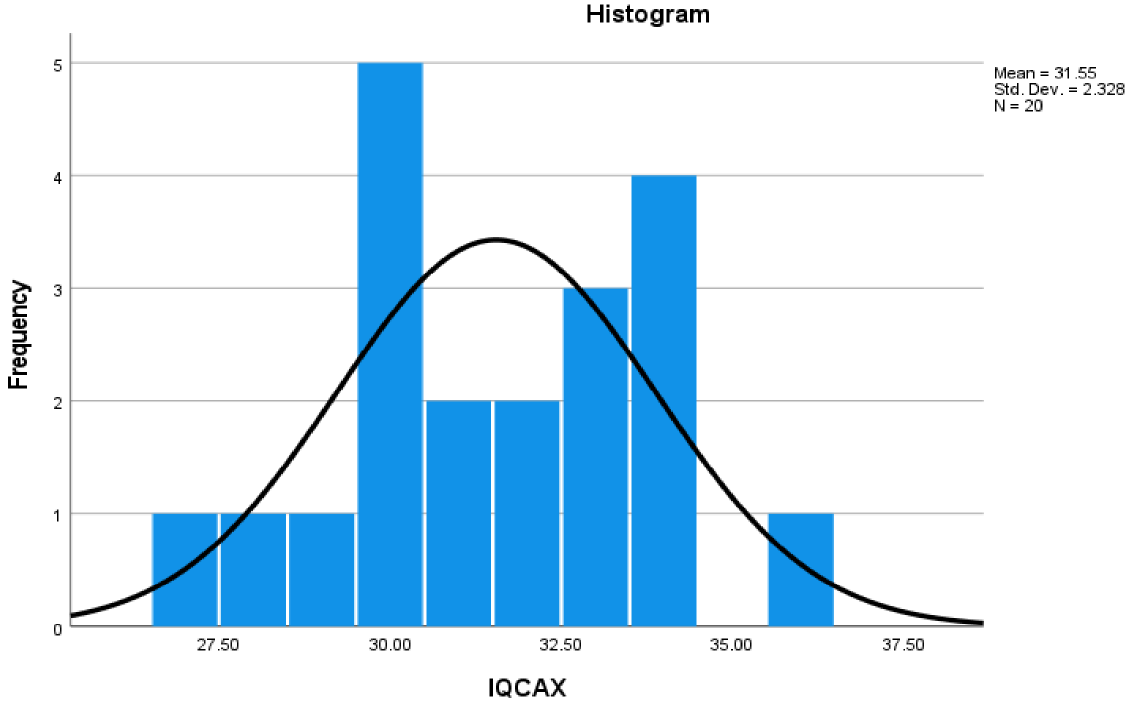
The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was used to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this, the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately. The concept attainment is one continuous dependent variable (CA post-test) and one categorical independent variable is constructivist pedagogy with two groups i.e., one experimental or treatment group and another control or traditional groups were tested.

Tests of Normality							
	Group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	Df	Sig.
CA POST	Experimental	.147	20	.200*	.962	20	.586
	Control	.121	20	.200*	.974	20	.831
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.1: Kolmogorov-Smirnov and Shapiro-Wilk Test of Experimental and Control Groups of Concept Attainment

The above SPSS output window (table 4.1) shows the normality test result. It shows the p values 0.586 and 0.831 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's concept attainment distributions across both groups i.e., experimental and control groups are acceptable and are normal with the NPC between the raw scores of the experimental group and control group of concept attainment (Fig. 4.1)

NPC with Histogram of the Raw Scores of Concept Attainment of Experimental Group



NPC with Histogram Plot of The Raw Scores of Concept Attainment of Control Group

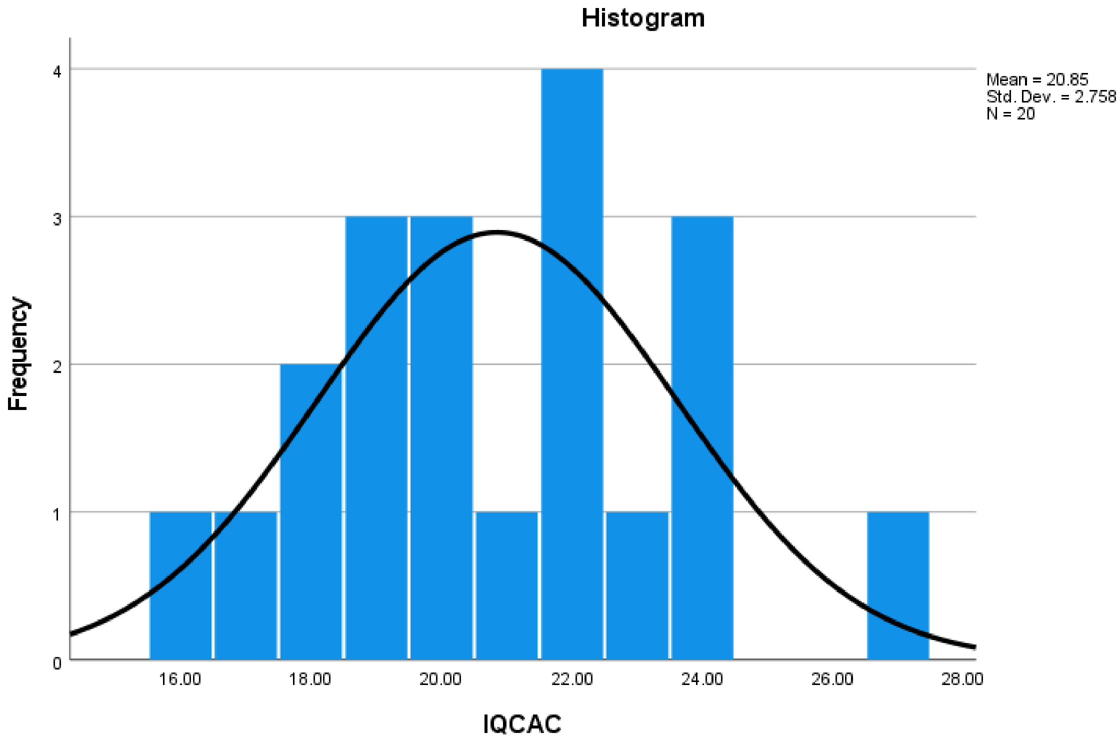


Fig. 4.1: NPC with Histogram Plot between Experimental and Control Groups of Concept Attainment

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of concept attainment i.e., one is the experimental group of constructivist pedagogy and the other is the control group for traditional teaching. It tests the null hypothesis that the variance of the population is equal (define the homogeneity of variance or homoscedasticity) in both groups. The obtained value of Levene's test is 0.490 which is higher than 0.05.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA Post	**Based on Mean**	.487	1	38	.489
	Based on Median	.470	1	38	.497
	Based on Median and with adjusted df	.470	1	35.618	.497
	Based on trimmed mean	.486	1	38	.490

Table 4.2: Levene's Test of Experimental and Control Groups of Concept Attainment

It refers to the variability of concept attainment (dependent variable) is the same across the experimental group and control group. Statistically, it can be shown **CA Post p (0.490) > 0.05.** Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified for the two selected samples. Therefore, the t-test was used to find out the effect of constructivist pedagogy (independent variable) on the concept attainment (dependent variable) **CA post** of the seventh grade students. The t-test verified the null hypothesis that there is no significant difference in the mathematical concept attainment between the experimental and control groups of students.

Two-tailed Significance t-test between Experimental group and Control group of Concept Attainment

<table>
<tr><th>Group</th><th>Mean</th><th>SD</th><th>N</th><th>Df</th><th>t-value</th><th>Significance</th></tr>
<tr><td>Experimental group of Concept Attainment</td><td>31.55</td><td>2.32775</td><td>20</td><td rowspan="2">38</td><td rowspan="2">9.1688</td><td rowspan="2">Significant
t > 2.03 at 0.05 level
t > 2.72 at 0.01 level</td></tr>
<tr><td>Control group of Concept Attainment</td><td>20.85</td><td>2.75824</td><td>20</td></tr>
</table>

Table 4.3: t-test between Experimental and Control Groups of Concept Attainment

Table 4.3 clarified that the obtained t-value 9.1688 at df 38 is greater than the table value of the t-test, i.e., 2.03 at 0.05 level and 2.72 at 0.01 level. Therefore, the result of the t-test shows that those students who were taught through constructivist pedagogy have significantly higher mathematical concept attainment (M= 31.55) than those students who were taught through the traditional teaching method (M= 20.85). Hence, it is proved the mean score of the post-test of concept attainment of the treatment or experimental group is significantly higher than the control or traditional group. Therefore, the first null hypothesis is not accepted.

4.2 OBJECTIVE: To study the effect of constructivist pedagogy on anxiety in mathematics among seventh-class students

$\mathbf{H_0^2}$: There is no significant difference in mathematical anxiety between experimental and control group students.

To find out the effect of constructivist pedagogy on the anxiety in mathematics of class seventh students, the t-test was used.

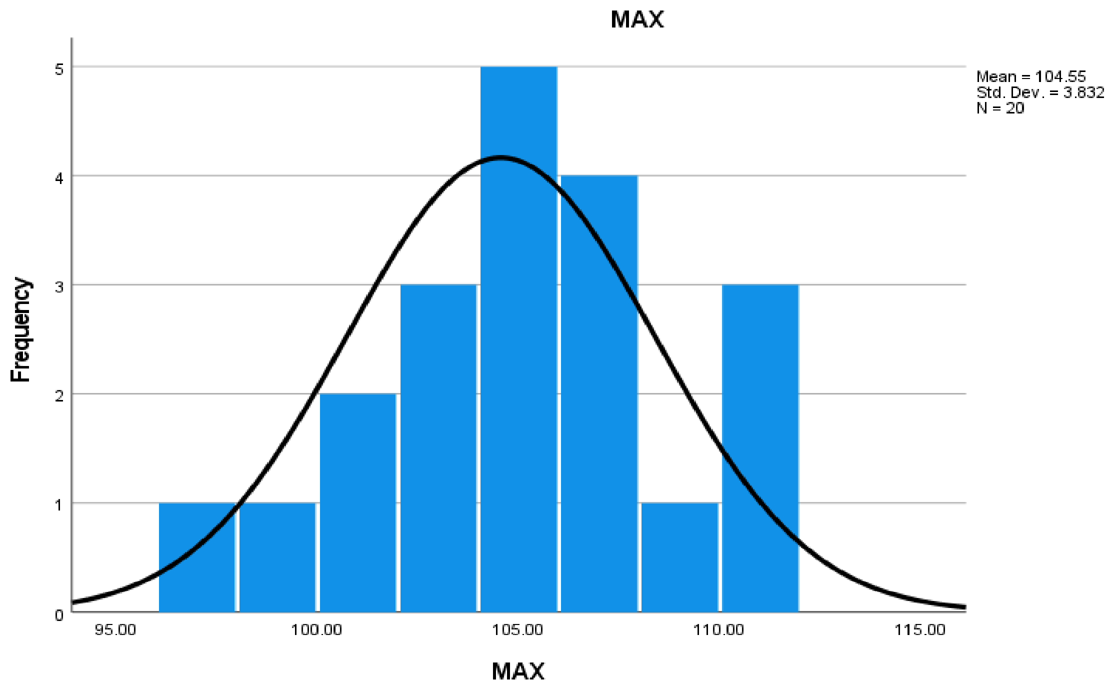
The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this, the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately. The mathematical anxiety is one continuous dependent variable (MA post-test) and one categorical independent variable is constructivist pedagogy with two groups' i.e. One experimental or treatment group and another control group were tested.

Tests of Normality							
	Group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	Df	Sig.
MA POST	C	.088	20	.200*	.983	20	.968
	X	.097	20	.200*	.977	20	.883
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.4: Kolmogorov-Smirnov and Shapiro-Wilk test of Experimental and Control Groups of Mathematical Anxiety

The above SPSS output window (table 4.4) shows the normality test result. It shows the p values 0.968 and 0.833 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's mathematical anxiety distributions across both groups i.e., experimental and control groups are acceptable and normal with NPC between the raw scores of the experimental group and control group of mathematical anxiety (Fig. 4.2).

NPC with Histogram of the Raw Scores of Mathematical Anxiety of Experimental Group



NPC with Histogram of The Raw Scores of Mathematical Anxiety of Control Group

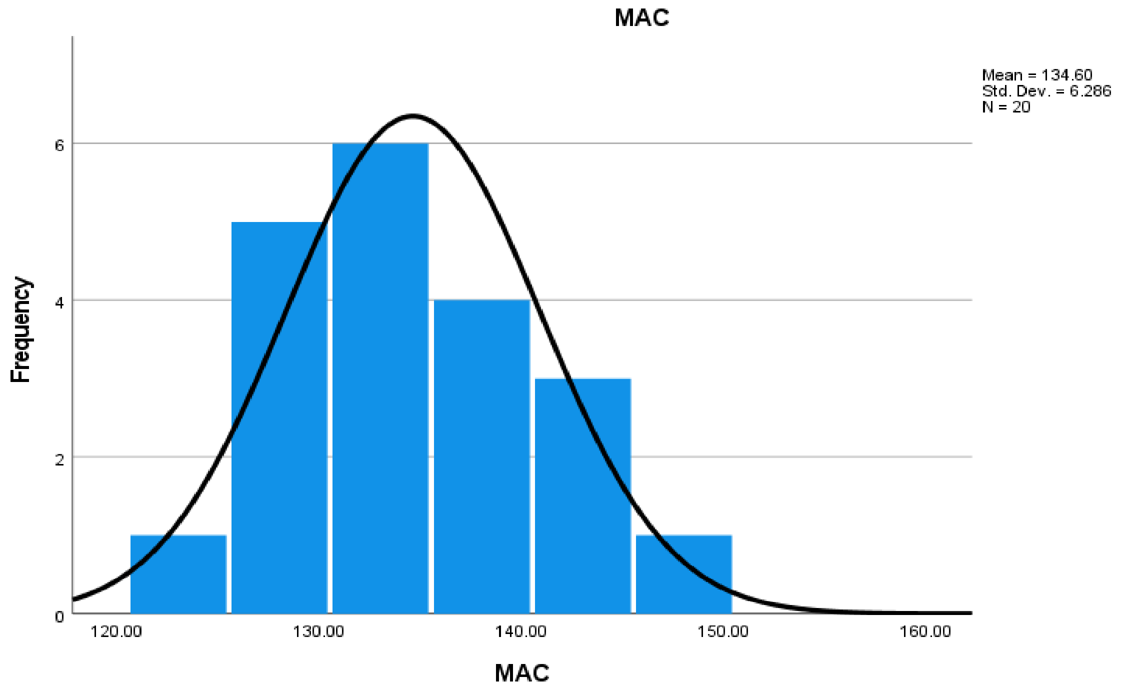


Fig. 4.2: NPC with Histogram Plot between Experimental and Control Groups of Mathematical Anxiety

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of mathematical anxiety i.e., one is the experimental group of constructivist pedagogy and the other is the control group for traditional teaching. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST	**Based on Mean**	3.942	1	38	.054
	Based on Median	3.508	1	38	.069
	Based on Median and with adjusted df	3.508	1	30.434	.071
	Based on trimmed mean	3.876	1	38	.056

Table 4.5: Levene's Test between Experimental and Control Groups of Mathematical Anxiety

The obtained value of Levene's test 0.056 (Table 4.5) is higher than 0.05, It refers to the variability of mathematical anxiety (dependent variable) is the same across between the experimental group and control group. Statistically, it can be shown **MA Post p (0.056) > 0.05.** Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified for the two selected dependent samples. Therefore, a t-test was used, to find out the effect of constructivist pedagogy on the mathematical anxiety **(MA post)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the experimental and control group of students.

Two-tailed Significance t-test between Experimental Group and Control Group of Mathematical Anxiety

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Mathematical Anxiety	104.55	3.832	20	38	12.06	Significant t > 2.03 at 0.05 level t > 2.72 at 0.01 level
Control Group of Mathematical Anxiety	134.60	6.286	20			

Table 4.6: t-test between Experimental and Control Groups of Mathematical Anxiety

Table 4.6 clarified that the obtained t-value 12.06 at df 38 is greater than the table value of the t-test, i.e., 2.03 at 0.05 level and 2.72 at 0.01 level. Therefore, the result of the t-test shows that those students who were taught through traditional teaching of the control group have a significantly high mean score of mathematical anxiety (M= 134.60) than those students who were taught through the constructivist pedagogy method (M= 104.55). Hence, the mathematical anxiety of the control group is significantly higher than the experimental group. It is proved the mean score of the post-test of the control group is significantly higher than the experimental group. Therefore, the second null hypothesis is not accepted.

4.3 OBJECTIVE: To study the effect of constructivist pedagogy on concept attainment in mathematics among seventh class students on the basis of intelligence quotient (I.Q) in experimental group

$\mathbf{H_0^3}$: There is no significant difference in mathematical concept attainment of experimental group students on the basis of Intelligence Quotient (I.Q.).

To find out the effect of constructivist pedagogy on the concept attainment in mathematics of class seventh students on the basis of Intelligence Quotient (I.Q.), the t-test was used.

The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it is necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and

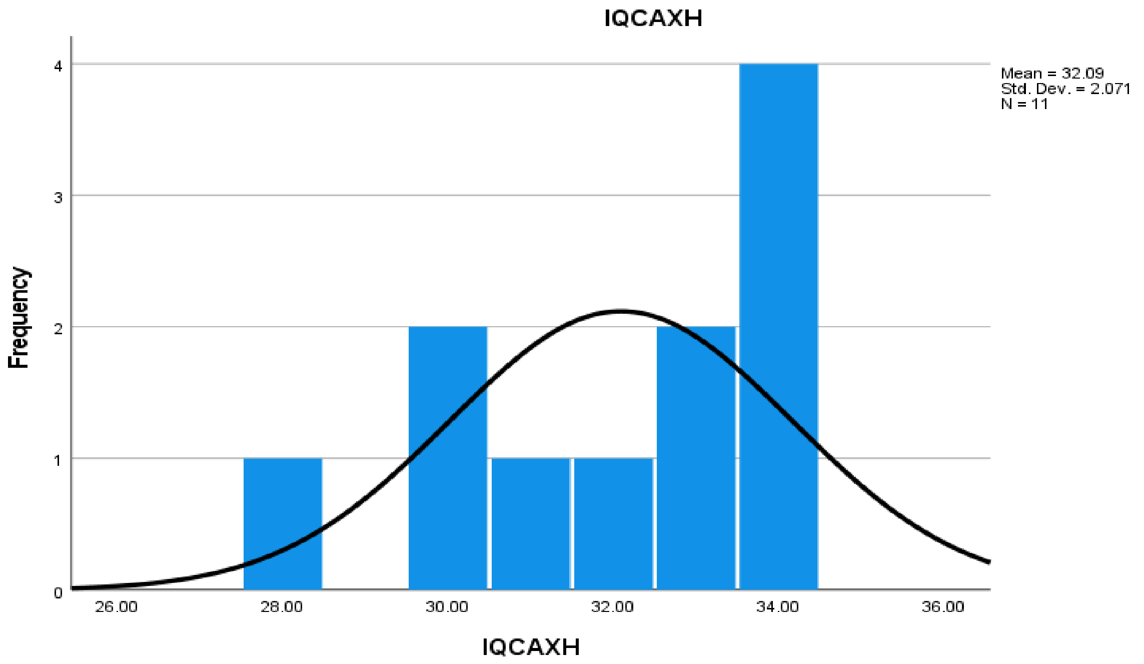
Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of concept attainment (CA POST - I.Q. based) for the experimental group of High I.Q. and Low I.Q.

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	I.Q	Statistic	df	Sig.	Statistic	Df	Sig.
CA POST	High-X	.215	11	.165	.864	11	.065
	Low-X	.184	9	.200*	.956	9	.761
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.7: Kolmogorov-Smirnov and Shapiro-Wilk test between High Experimental group and Low Experimental Group of Concept Attainment on the basis of I.Q.

The above SPSS output window (table 4.7) shows the normality test results. It shows the p values 0.065 and 0.761 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student’s concept attainment distributions across both groups i.e., High I.Q. of the experimental group and Low I.Q. of the experimental group are bell-shaped or normal (Fig. 4.3).

NPC with Histogram Plot of The Raw Scores of Concept Attainment of Experimental Group based on High I.Q.



NPC with Histogram Plot of The Raw Scores of Concept Attainment of Experimental Group based on Low I.Q.

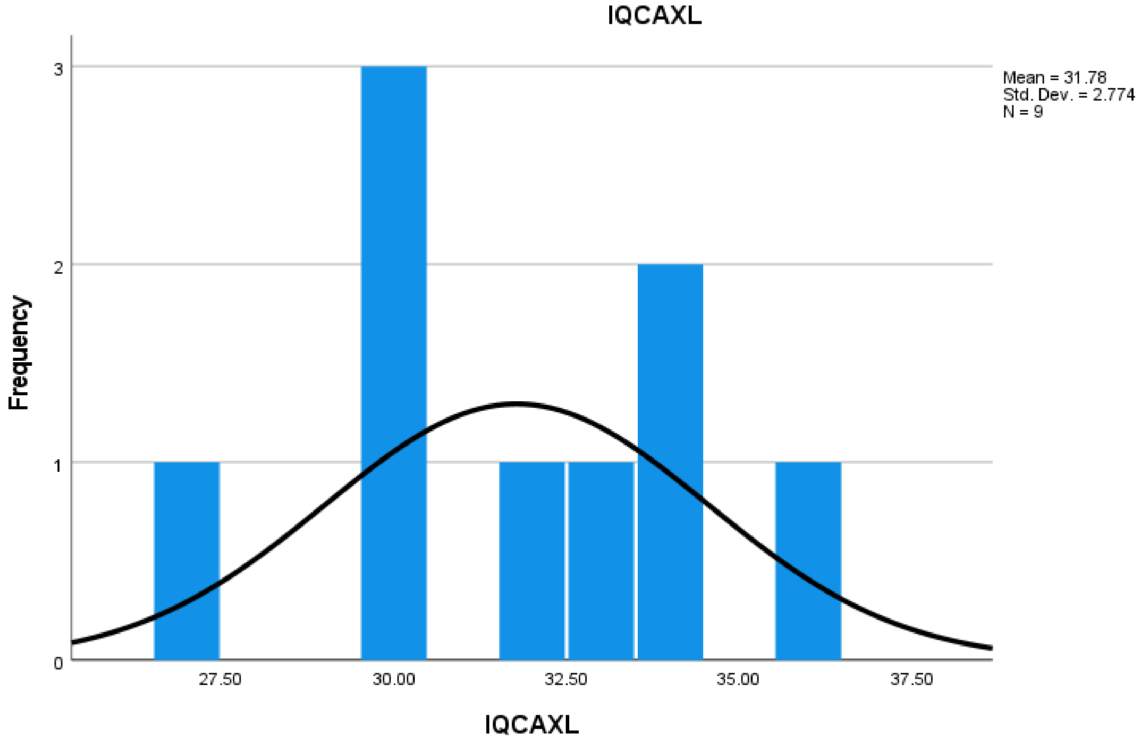


Fig. 4.3: NPC with Histogram Plot between High Experimental Group and Low Experimental Group of Concept Attainment on the basis of I.Q.

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of concept attainment i.e., one is the experimental group based on high I.Q. and the other is the experimental group based on low I.Q. It tests the null hypothesis that the variance of the population is equal (define the homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA POST	**Based on Mean**	.936	1	18	.346
	Based on Median	.763	1	18	.394
	Based on Median and with adjusted df	.763	1	17.997	.394
	Based on trimmed mean	.938	1	18	.346

Table 4.8: Levene's test between the High Experimental group and Low Experimental Group of Concept Attainment on the basis of I.Q.

The obtained value of Levene's test 0.346 (Table 4.8) is higher than 0.05, It refers to the variability of concept attainment is the same across the experimental group of high I.Q. and the experimental group of low I.Q. Statistically, it can be shown **CA Post p (0.346) > 0.05** based on the I.Q. in the experimental group. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of the subject, normality of distribution, and homogeneity of variance were verified for the two selected dependent samples. Therefore, t-test was used, to know the effect of constructivist pedagogy on the concept attainment between the experimental group based on high I.Q. and the experimental group based on low I.Q. (**CA post X -I.Q.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical concept attainment between the selected groups.

Two-Tailed Significance t-test between Concept Attainment Experimental Group of High I.Q. and Concept Attainment Experimental Group of Low I.Q.

Group	Mean	SD	N	df	t-value	Significance
Concept Attainment Experimental Group of High I.Q.	32.09091	2.07145	11	18	0.1914	Significant t > 2.10 at 0.05 level
Concept Attainment Experimental Group of Low I.Q.	31.7778	2.7773	9			t > 2.88 at 0.01 level

Table 4.9: t-test between High Experimental Group and Low Experimental Group of Concept Attainment on the basis of I.Q.

Table 4.9 clarified that the obtained t-value 0.1914 at df 18 is not greater than the table value of t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. Therefore, the result of the t-test was shows that those students who were of high I.Q. in experimental group taught through constructivist pedagogy have not significantly higher mathematical concept attainment (M= 32.09091) than those students who were of low I.Q. of the experimental group taught through the constructivist pedagogy method (M= 31.7778). Therefore, the null hypothesis is accepted.

4.4 OBJECTIVE: To study the effect of constructivist pedagogy on anxiety in mathematics among seventh class students on the basis of intelligence quotient (I.Q.) in experimental group

H_0^4: There is no significant difference in mathematical anxiety of experimental group students on the basis of Intelligence Quotient (I.Q.).

To find out the effect of constructivist pedagogy on the anxiety in mathematics of class seventh students on the basis of Intelligence Quotient (I.Q.), the t-test was used.

The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it is necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and

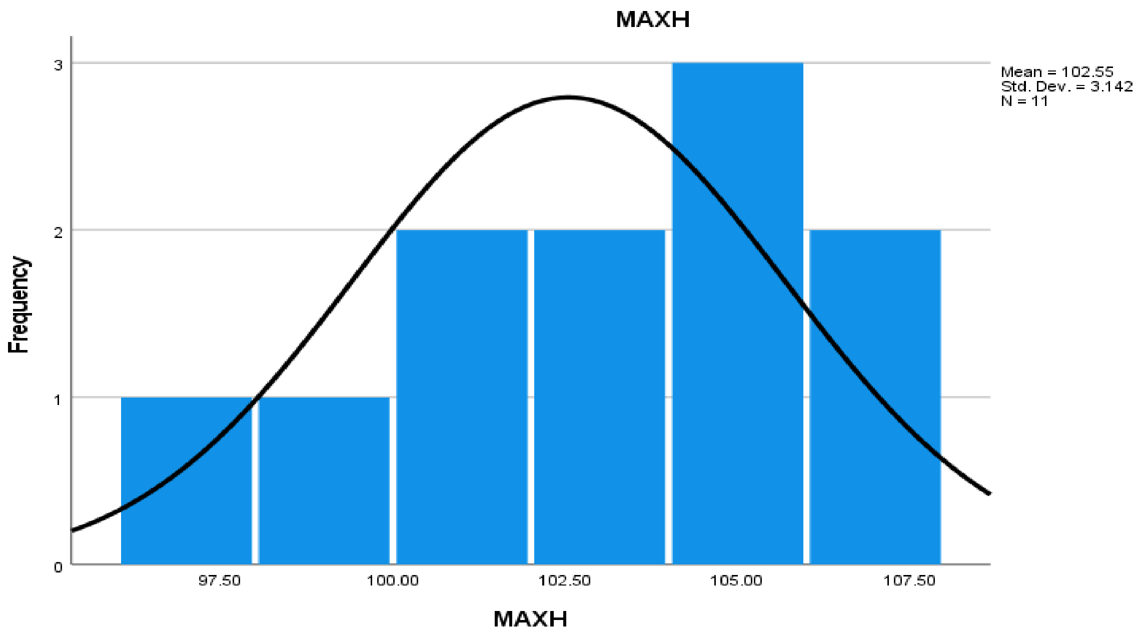
Shapiro-Wilk test (KSSWT) was used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of mathematical anxiety (MA POST - I.Q. based) for the experimental group of High I.Q. and Low I.Q.

Tests of Normality							
	I.Q.	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
MA POST	X-H	.146	11	.200*	.966	11	.838
	X-L	.178	9	.200*	.927	9	.452
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.10: Kolmogorov-Smirnov and Shapiro-Wilk test between High Experimental Group and Low Experimental Group of Mathematical Anxiety on the basis of I.Q.

The above SPSS output window (table 4.10) shows the normality test results. It shows the p values 0.838 and 0.452 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the students' mathematical anxiety distributions across both groups i.e., High I.Q. of the experimental group and Low I.Q. of the experimental group are bell-shaped (normal) Fig. 4.4.

NPC with Histogram Plot of The Raw Scores of Mathematical Anxiety of Experimental Group based on High I.Q. of



NPC with Histogram Plot of The Raw Scores of Mathematical Anxiety of Experimental Group based on Low I.Q. of

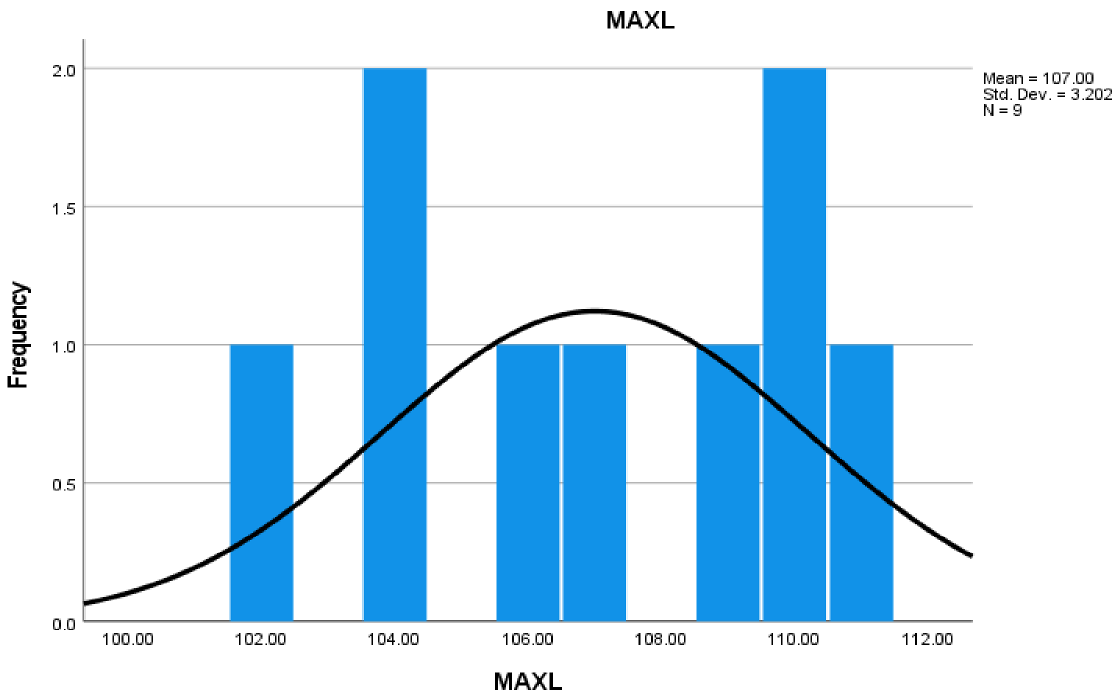


Fig. 4.4: NPC with Histogram Plot between High Experimental Group and Low Experimental Group of Mathematical Anxiety on the basis of I.Q.

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for the two groups of mathematical anxiety i.e., one is the experimental group based on high I.Q. and the other is the experimental group based on low I.Q. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST-X	**Based on Mean**	.011	1	18	.919
	Based on Median	.027	1	18	.872
	Based on Median and with adjusted df	.027	1	17.599	.872
	Based on trimmed mean	.011	1	18	.917

Table 4.11: Levene's test between the High Experimental Group and Low Experimental Group of Mathematical Anxiety on the basis of I.Q.

The obtained value of Levene's test 0.917 (Table 4.11) is higher than 0.05. It refers to the variability of mathematical anxiety being the same across the experimental group of high I.Q. and the experimental group of low I.Q. Statistically, it can be shown as MA Post p (0.917) > 0.05 based on the I.Q. in the experimental group. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified for the two selected dependent samples. Therefore, a t-test was used to know the effect of constructivist pedagogy on the mathematical anxiety between the experimental group of high I.Q. and the experimental group of low I.Q. (**MA post X -I.Q.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the selected groups.

Two-Tailed Significance t-test between High Experimental Group and Low Experimental Group of Mathematical Anxiety based on I.Q.

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Mathematical Anxiety based on High I.Q.	102.55	3.142	11	18	2.09	Not Significant t < 2.10 at 0.05 t < 2.88 at 0.01 level
Experimental Group of Mathematical Anxiety based on Low I.Q.	107.0	3.202	9			

Table 4.12: t-test between High Experimental Group and Low Experimental Group of Mathematical Anxiety on the basis of I.Q.

Table 4.12 clarified that the obtained t-value 2.09 at df 18 is not greater than the table value of the t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. Therefore, the result of the t-test shows that those students who were low I.Q. of the experimental group taught through the constructivist pedagogy method have not significantly higher mathematical anxiety (M= 107) than those students who were from high I.Q. of the experimental group taught through constructivist pedagogy (M= 102.55). Therefore, the null hypothesis is accepted.

4.5 OBJECTIVE: To compare concept attainment in mathematics between experimental and control group students on the basis of intelligence quotient

$\mathbf{H_0^5}$: There is no significant difference in mathematical concept attainment between experimental and control group students on the basis of Intelligence Quotient (I.Q.).

4.5.1 To compare the effect of constructivist pedagogy on the mathematical Concept Attainment of Low I.Q. of the Experimental Group and Low I.Q. of Control Group among seventh class students on the basis of intelligence quotient

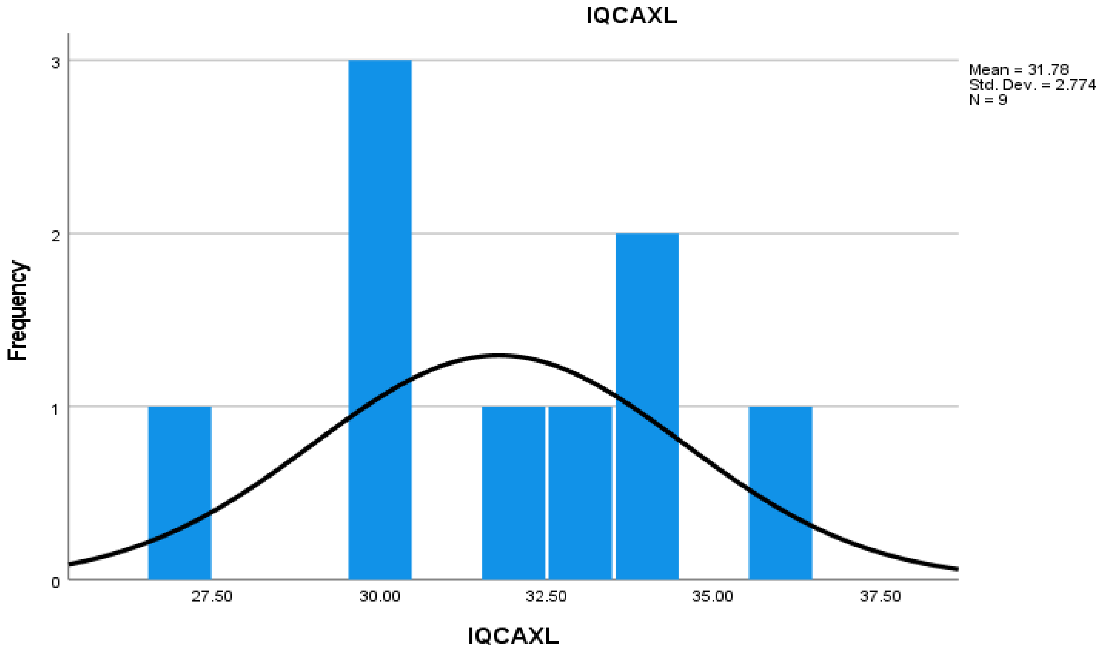
$\mathbf{H_0^{5.1}}$: There is no significant difference in mathematical Concept Attainment of the Low I.Q. of the Experimental Group and the Low I.Q. of the Control Group of students.

To find out the effect of constructivist pedagogy on mathematical Concept Attainment of Low I.Q. of Experimental Group and Low I.Q. of Control Group students of class seventh), the t-test was used. The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of concept attainment (CA POST - I.Q. based) for the experimental group of Low I.Q. and control group of Low I.Q. The above SPSS output window (table 4.13) shows the normality test result. It shows the p values 0.462 and 0.761 from Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's concept attainment distributions across both groups i.e., Low I.Q. of experimental group and Low I.Q. of control group are bell shaped (normal) Fig. 4.5.

Tests of Normality							
		Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	I.Q	**Statistic**	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
CA POST	**Low-C**	.182	10	.200*	.931	10	.462
	Low-X	.184	9	.200*	.956	9	.761
* This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.13: Kolmogorov-Smirnov and Shapiro-Wilk test between Low Experimental Group and Low Control Group of concept attainment on the basis of I.Q.

NPC with Histogram Plot of The Raw Scores of Concept Attainment of Experimental Group based on Low I.Q.



NPC with Histogram Plot of The Raw Scores of Concept Attainment of Control Group based on Low I.Q. of Class Seventh Students

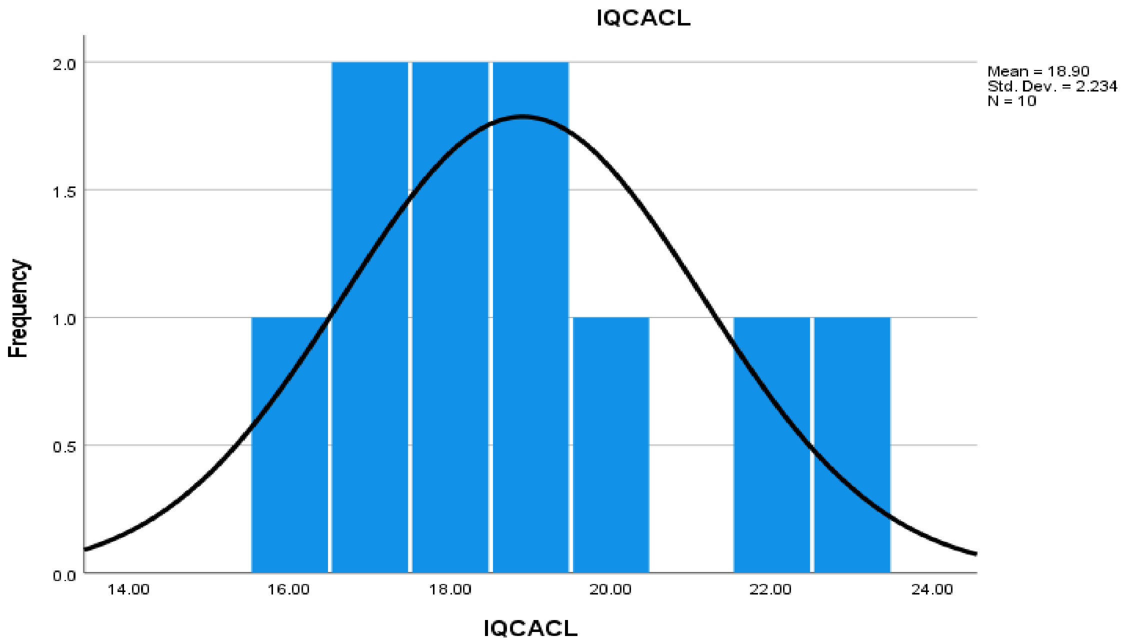


Fig. 4.5: NPC with Histogram Plot between Low Experimental Group and Low Control Group of concept attainment on the basis of I.Q.

Hereafter the researcher has used the Levene's test to verify the homogeneity of variance between the two independent samples. It tests the null hypothesis that the variance of population is equal (define homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA POST	**Based on Mean**	.750	1	17	.399
	Based on Median	.625	1	17	.440
	Based on Median and with adjusted df	.625	1	16.944	.440
	Based on trimmed mean	.736	1	17	.403

Table 4.14: Levene's test between Low Experimental Group and Low Control Group of concept attainment on the basis of I.Q.

The obtained value of Levene's test 0.403 (Table 4.14) is higher than 0.05. It refers to the variability of concept attainment being the same across the experimental group of high I.Q. and the control group of low I.Q. Statistically, it can be shown CA Post p (0.403) > 0.05 based on the I.Q. in low I.Q. experimental group and low I.Q. in the control group. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified for the two selected dependent samples. Therefore, a t-test was used, to know the effect of constructivist pedagogy on the concept attainment between the experimental group based on low I.Q. and the control group based on low I.Q. (**CA post X -I.Q.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical concept attainment between the selected groups.

Two-Tailed Significance t-test between Experimental Group based on Low I.Q. and Control Group based on Low I.Q. of Concept Attainment

Group	Mean	SD	N	df	t-value	Significance
Concept Attainment Experimental Group of Low I.Q.	31.7778	2.7773	9	17	7.46	Significant t > 2.11 at 0.05 level t > 2.90 at 0.01 level
Concept Attainment Control Group of Low I.Q.	18.9	2.2335	10			

Table 4.15: Levene's test between Low Experimental Group and Low Control Group of concept attainment on the basis of I.Q.

Table 4.15 clarified that the obtained t-value 7.46 at df 17 is greater than the table value of the t-test, i.e., 2.11 at 0.05 level and 2.90 at 0.01 level. Therefore, the result of the t-test shows that those students who were of low I.Q. of the experimental group taught through constructivist pedagogy have significantly higher mathematical concept attainment (M= 31.7778) than those students who were low I.Q. of the control group taught through the traditional method (M= 18.9). Therefore, the null hypothesis is not accepted.

4.5.2 To compare the effect of constructivist pedagogy on the mathematical Concept Attainment of High I.Q. of the Experimental Group and High I.Q. of the Control Group among seventh class students on the basis of intelligence quotient

$\mathbf{H_0^{5.2}}$: There is no significant difference in mathematical Concept Attainment of the High I.Q. of the Experimental Group and the High I.Q. of the Control Group of students.

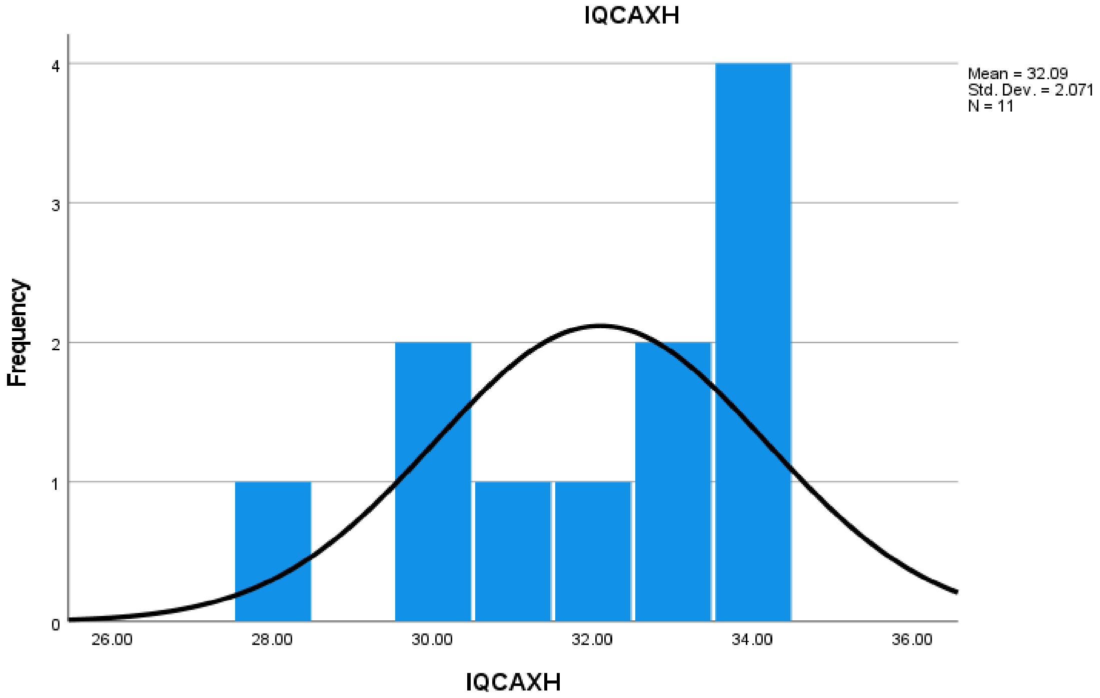
To find out the effect of constructivist pedagogy on mathematical Concept Attainment of High I.Q. of Experimental Group and High I.Q. of Control Group students of class seventh), the t-test was used. The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of concept attainment (CA POST - I.Q. based) for the experimental group of High I.Q. and control group of High I.Q.

Tests of Normality							
		Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	I.Q	**Statistic**	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
CA POST	**High-C**	.218	10	.197	.914	10	.309
	High-X	.215	11	.165	.864	11	.065
* This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.16: Kolmogorov-Smirnov and Shapiro-Wilk test between High Experimental Group and Low Control Group of Concept Attainment on the basis of I.Q.

The above SPSS output window (table 4.16) shows the normality test result. It shows the p values 0.309 and 0.065 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's concept attainment distributions across both groups i.e., the distributions across High I.Q. of the experimental group and High I.Q. of the control group are bell-shaped (normal) Fig. 4.6.

NPC with Histogram Plot of The Raw Scores of Concept Attainment of Experimental Group based on High I.Q.



NPC with Histogram Plot of The Raw Scores of Concept Attainment of Control Group based on High I.Q. of Class Seventh Students

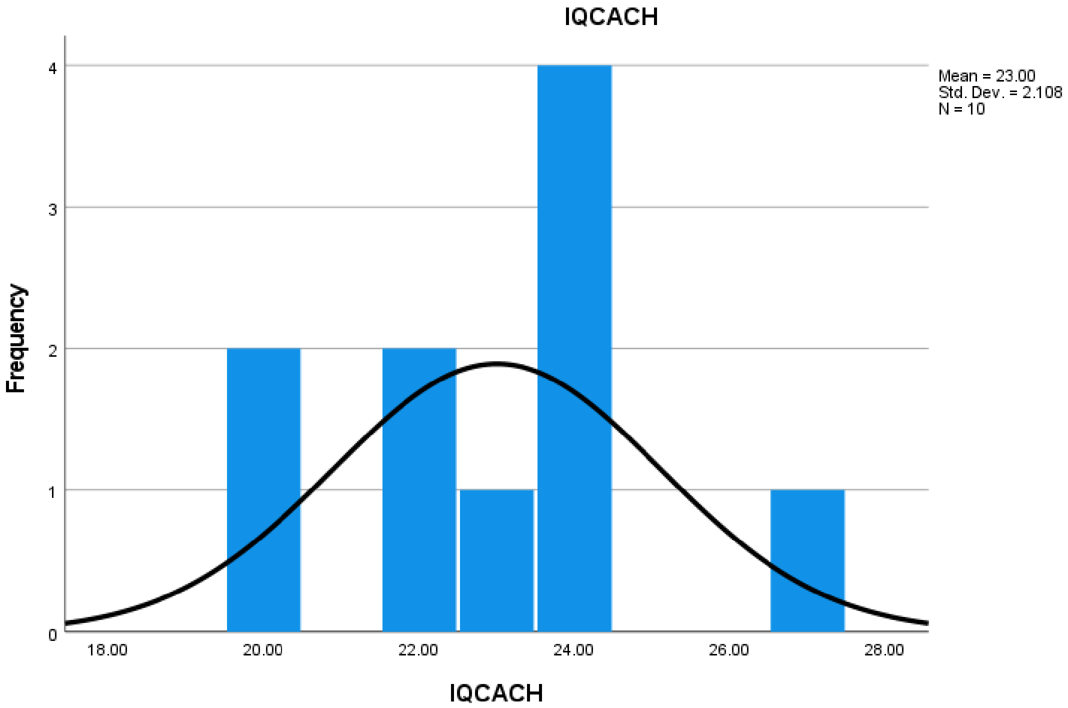


Fig. 4.6: NPC with Histogram Plot between High Experimental Group and High Control Group of concept attainment on the basis of I.Q.

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of concept attainment i.e., one is the experimental group based on high I.Q. and the other is the control group based on high I.Q. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA POST	**Based on Mean**	.057	1	19	.814
	Based on Median	.003	1	19	.955
	Based on Median and with adjusted df	.003	1	18.845	.955
	Based on trimmed mean	.037	1	19	.849

Table 4.17: Levene's test between the High Experimental Group and the High Control Group of concept attainment on the basis of I.Q.

The obtained value of Levene's test 0.849 (Table 4.17) is higher than 0.05. It refers to the variability of concept attainment (dependent variable) is the same across the experimental group of high I.Q. and the control group of high I.Q. Statistically, it can be shown CA Post p (0.849) > 0.05 based on the high I.Q. in the experimental group and the high I.Q. in the control group. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was used to know the effect of constructivist on the concept attainment between the experimental group based on high I.Q. and the control group based on high I.Q. (CA post X -I.Q.) of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical concept attainment between the selected groups.

Two-Tailed t-test between High Experimental Group and High Control Group of Concept Attainment based on I.Q.

Group	Mean	SD	N	df	t-value	Significance
Concept Attainment Experimental Group of High I.Q.	32.0909	2.0714	11	19	6.958	Significant t > 2.09 at 0.05 level t > 2.86 at 0.01 level
Concept Attainment Control Group of High I.Q.	23	2.10811	10			

Table 4.18: t-test between High Experimental Group and High Control Group of concept attainment on the basis of I.Q.

Table 4.18 clarified that the obtained t-value 6.958 at df 19 is greater than the table value of the t-test, i.e., 2.09 at 0.05 level and 2.86 at 0.01 level. Therefore, the result of the t-test shows that those students who were high I.Q. of the experimental group taught through constructivist pedagogy have significantly higher mathematical concept attainment (M= 32.0909) than those students who were high I.Q. of the control group taught through the traditional method (M= 23). Therefore, the null hypothesis is not accepted.

4.5.3 To compare the effect of constructivist pedagogy on the mathematical Concept Attainment of Low I.Q. of Experimental Group and High I.Q. of Control Group among seventh class students on the basis of intelligence quotient

$\mathbf{H_0^{5.3}}$: There is no significant difference in mathematical Concept Attainment of the Low I.Q. of the Experimental Group and High I.Q. of the Control Group of students.

To find out the effect of constructivist pedagogy on mathematical Concept Attainment of Low I.Q. of the Experimental Group and High I.Q. of Control Group students of class seventh), the t-test was used.

The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to

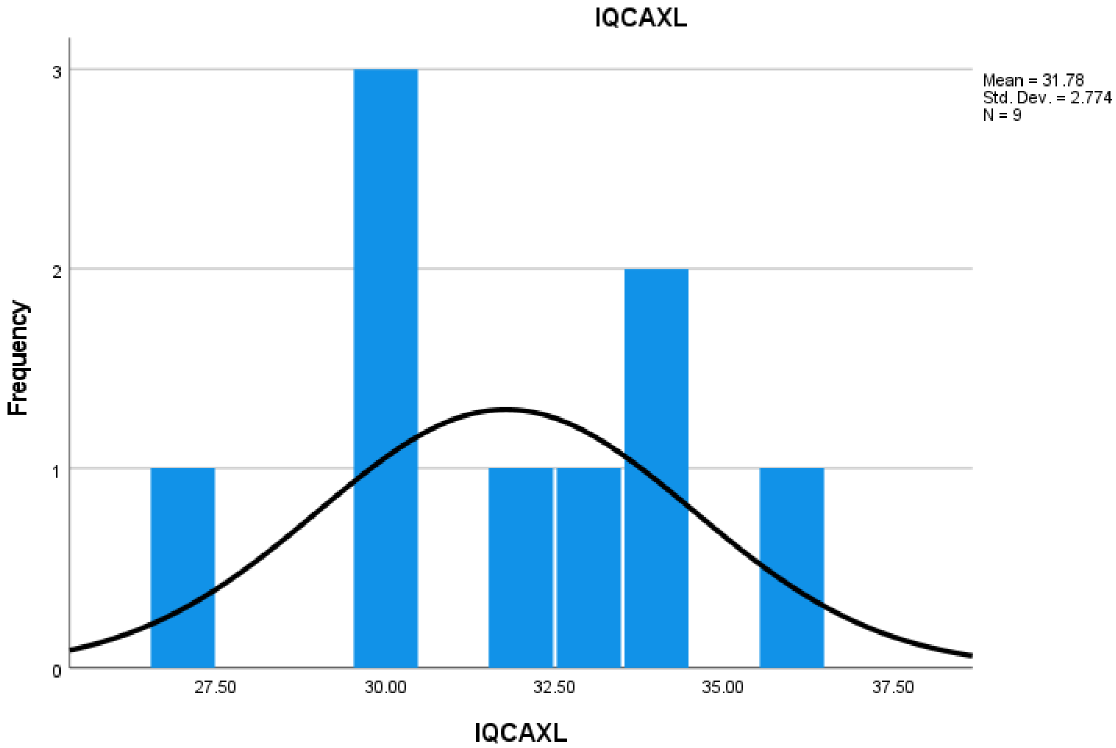
test the significance of means between the two independent samples. Before testing the null hypothesis, it is necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of concept attainment (CA POST - I.Q. based) for the experimental group of Low I.Q. and control group of High I.Q.

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	I.Q	Statistic	df	Sig.	Statistic	df	Sig.
CA POST	High-C	.218	10	.197	.914	10	.309
	Low-X	.184	9	.200*	.956	9	.761
* This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.19: Kolmogorov-Smirnov and Shapiro-Wilk test between Low Experimental Group and High Control Group of Concept Attainment on the basis of I.Q.

The above SPSS output window (Table 4.19) shows the normality test results. It shows the p values 0.309 and 0.761 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's concept attainment distributions across both groups i.e., the distributions across Low I.Q. of the experimental group and High I.Q. of the control group are bell-shaped (normal) Fig. 4.7.

NPC with Histogram Plot of The Raw Scores of Concept Attainment of Experimental Group based on Low I.Q.



NPC with Histogram Plot of The Raw Scores of Concept Attainment of Control Group based on High I.Q. of Class Seventh Students

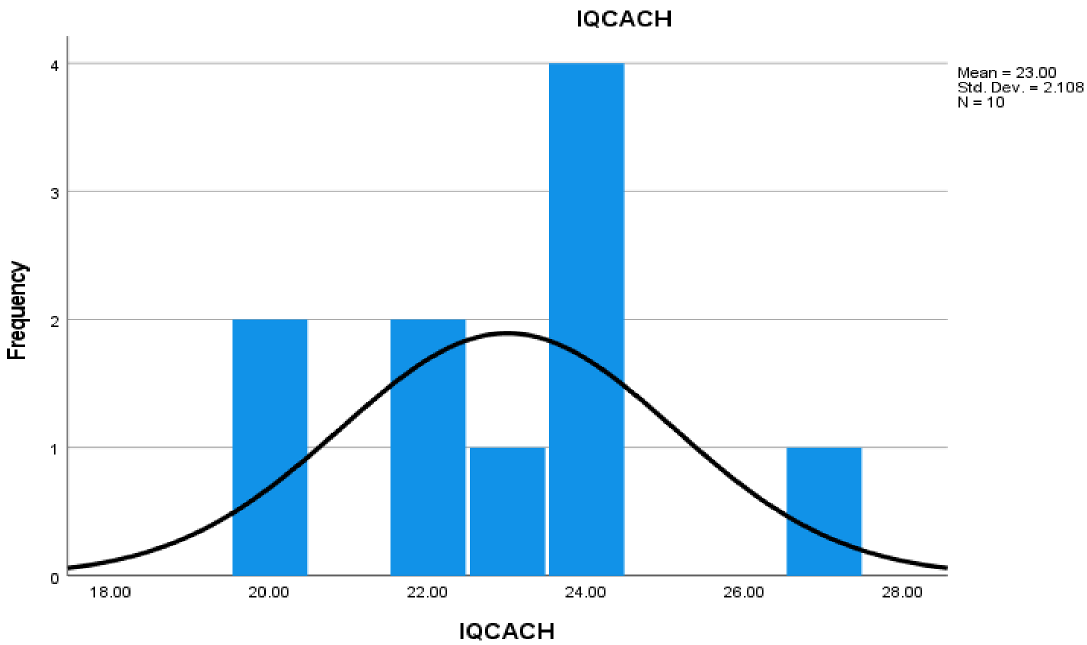


Fig. 4.7: NPC with Histogram Plot between Low Experimental Group and High Control Group of Concept Attainment on the basis of I.Q.

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA POST	**Based on Mean**	1.104	1	17	.308
	Based on Median	.905	1	17	.355
	Based on Median and with adjusted df	.905	1	16.897	.355
	Based on trimmed mean	1.061	1	17	.317

Table 4.20: Levene's test between the Low Experimental Group and High Control Group of Concept Attainment on the basis of I.Q.

The obtained value of Levene's test 0.317 (Table 4.20) is higher than 0.05. It refers to the variability of concept attainment (dependent variable) is the same across the experimental group of low I.Q. and the control group of high I.Q. Statistically, it can be shown as CA Post p (0.317) > 0.05 based on the low I.Q. in the experimental group and high I.Q. in the control group. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified for the two selected samples. Therefore, a t-test was used to know the effect of constructivist pedagogy on the concept attainment (dependent variable) between the experimental group based on low I.Q. and the control group based on high I.Q. (**CA post X -I.Q.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical concept attainment between the selected groups.

Two-Tailed Significance t-test between Experimental Group of Low I.Q. and Control Group of High I.Q. of Concept Attainment

Group	Mean	SD	N	df	t-value	Significance
Concept Attainment Experimental Group of Low I.Q.	31.7778	2.7773	9	17	5.2146	Significant t > 2.11 at 0.05 level t > 2.90 at 0.01 level
Concept Attainment Control Group of High I.Q.	23	2.1081	10			

Table 4.21: t-test between Low Experimental Group and High Control Group of Concept Attainment on the basis of I.Q.

Table 4.21 clarified that the obtained t-value 5.2146 at df 17 is greater than the table value of the t-test, i.e., 2.11 at 0.05 level and 2.90 at 0.01 level. So, the result of the t-test shows that those students who were low I.Q. of the experimental group taught through constructivist pedagogy have significantly higher mathematical concept attainment (M= 31.7778) than those students who were high I.Q. of control group taught through the traditional method (M= 23). Therefore, the null hypothesis is not accepted.

4.6 OBJECTIVE: To compare anxiety in mathematics between experimental and control group students on the basis of intelligence quotient

H_0^6: There is no significant difference in mathematical anxiety between experimental and control group students on the basis of Intelligence Quotient (I.Q.).

4.6.1 To compare the effect of constructivist pedagogy on the mathematical anxiety of High I.Q. of Experimental Group and High I.Q. of Control Group among seventh class students

$H_0^{6.1}$: There is no significant difference in mathematical anxiety of High I.Q. of Experimental Group and High I.Q. of Control Group of students.

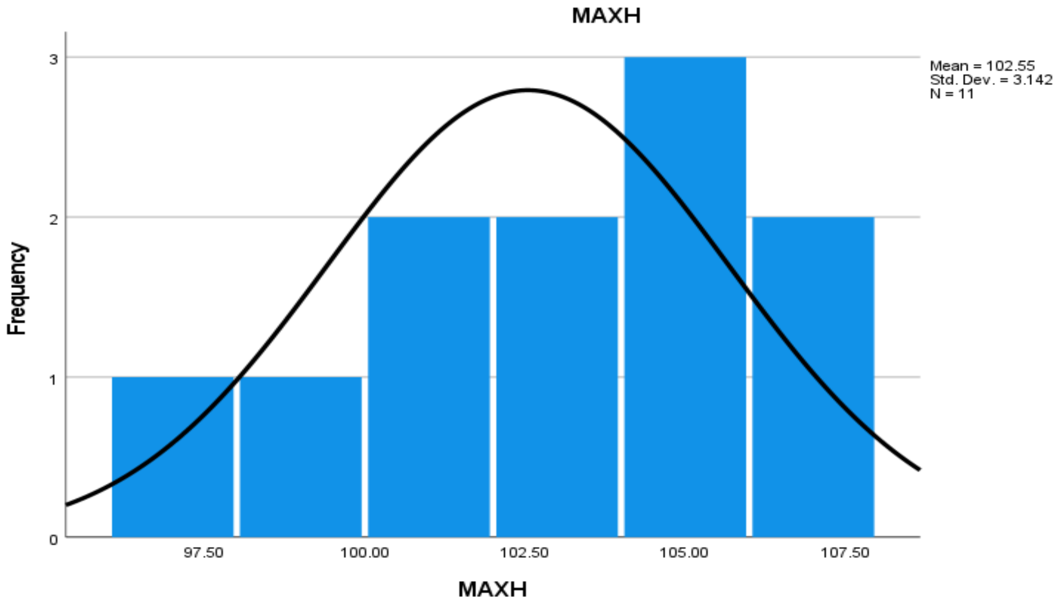
To compare the effect of constructivist pedagogy on mathematical anxiety of High I.Q. of Experimental Group and High I.Q. of Control Group students of class seventh, the t-test was used. The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of mathematical anxiety (MA POST - I.Q. based) for the experimental group of High I.Q. and control group of High I.Q.

Tests of Normality							
		Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	I.Q.	**Statistic**	**df**	**Sig.**	**Statistic**	**Df**	**Sig.**
MA POST	**High-C**	.209	10	.200*	.863	10	.082
	High-X	.146	11	.200*	.966	11	.838
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.22: Kolmogorov-Smirnov and Shapiro-Wilk test between High Experimental Group and High Control Group of mathematical anxiety on the basis of I.Q.

The above SPSS output window (table 4.22) shows the normality test results. It shows the p values 0.082 and 0.838 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's mathematical anxiety distributions across both groups i.e., the distributions across High I.Q. of the experimental group and High I.Q. of the control group are bell-shaped (normal) Fig. 4.8.

NPC with Histogram Plot of The Raw Scores of Mathematical Anxiety of Experimental Group based on High I.Q. of Class Seventh Students



NPC with Histogram Plot of The Raw Scores of Mathematical Anxiety of Control Group based on High I.Q. of Class Seventh Students

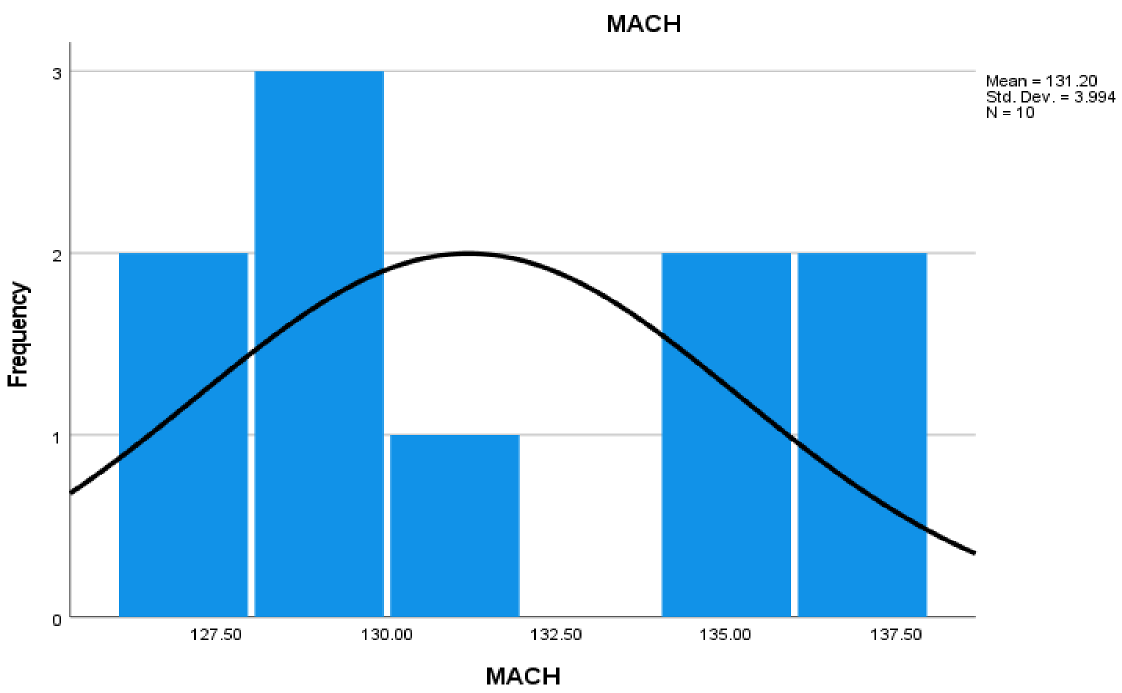


Fig. 4.8: NPC with Histogram between High Experimental Group and High Control Group of mathematical anxiety on the basis of I.Q.

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST	**Based on Mean**	1.424	1	19	.248
	Based on Median	.994	1	19	.331
	Based on Median and with adjusted df	.994	1	18.179	.332
	Based on trimmed mean	1.319	1	19	.265

Table 4.23: Levene's test between the High Experimental Group and High Control Group of mathematical anxiety on the basis of I.Q.

The obtained value of Levene's test 0.265 (Table 4.23) is higher than 0.05, It refers to the variability of mathematical anxiety (dependent variable) is the same across the experimental group of high I.Q. and the control group of high I.Q. Statistically, it can be shown CA Post p (0.265) > 0.05 based on the high I.Q. in the experimental group and the high I.Q. in the control group**.** Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was used, to know the effect of constructivist pedagogy (independent variable on the mathematical anxiety (dependent variable) between the experimental group based on high I.Q. and the control group based on high I.Q. (**MA post-XC-I.Q.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the selected groups.

Two-Tailed Significance t-test between Experimental Group of Mathematical Anxiety based on High I.Q. and Control Group of Mathematical Anxiety based on High I.Q.

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Mathematical Anxiety based on High I.Q.	102.55	3.142	11	19	12.34	Significant t > 2.09 at 0.05 level t > 2.86 at 0.01 level
Control Group of Mathematical Anxiety based on High I.Q.	131.20	3.994	10			

Table 4.24: t-test between High Experimental Group and High Control Group of mathematical anxiety on the basis of I.Q.

Table 4.24 clarified that the obtained t-value 12.34 at df 19 is greater than the table value of the t-test, i.e., 2.09 at 0.05 level and 2.86 at 0.01 level. So, the result of the t-test shows that those students who were taught through the traditional teaching method of the control group have significantly high mean scores of mathematical anxiety (M= 131.20) than those students who were taught through the constructivist pedagogy method of the experimental group (M= 102.55). Hence, the mathematical anxiety of the control or traditional group is significantly higher than the experimental group. It proved the mean score of the post-test of the experimental group is significantly higher than the control group. Therefore, the null hypothesis is not accepted.

4.6.2 To compare the effect of constructivist pedagogy on the mathematical anxiety of Low I.Q. of Experimental Group and Low I.Q. of Control Group among seventh class students

$\mathbf{H_0^{6.2}}$: There is no significant difference in mathematical anxiety of Low I.Q. of Experimental Group and Low I.Q. of Control Group of students.

To compare the effect of constructivist pedagogy on mathematical anxiety of Low I.Q. of Experimental Group and Low I.Q. of Control Group students of class seventh), the t-test was used.

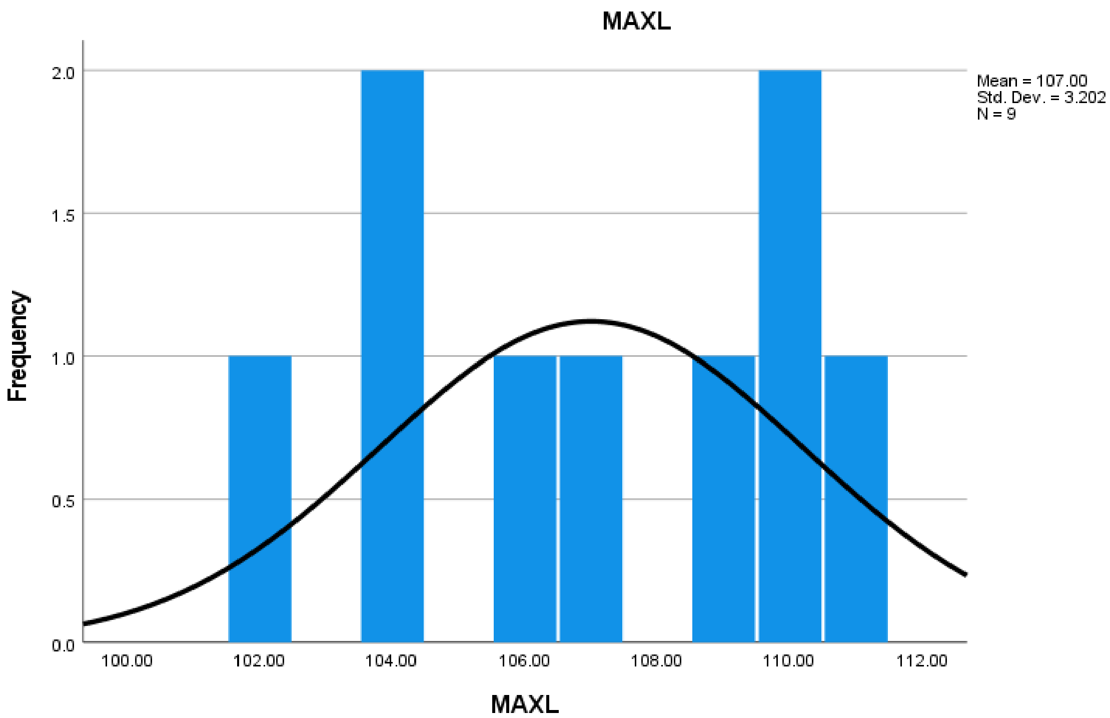
The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of mathematical anxiety (MA POST XC- I.Q. based) for the experimental group of Low I.Q. and control group of Low I.Q.

Tests of Normality							
		Kolmogorov-Smirnov			**Shapiro-Wilk**		
	I.Q.	**Statistic**	**Df**	**Sig.**	**Statistic**	**df**	**Sig.**
MA POST	**C-L**	.197	10	.200*	.934	10	.486
	X-L	.178	9	.200*	.927	9	.452
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.25: Kolmogorov-Smirnov and Shapiro-Wilk test between Low Experimental Group and Low Control Group of mathematical anxiety on the basis of I.Q.

The above SPSS output window (Table 4.25) shows the normality test results. It shows the p values 0.486 and 0.452 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's mathematical anxiety distributions across both greater than 0.05. This is indicated that the student's mathematical anxiety distributions across both groups i.e., the distributions across Low I.Q. of the experimental group and Low I.Q. of the control group are bell-shaped (normal) Fig. 4.9.

NPC with Histogram Plot of The Raw Scores of Mathematical Anxiety of Experimental Group based on Low I.Q. of Class Seventh Students



NPC with Histogram Plot of The Raw Scores of Mathematical Anxiety of Control Group based on Low I.Q. of Class Seventh Students

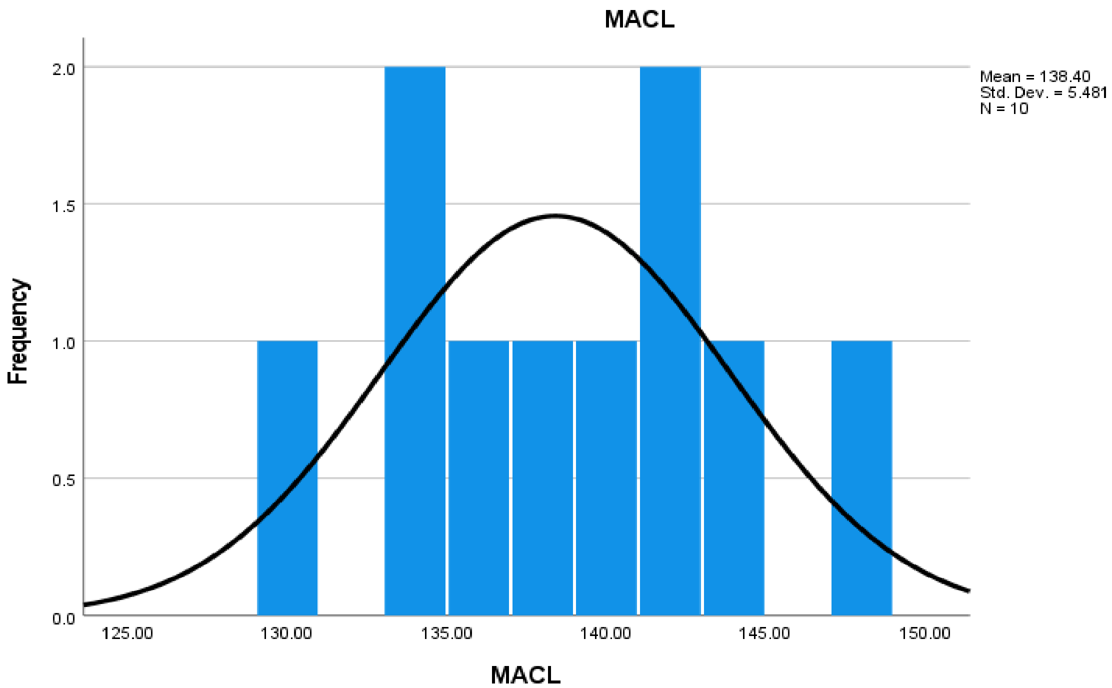


Fig. 4.9: NPC with Histogram between Low Experimental Group and Low Control Group of mathematical anxiety on the basis of I.Q.

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST	**Based on Mean**	2.169	1	17	.159
	Based on Median	2.090	1	17	.166
	Based on Median and with adjusted df	2.090	1	14.488	.170
	Based on trimmed mean	2.154	1	17	.160

Table 4.26: Levene's test between the Low Experimental Group and Low Control Group of Mathematical Anxiety on the basis of I.Q.

The obtained value of Levene's test 0.160 (Table 4.26) is higher than 0.05. It refers to the variability of mathematical anxiety (dependent variable) is the same across the experimental group of low I.Q. and the control group of low I.Q. Statistically, it can be shown as MA Post XC p (0.160) > 0.05 based on the low I.Q. in the experimental group and the low I.Q. in the control group. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e. random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was used, to know the effect of constructivist pedagogy (independent variable on the mathematical anxiety (dependent variable) between the experimental group based on low I.Q. and the control group based on low I.Q. (**MA post-XC-I.Q.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the selected groups.

Two-Tailed Significance t-test between Experimental Group of Mathematical Anxiety based on Low I.Q. and Control Group of Mathematical Anxiety Based on Low I.Q.

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Mathematical Anxiety Based on Low I.Q.	107	3.202	9	17	10.64	Significant t > 2.11 at 0.05 t < 2.90 at 0.01 level
Control Group of Mathematical Anxiety based on Low I.Q.	138.40	5.481	10			

Table 4.27: t-test between Low Experimental Group and Low Control Group of Mathematical Anxiety on the basis of I.Q.

Table 4.27 clarified that the obtained t-value 10.64 at df 17 is greater than the table value of the t-test, i.e., 2.11 at 0.05 level and 2.90 at 0.01 level. So, the result of the t-test shows that those students who were taught through the traditional teaching method have significantly high mathematical anxiety (M= 138.40) than those students who were taught through the constructivist pedagogy method (M= 107). According to the test result, the mathematical anxiety of the control group is significantly higher than the treatment or experimental group. It proved the mean score of the post-test of the control group is significantly higher than the treatment or experimental group. Therefore, the null hypothesis is not accepted.

4.6.3 To compare the effect of constructivist pedagogy on the mathematical anxiety of Low I.Q. of Experimental Group and High I.Q. of Control Group among seventh class students

$\mathbf{H_0^{6.3}}$: There is no significant difference in mathematical anxiety of Low I.Q. of Experimental Group and High I.Q. of Control Group of students.

To compare the effect of constructivist pedagogy on mathematical anxiety of Low I.Q. of Experimental Group and High I.Q. of Control Group students of class seventh), the t-test was used.

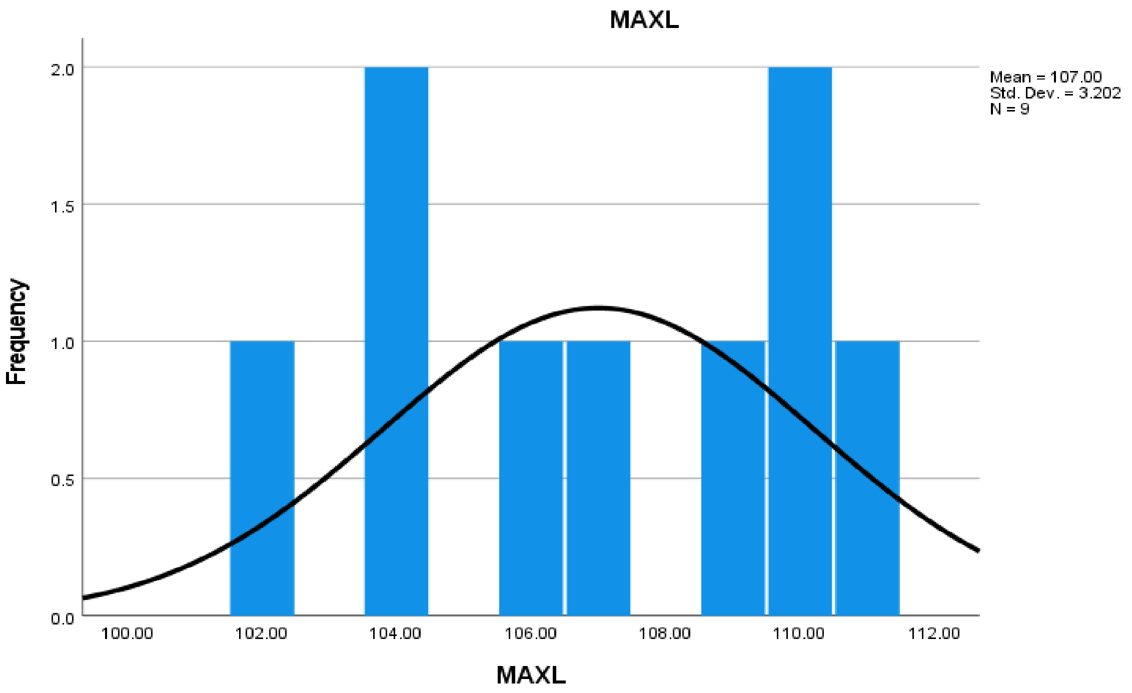
The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it is necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of mathematical anxiety (MA POST XC- I.Q. based) for the experimental group of Low I.Q. and control group of High I.Q.

Tests of Normality							
		Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	I.Q.	**Statistic**	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
MA POST	**C-H**	.209	10	.200*	.863	10	.082
	X-L	.178	9	.200*	.927	9	.452
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.28: Kolmogorov-Smirnov and Shapiro-Wilk test between Low Experimental Group and High Control Group of Mathematical Anxiety on the basis of I.Q.

The above SPSS output window (table 4.28) shows the normality test results. It shows the p values 0.082 and 0.452 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's mathematical anxiety distributions across both groups i.e., the distributions across Low I.Q. of the experimental group and High I.Q. of the control group are bell-shaped (normal) Fig. 4.10.

NPC with Histogram Plot of The Raw Scores of Mathematical Anxiety of Experimental Group based on Low I.Q. of Class Seventh Students



NPC with Histogram Plot of The Raw Scores of Mathematical Anxiety of Control Group based on High I.Q. of Class Seventh Students

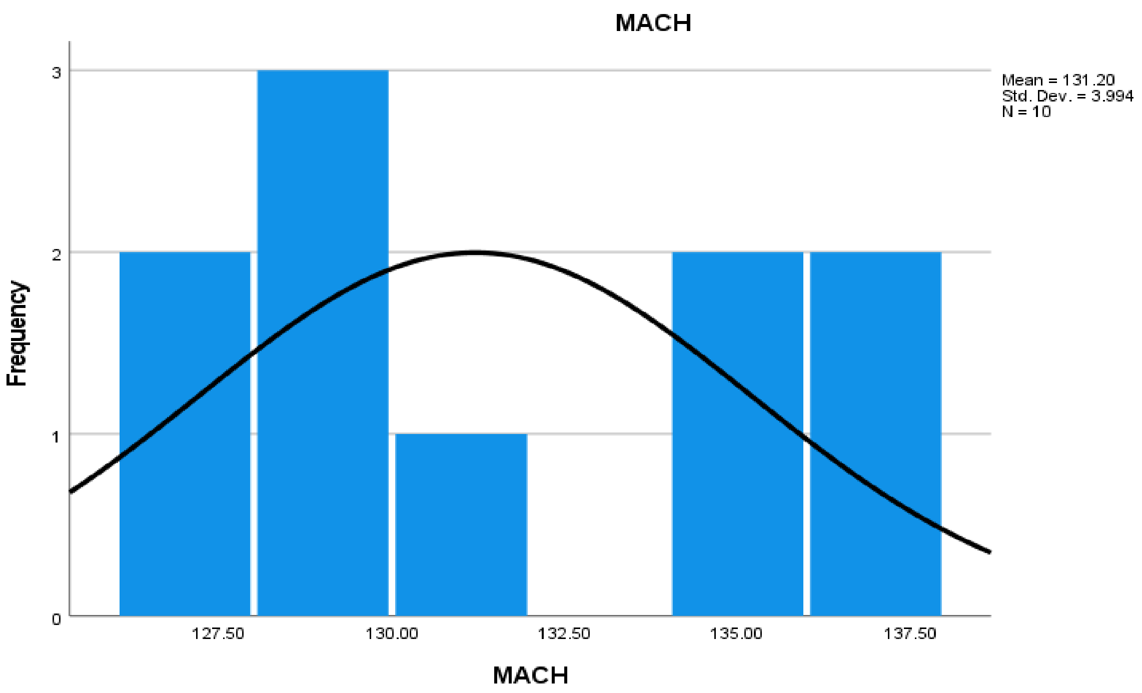


Fig. 4.10: NPC with Histogram Plot between Low Experimental Group and High Control Group of Mathematical Anxiety on the basis of I.Q.

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of mathematical anxiety i.e., one is the experimental group based on low I.Q. and the other is the control group based on high I.Q. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST	**Based on Mean**	1.113	1	17	.306
	Based on Median	.717	1	17	.409
	Based on Median and with adjusted df	.717	1	15.185	.410
	Based on trimmed mean	1.021	1	17	.326

Table 4.29: Levene's test between the Low Experimental Group and High Control Group of Mathematical Anxiety on the basis of I.Q.

The obtained value of Levene's test 0.326 (Table: 4.29) is higher than 0.05. It refers to the variability of mathematical anxiety (dependent variable) is the same across the experimental group of low I.Q. and the control group of high I.Q. Statistically, it can be shown **MA Post XC p (0.326) > 0.05** based on the low I.Q. in the experimental group and the high I.Q. in the control group. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of the subject, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was computed, to know the effect of constructivist pedagogy on the mathematical anxiety between the experimental group based on low I.Q. and the control group based on high I.Q. (**MA post-XC-I.Q.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the selected groups.

Independent Sample Two-Tailed t-test between Experimental Group of Low I.Q. of Mathematical Anxiety and Control Group of High I.Q. of Mathematical Anxiety

<table>
<tr><th>Group</th><th>Mean</th><th>SD</th><th>N</th><th>df</th><th>t-value</th><th>Significance</th></tr>
<tr><td>Experimental Group of Mathematical Anxiety Based on Low I.Q.</td><td>107</td><td>3.202</td><td>9</td><td rowspan="2">17</td><td rowspan="2">9.83</td><td rowspan="2">Significant
t < 2.11 at 0.05
t < 2.90 at 0.01 level</td></tr>
<tr><td>Control Group of Mathematical Anxiety Based on High I.Q.</td><td>131.2</td><td>3.994</td><td>10</td></tr>
</table>

Table 4.30: t- test between the Low Experimental Group and High Control Group of Mathematical Anxiety on the basis of I.Q.

Table 4.30 clarified that the obtained t-value 9.83 at df 17 is greater than the table value of the t-test, i.e., 2.11 at 0.05 level and 2.90 at 0.01 level. So, the result of the t-test shows that those students who were taught through the traditional teaching method have a significantly high mean score of mathematical anxiety based on the high I.Q. of the control group (M= 131.2) than the mean score of mathematical anxiety based on the low I.Q. of experimental group those students who were taught through the constructivist pedagogy (M= 107). According to the mathematical anxiety scale, the mathematical anxiety of the control or traditional group is significantly higher than the treatment or experimental group. It proved the mean score of the post-test of the control group is significantly higher than the experimental group. Therefore, the null hypothesis is not accepted.

4 (B) Analysis and Interpretation of Data on the Basis of Gender

4.7 OBJECTIVE: To study the effect of constructivist pedagogy on concept attainment in mathematics among seventh class students with respect to their gender

H_0^7: There is no significant difference in mathematical concept attainment of experimental group students with respect to their gender.

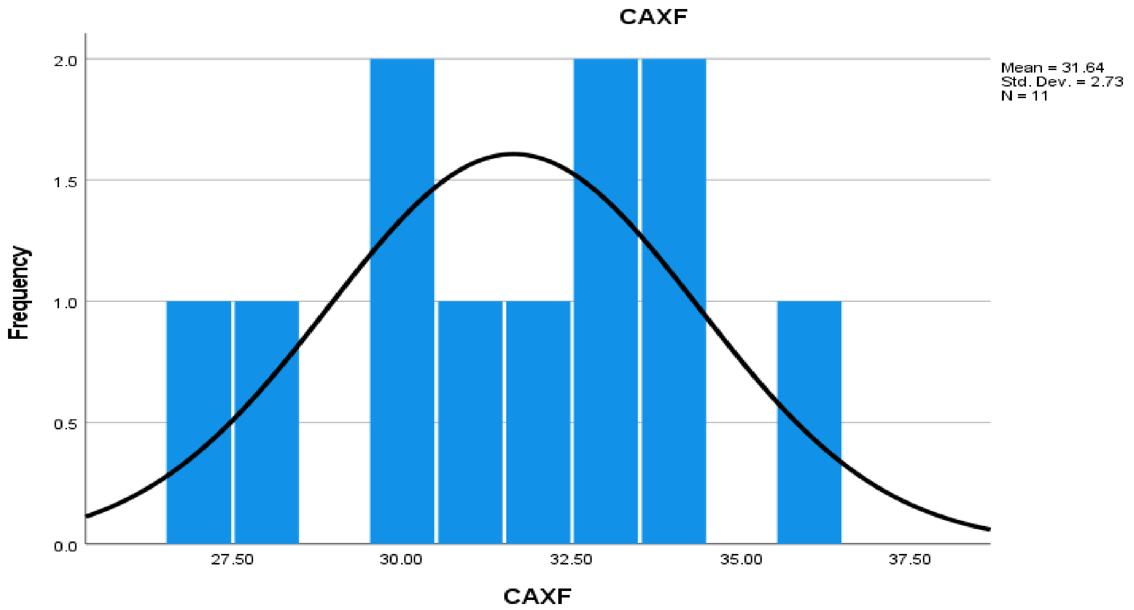
To find out the effect of constructivist pedagogy on the concept attainment in mathematics of class seventh students on the basis of their gender, the t-test was used.

The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of concept attainment (CA POST Gender-based) for the experimental group.

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Gender	Statistic	df	Sig.	Statistic	df	Sig.
CA POST	Female	.146	11	.200*	.970	11	.885
	Male	.224	9	.200*	.895	9	.223
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction.							

Table 4.31: Kolmogorov-Smirnov and Shapiro-Wilk test between Concept Attainment Scores of Female Students of Experimental Group and Male Students of Experimental Group

NPC with Histogram Plot of The Raw Scores of Female Students of Experimental Group of Concept Attainment



NPC with Histogram Plot of The Raw Scores of Male Students of Experimental Group of Concept Attainment

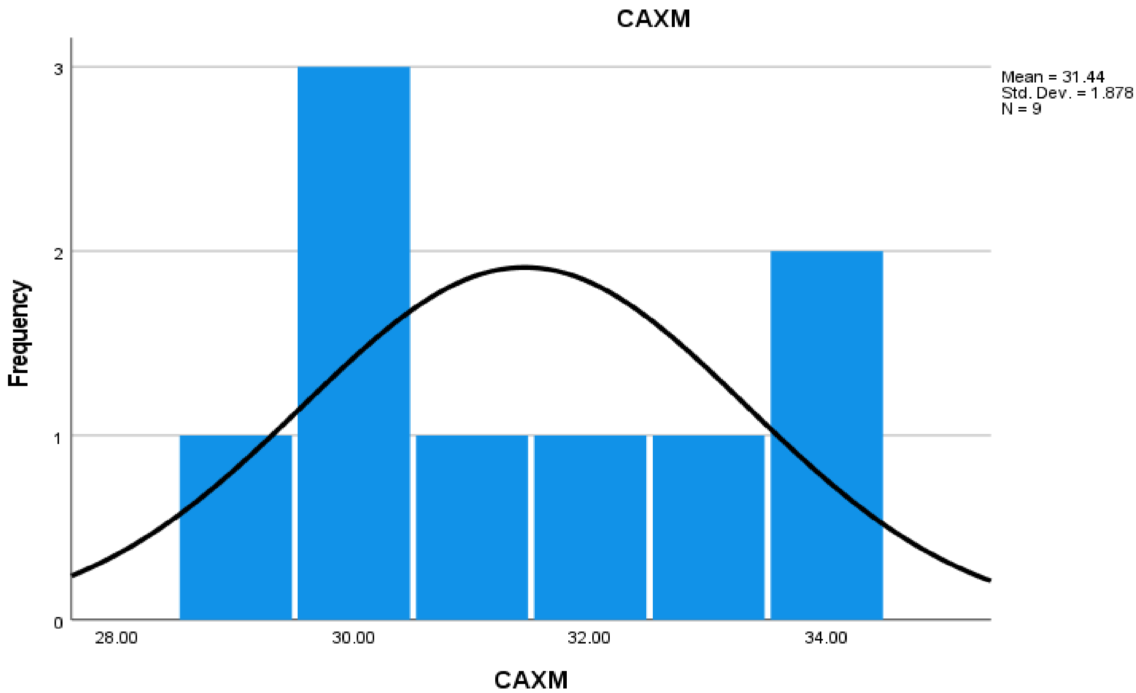


Fig. 4.11: NPC with Histogram Plot between Concept Attainment Scores of Female Students of Experimental Group and Male Students of Experimental Group

The above SPSS output window (table 4.31) shows the normality test results. It shows the p values 0.885 and 0.223 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's concept attainment distributions across both groups i.e., experimental group on the basis of gender are bell-shaped (normal) Fig. 4.11.

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of concept attainment i.e., one was the experimental group of female students and the other was the experimental group of male students. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA POST	**Based on Mean**	1.294	1	18	.270
	Based on Median	1.097	1	18	.309
	Based on Median and with adjusted df	1.097	1	15.780	.311
	Based on trimmed mean	1.286	1	18	.272

Table 4.32: Levene's test between Concept Attainment Scores of Female Students of Experimental Group and Male Students of Experimental Group

The obtained value of Levene's test 0.272 (Table 4.32) is higher than 0.05. It refers to the variability of concept attainment (dependent variable) is the same across the experimental group of female students and the experimental group of male students. Statistically, it can be shown CA Post X-G p (0.272) > 0.05 based on the gender in the experimental group. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was computed, to know the effect of constructivist pedagogy on the concept attainment (dependent variable) between the experimental group of female students and the experimental group of male students (**CA post X- G)**. The t-test verifies the null hypothesis that there is no significant difference in the mathematical concept attainment between the selected groups.

Two-Tailed Significance t-test between Experimental Group of Female Students and Experimental Group of Male Students of Concept Attainment

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Female Students of Concept Attainment	31.6363	2.7303	11	18	0.1256	Not Significant t < 2.10 at 0.05 t < 2.88 at 0.01 level
Experimental Group of Male Students of Concept Attainment	31.4444	1.8782	9			

Table 4.33: t-test between Concept Attainment Scores of Female Students of Experimental Group and Male Students of Experimental Group

Table 4.33 clarified that the obtained t-value 0.1256 at df 18 is not greater than the table value of the t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. So, the result of the t-test shows that the female students of the experimental group taught through constructivist pedagogy have not significantly higher mathematical concept attainment (M= 31.6363) than male students of the experimental group taught through the constructivist pedagogy method (M= 31.4444). Therefore, the null hypothesis is accepted.

4.8 OBJECTIVE: To study the effect of a constructivist pedagogy on anxiety in mathematics among seventh class students with respect to their gender

H_0^8: There is no significant difference in mathematical anxiety of experimental group students with respect to their gender.

To find out the effect of constructivist pedagogy on the mathematical anxiety in mathematics of class seventh students on the basis of with respect to their gender, the t-test was used.

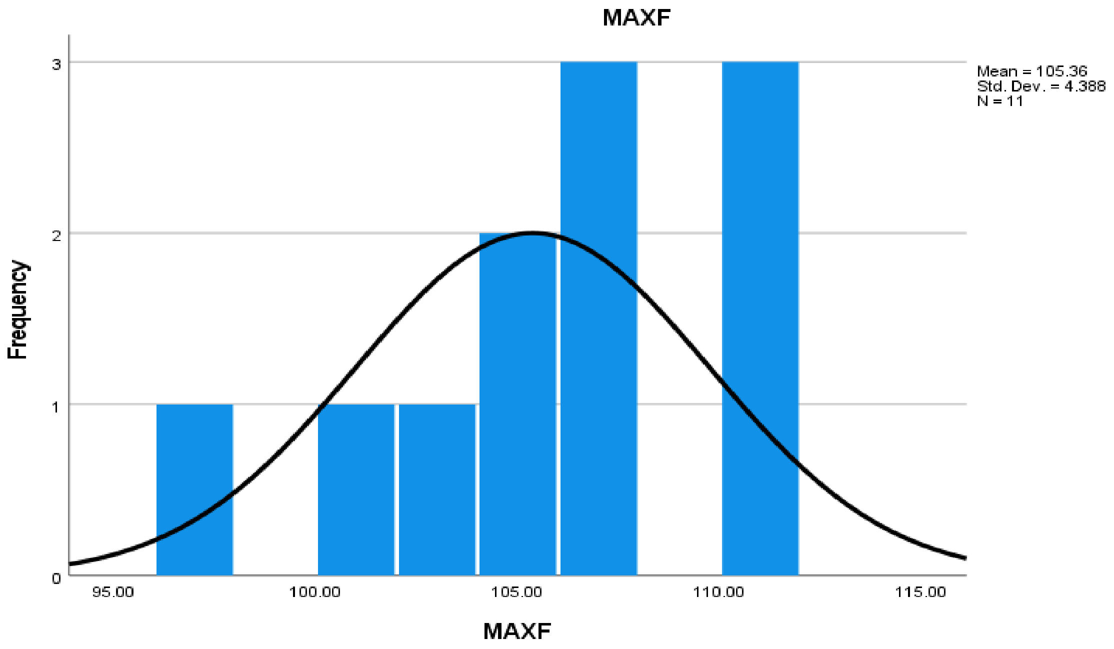
The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of mathematical anxiety (MA POST - Gender-based) for the experimental group of female and male students.

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Gender	Statistic	df	Sig.	Statistic	df	Sig.
MA POST	Female-X	.127	11	.200*	.951	11	.659
	Male-X	.145	9	.200*	.979	9	.961
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.34: Kolmogorov-Smirnov and Shapiro-Wilk test between Mathematical Anxiety Scores of Female Students of Experimental Group and Male Students of Experimental Group

The above SPSS output window (table 4.34) shows the normality test results. It shows the p values 0.659 and 0.961 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the students' mathematical anxiety distributions across both groups i.e., Female students of the experimental group and Male students of the experimental group are bell-shaped (normal) Fig. 4.12.

NPC with Histogram Plot of The Raw Scores of Female Students of Experimental Group of Mathematical Anxiety



NPC with Histogram Plot of The Raw Scores of Male Students of Experimental Group of Mathematical Anxiety

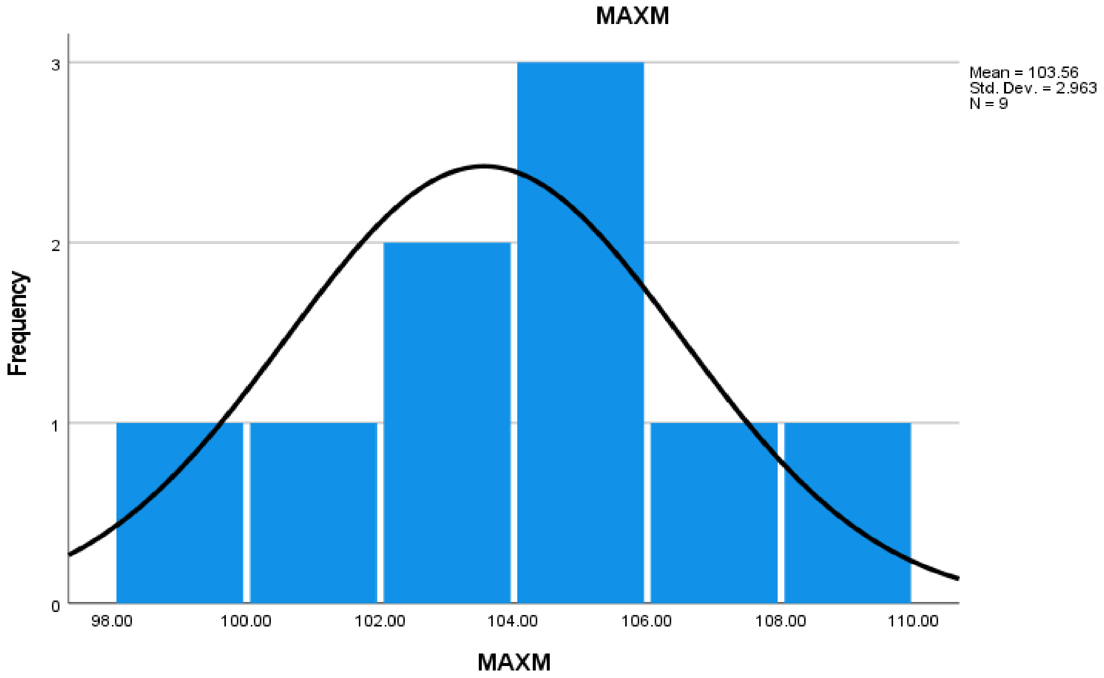


Fig. 4.12: NPC with Histogram Plot between Mathematical Anxiety Scores of Female Students of Experimental Group and Male Students of Experimental Group

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of mathematical anxiety i.e., one was the experimental group of female students and the other was the experimental group of male students. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST	**Based on Mean**	1.346	1	18	.261
	Based on Median	1.160	1	18	.296
	Based on Median and with adjusted df	1.160	1	16.130	.297
	Based on trimmed mean	1.285	1	18	.272

Table 4.35.: Levene's test between Mathematical Anxiety Scores of Female Students of Experimental Group and Male Students of Experimental Group

The obtained value of Levene's test 0.272 (Table 4.35) is higher than 0.05. It refers to the variability of mathematical anxiety (dependent variable) is the same across the experimental group of female students and the experimental group of male students. Statistically, it can be shown MA Post X-G p (0.272) > 0.05 based on the gender in the experimental group. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected samples. Therefore, a t-test was computed, to know the effect of constructivist pedagogy on the mathematical anxiety (dependent variable) between the experimental group of female students and the experimental group of male students (**MA post X- G)**. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the selected groups.

Two-Tailed Significance t-test between Female Students of Experimental Group and Male Students of Experimental Group of Mathematical Anxiety

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Female Students of Mathematical Anxiety	105.36	4.388	11	18	0.7416	Not Significant $t < 2.10$ at 0.05 $t < 2.88$ at 0.01 level
Experimental Group of Male Students of Mathematical Anxiety	103.56	2.963	9			

Table 4.36: t-test between Mathematical Anxiety Scores of Female Students of Experimental Group and Male Students of Experimental Group

Table 4.36 clarified that the obtained t-value 0.7416 at df 18 is not greater than the table value of the t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. So, the result of the t-test shows that the female students of the experimental group taught through constructivist pedagogy have not significantly higher mathematical anxiety (M= 105.36) than male students of the experimental group taught through the constructivist pedagogy method (M= 103.56). Therefore, the null hypothesis is accepted.

4.9 OBJECTIVE: To compare the concept attainment in mathematics between experimental and control group students with respect to their gender

$\mathbf{H_0^9}$**:** There is no significant difference in mathematical concept attainment between experimental and control group students with respect to their gender.

4.9.1 To compare concept attainment in mathematics between female experimental and female-control group students of class seventh

$\mathbf{H_0^{9.1}}$: There is no significant difference in mathematical concept attainment between female experimental and female-control group students.

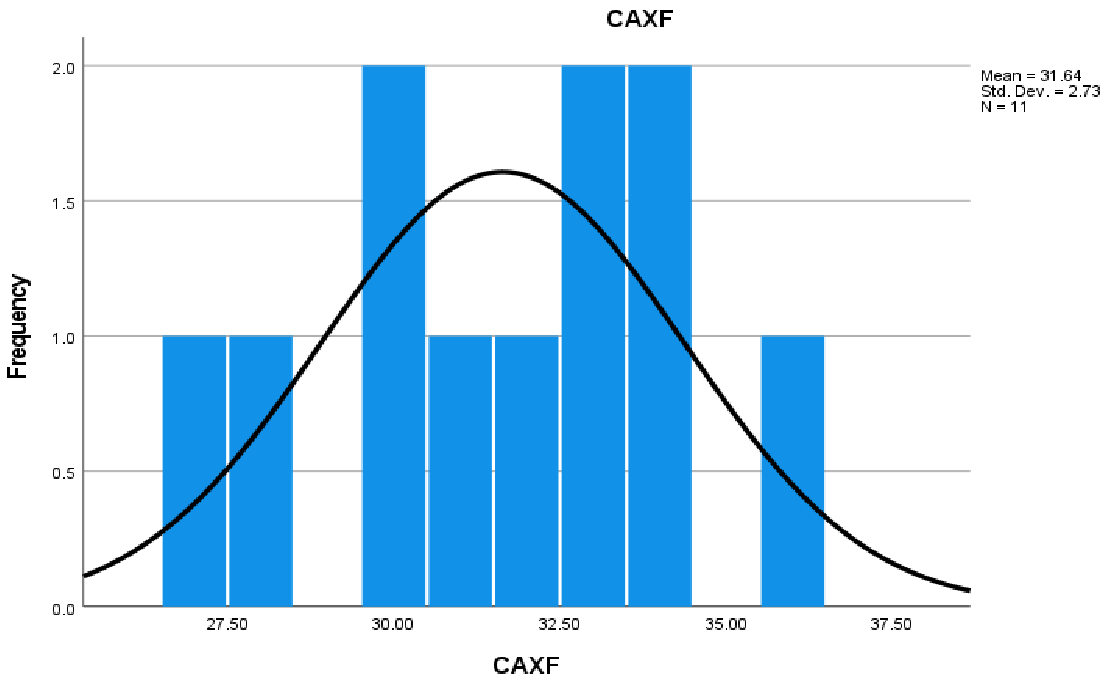
To compare the effect of constructivist pedagogy on the concept attainment in mathematics of class seventh students on the basis of their gender, the t-test was used. The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of concept attainment (CA POST Gender-based) for the experimental group of Female students and the control group of Female students.

Tests of Normality							
		Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	GROUP	**Statistic**	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
CA POST	**Female-C**	.168	9	.200*	.960	9	.793
	Female-X	.146	11	.200*	.970	11	.885
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.37: Kolmogorov-Smirnov and Shapiro-Wilk test between Concept Attainment Scores of Female Students of Experimental Group and Female Students of Control Group

The above SPSS output window (table 4.37) shows the normality test results. It shows the p values 0.793 and 0.885 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's concept attainment distributions across both groups i.e., concept attainment distributions across Female students of the experimental group and Female students of the control group are bell-shaped (normal) Fig. 4.13.

NPC with Histogram Plot of The Raw Scores of Female Students of Experimental Group of Concept Attainment



NPC with Histogram Plot of The Raw Scores of Female Students of Control Group of Concept Attainment

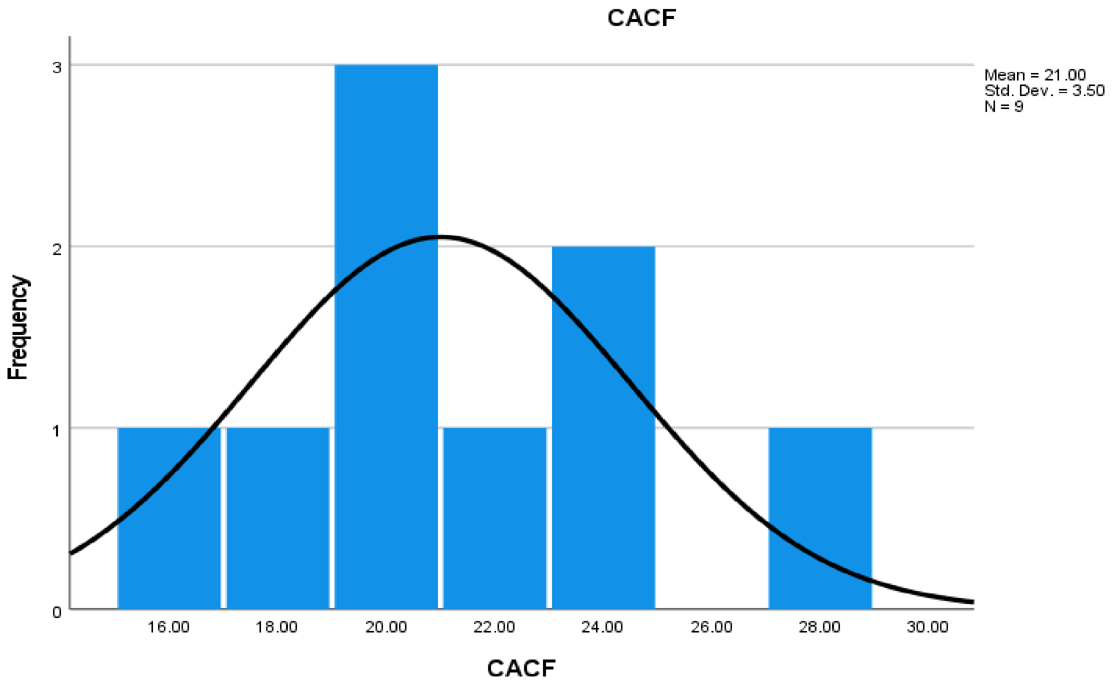


Fig. 4.13: NPC with Histogram Plot between Concept Attainment Scores of Female Students of Experimental Group and Female Students of Control Group

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of concept attainment i.e., one was the experimental group of female students and the other was the control group of female students. It tests the null hypothesis that the variance of the population is equal (define the homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA POST	**Based on Mean**	.931	1	18	.347
	Based on Median	.517	1	18	.481
	Based on Median and with adjusted df	.517	1	16.128	.482
	Based on trimmed mean	.909	1	18	.353

Table 4.38: Levene's test between Concept Attainment Scores of Female Students of Experimental Group and Female Students of Control Group

The obtained value of Levene's test 0.353 (Table 4.38) is higher than 0.05. It refers to the variability of concept attainment (dependent variable) being the same across both groups. Statistically, it can be shown CA Post XC-G p (0.353) > 0.05 based on the experimental group of female students and the control group of female students. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified for the two selected dependent samples. Therefore, a t-test was computed, to know the effect of constructivist pedagogy on the concept attainment (dependent variable) between the experimental group of female students and the other was the control group of female students (**CA post X- G)**. The t-test verifies the null hypothesis that there is no significant difference in the mathematical concept attainment between the selected groups.

Two-Tailed Significance t-test between Female Students of Experimental Group and Female Students of Control Group of Concept Attainment

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Female Students of Concept Attainment	31.6363	2.7303	11	18	5.3991	Significant t > 2.10 at 0.05 t > 2.88 at 0.01 level
Control Group of Male Students of Concept Attainment	21	3.5	9			

Table 4.39: t-test between Concept Attainment Scores of Female Students of Experimental Group and Female Students of Control Group

Table 4.39 clarified that the obtained t-value 5.3991 at df 18 is not greater than the table value of t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. So, the result of the t-test shows that the female students of experimental group taught through constructivist pedagogy have significantly higher mathematical concept attainment (M= 31.6363) than female students of control group taught through the constructivist pedagogy method (M= 21). Therefore, the null hypothesis is not accepted.

4.9.2 To compare concept attainment in mathematics between male experimental and male control group students of class seventh

$\mathbf{H_0^{9.2}}$**:** There is no significant difference in mathematical concept attainment between male experimental and male control groups of students.

To compare the effect of constructivist pedagogy on the concept attainment in mathematics between the experimental group of male students and the control group of male students of class seventh, the t-test was used.

The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two

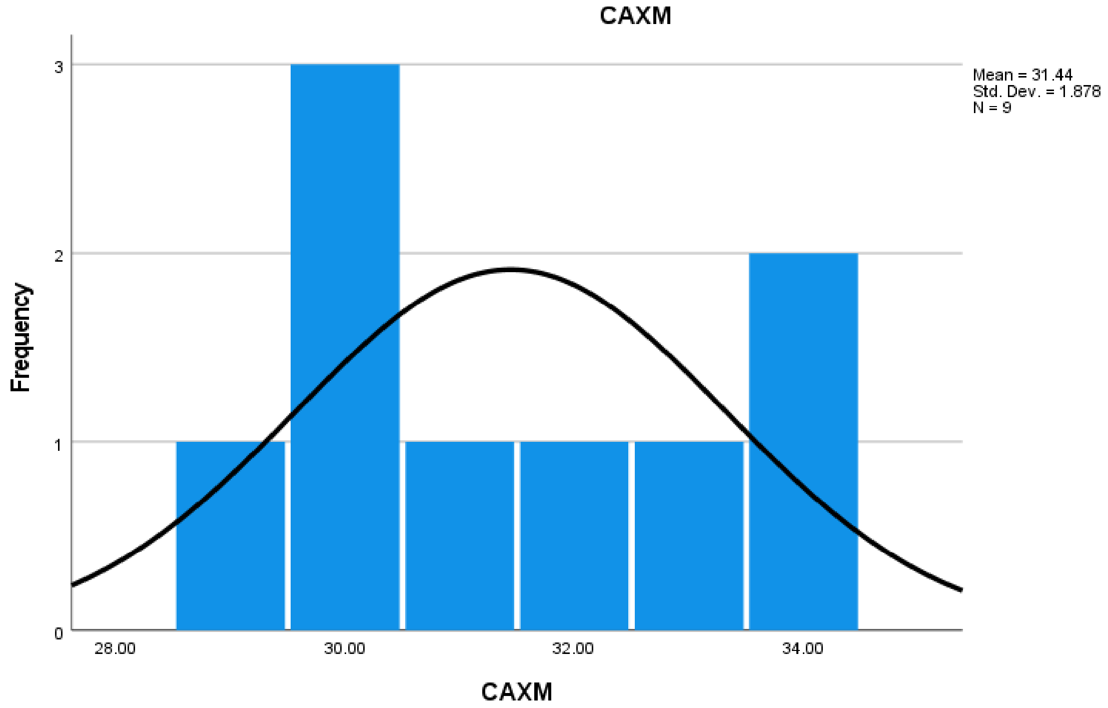
independent samples separately i.e., the tests were used to verify the normality between the post test scores of concept attainment (CA POST - Gender based) for the experimental group of male students and the control group of male students.

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
CA POST	Male-C	.178	11	.200*	.967	11	.852
	Male-X	.224	9	.200*	.895	9	.223
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.40: Kolmogorov-Smirnov and Shapiro-Wilk test between Concept Attainment Scores of Male Students of Experimental Group and Male Students of Control Group

The above SPSS output window (table 4.40) shows the normality test results. It shows the p values 0.852 and 0.223 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's concept attainment distributions across both groups i.e., concept attainment distributions across male students of the experimental group and male students of the control group are bell-shaped (normal) Fig. 4.14.

NPC with Histogram Plot between the Raw Scores of Male Students of Experimental Group of Concept Attainment



NPC with Histogram Plot between the Raw Scores of Male Students of Control Group of Concept Attainment

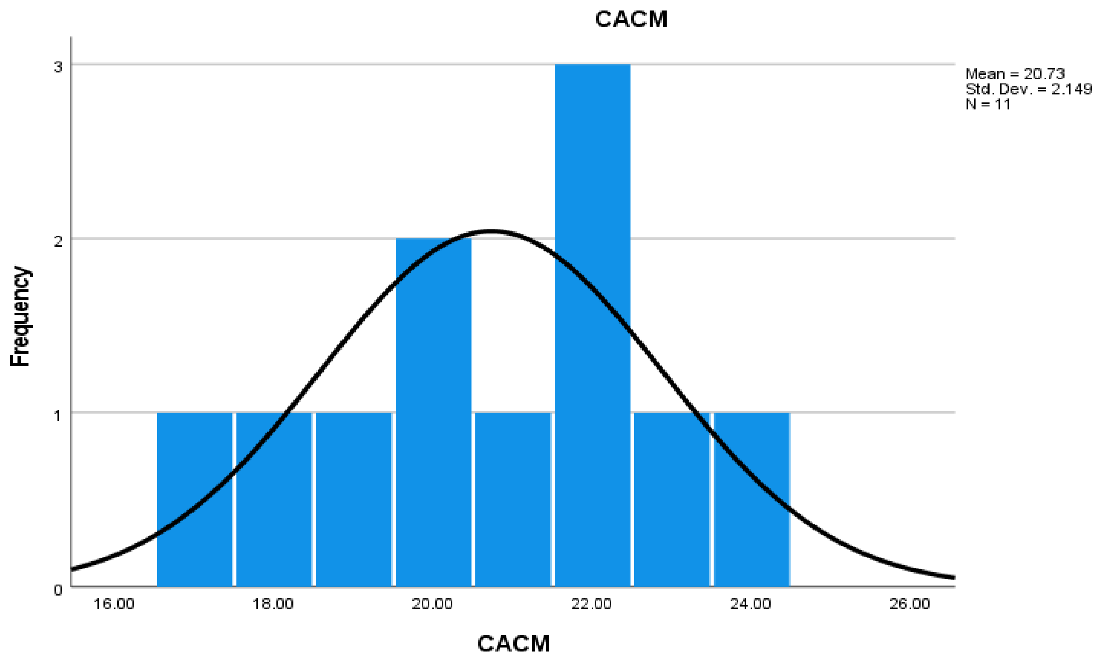


Fig. 4.14: NPC with Histogram Plot between Concept Attainment Scores of Male Students of Experimental Group and Male Students of Control Group

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of concept attainment i.e., one was the experimental group of male students and the other was the control group of male students. It tests the null hypothesis that the variance of the population is equal (define the homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA POST	**Based on Mean**	.110	1	18	.743
	Based on Median	.117	1	18	.736
	Based on Median and with adjusted df	.117	1	17.573	.736
	Based on trimmed mean	.107	1	18	.747

Table 4.41: Levene's test between Concept Attainment Scores of Male Students of Experimental Group and Male Students of Control Group

The obtained value of Levene's test 0.747 (Table 4.41) is higher than 0.05. It refers to the variability of concept attainment (dependent variable) being the same across both groups. Statistically, it can be shown CA Post XC-G p (0.747) > 0.05 based on the experimental group of male students and the control group of male students**.** Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was used to know the effect of constructivist pedagogy on the concept attainment (dependent variable) between the experimental group of male students and the control group of male students (**CA post X- G)**. The t-test verifies the null hypothesis that there is no significant difference in the mathematical concept attainment between the selected groups.

Two-Tailed Significance t-test between Male Experimental Group and Male Control Group of Concept Attainment

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Male Students of Concept Attainment	31.4444	1.87823	9	18	7.977	Significant t > 2.10 at 0.05 t > 2.88 at 0.01 level
Control Group of Male Students of Concept Attainment	20.7272	2.1489	11			

Table 4.42: t-test between Concept Attainment Scores of Male Students of Experimental Group and Male Students of Control Group

Table 4.42 clarified that the obtained t-value 7.977 at df 18 is not greater than the table value of the t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. So, the result of the t-test was used that the male students of the experimental group taught through constructivist pedagogy have significantly higher mathematical concept attainment (M= 31.4444) than male students of the control group taught through the traditional teaching method (M= 20.7272). Therefore, the null hypothesis is not accepted.

4.9.3 To compare concept attainment in mathematics between male experimental and female control group students of class seventh

$\mathbf{H_0^{9.3}}$: There is no significant difference in mathematical concept attainment between male experimental and female control group students.

To compare the effect of constructivist pedagogy on the concept attainment in mathematics between the male experimental group and the female control group students of class seventh, the t-test was used.

The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two

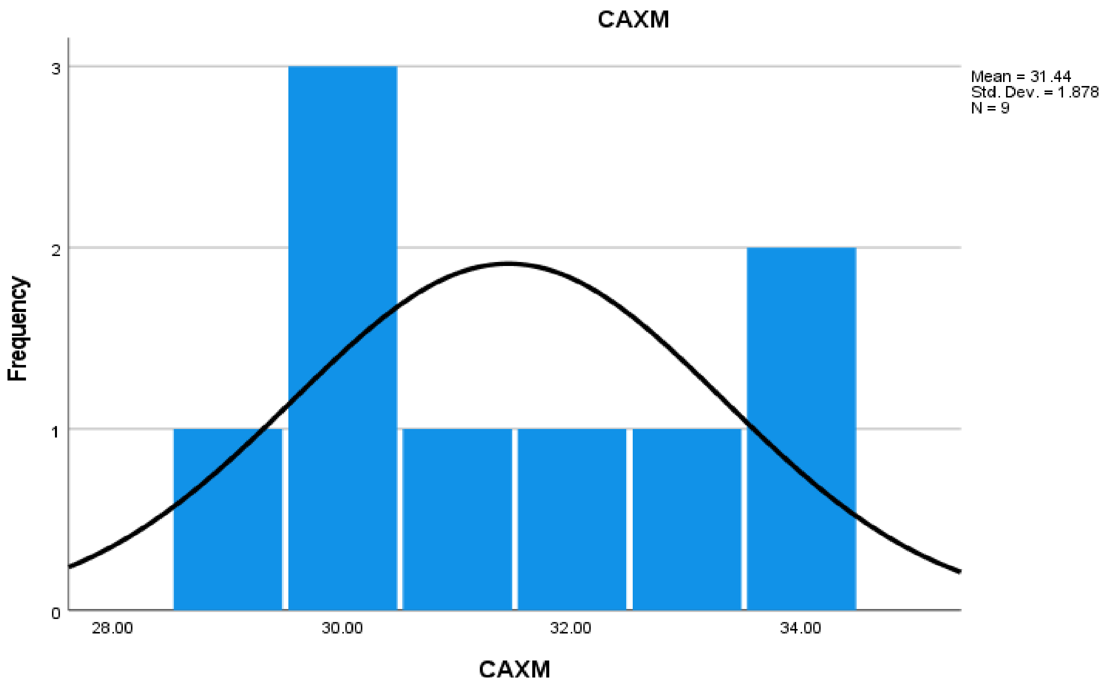
independent samples separately i.e., the tests were used to verify the normality between the post-test scores of concept attainment (CA POST - Gender-based) for the experimental group of male students and the control group of female students.

Tests of Normality							
		Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	Group	**Statistic**	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
CA POST	**Female-C**	.168	9	.200*	.960	9	.793
	Male-X	.224	9	.200*	.895	9	.223
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.43: Kolmogorov-Smirnov and Shapiro-Wilk test between Concept Attainment Scores of Male Students of Experimental Group and Female Students of Control Group

The above SPSS output window (table 4.43) shows the normality test results. It shows the p values 0.793 and 0.223 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's concept attainment distributions across both groups. i.e., concept attainment distributions across the experimental group of male students and the control group of female students are bell-shaped (normal) Fig. 4.15.

NPC with Histogram Plot of The Raw Scores of Male Students of Experimental Group of Concept Attainment



NPC with Histogram Plot of The Raw Scores of Female Students Control Group of Concept Attainment

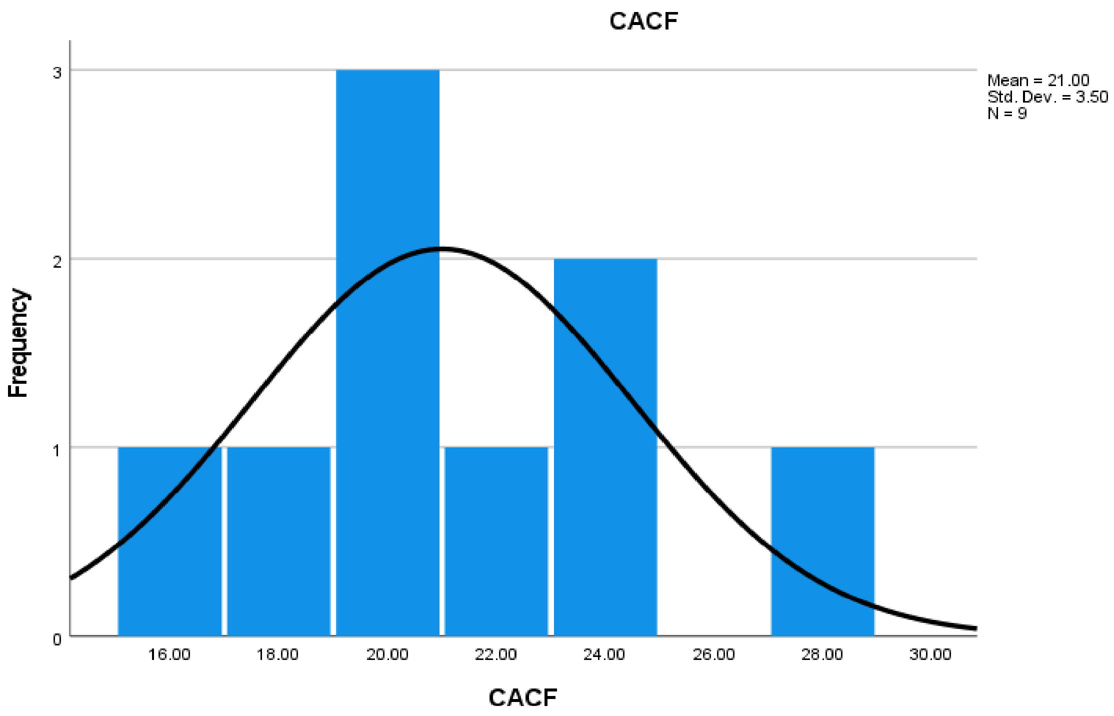


Fig. 4.15: NPC with Histogram Plot between Concept Attainment Scores of Male Students of Experimental Group and Female Students of Control Group

After that, the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of concept attainment i.e., one was experimental group of male students and the control group of female students. It tests the null hypothesis that the variance of the population is equal (define the homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA POST	**Based on Mean**	4.250	1	16	.056
	Based on Median	2.350	1	16	.145
	Based on Median and with adjusted df	2.350	1	11.343	.153
	Based on trimmed mean	4.159	1	16	.058

Table 4.44: Levene's test between Concept Attainment Scores of Male Students of Experimental Group and Female Students of Control Group

The obtained value of Levene's test 0.058 (Table 4.44) is higher than 0.05. It refers to the variability of concept attainment (dependent variable) being the same across both groups. Statistically, it can be shown CA Post XC-G p (0.058) > 0.05 based on the experimental group of male students and the control group of female students. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected samples. Therefore, a t-test was computed to know the effect of constructivist pedagogy on the concept attainment (dependent variable) between the experimental group of male students and the control group of female students (**CA post XC- G)**. The t-test verifies the null hypothesis that there is no significant difference in the mathematical concept attainment between the selected groups.

Two Tailed Significance t-test between Male Students of Experimental Group and Female Students of Control Group of Concept Attainment

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Male Students of Concept Attainment	31.4444	1.87823	9	16	5.4970	Significant t > 2.12 at 0.05 t > 2.92 at 0.01 level
Control Group of Female Students of Concept Attainment	21	3.5	9			

Table 4.45: t-test between Concept Attainment Scores of Male Students of Experimental Group and Female Students of Control Group

Table 4.45 clarified that the obtained t-value 5.4970 at df 16 is not greater than the table value of the t-test, i.e., 2.12 at 0.05 level and 2.92 at 0.01 level. Therefore, the result of the t-test shows that the male students of the experimental group taught through constructivist pedagogy have significantly higher mathematical concept attainment (M= 31.4444) than female students of the control group taught through the traditional teaching method (M= 21). Therefore, the null hypothesis is not accepted.

4.9.4 To compare concept attainment in mathematics between female experimental and male control group students of class seventh

$H_0^{9.4}$: There is no significant difference in mathematical concept attainment between female experimental and male control group students.

To compare the effect of constructivist pedagogy on the concept attainment in mathematics between the female experimental group and the male control group students of class seventh, the t-test was used.

The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two

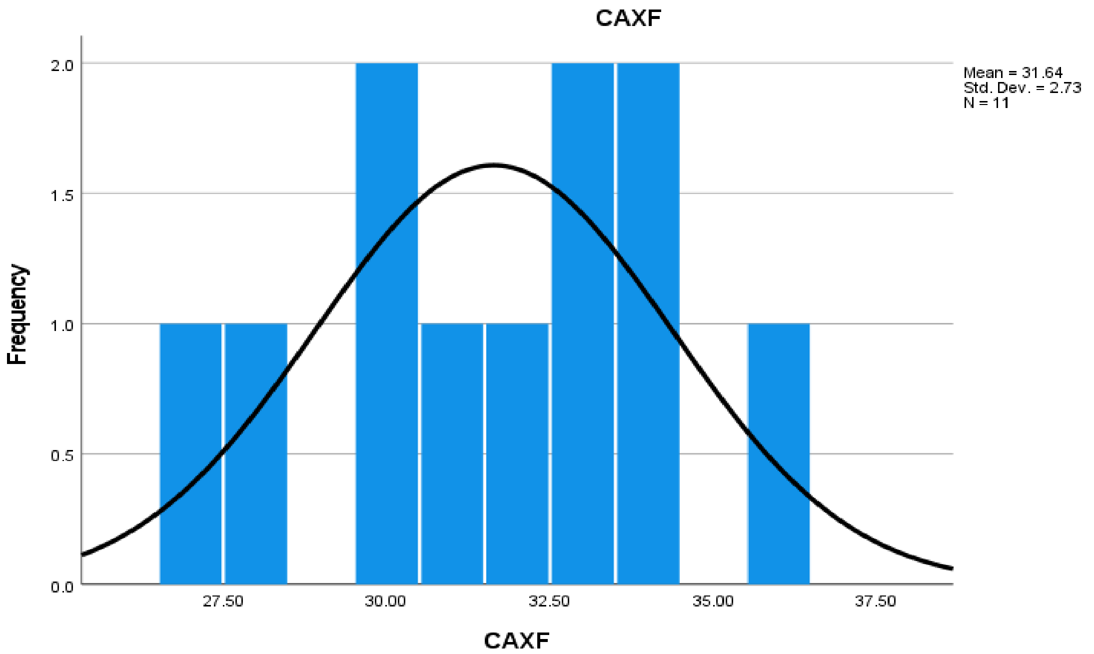
independent samples separately i.e., the tests were used to verify the normality between the post-test scores of concept attainment (CA POST Gender-based) for the experimental group of female students and the control group of male students.

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
CA POST	Female-X	.146	11	.200*	.970	11	.885
	Male-C	.178	11	.200*	.967	11	.852
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.46: Kolmogorov-Smirnov and Shapiro-Wilk test between Concept Attainment Scores of Female Students of Experimental Group and Male Students of Control Group

The above SPSS output window (table 4.46) shows the normality test results. It shows the p values 0.885 and 0.852 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's concept attainment distributions across both groups i.e., concept attainment distributions across female of the experimental group of female students and the control group of male students are bell-shaped (normal) Fig. 4.16.

NPC with Histogram Plot of The Raw Scores of Female Students of Experimental Group of Concept Attainment



NPC with Histogram Plot of The Raw Scores of Male Students of Control Group of Concept Attainment

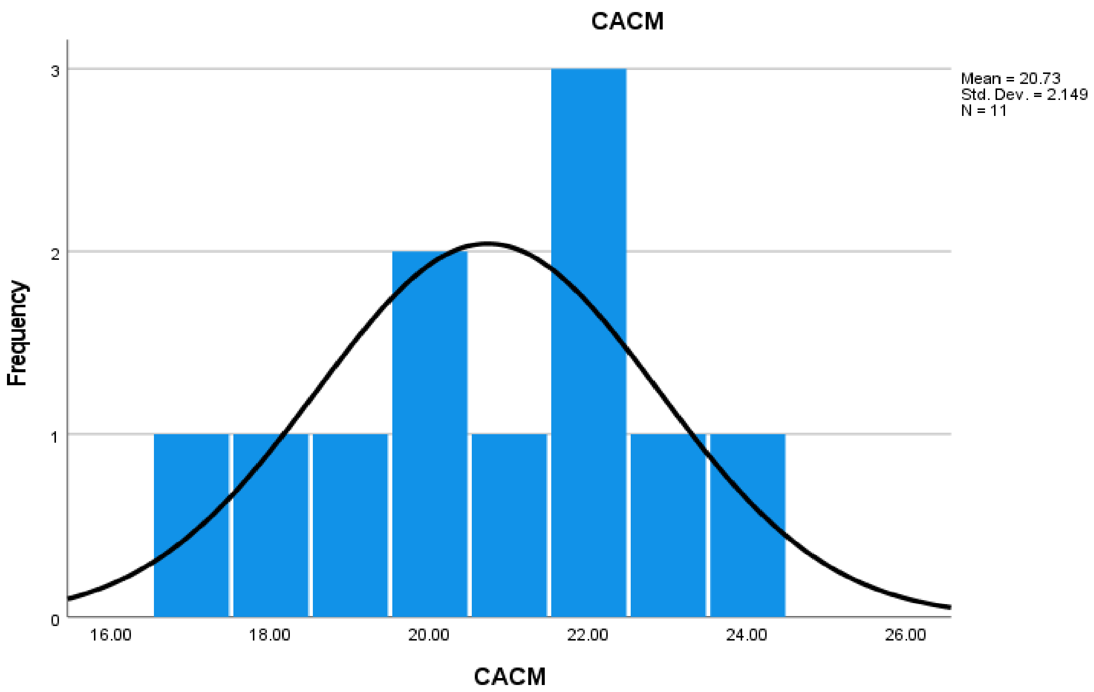


Fig. 4.16: NPC with Histogram Plot between Concept Attainment Scores of Female Students of Experimental Group and Male Students of Control Group

Hereafter, the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of concept attainment i.e., one was the experimental group of female students and the other was the control group of male students. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA POST	**Based on Mean**	.714	1	20	.408
	Based on Median	.601	1	20	.447
	Based on Median and with adjusted df	.601	1	18.824	.448
	Based on trimmed mean	.713	1	20	.408

Table 4.47: Levene's test between Concept Attainment Scores of Female Students of Experimental Group and Male Students of Control Group

The obtained value of Levene's test 0.408 (Table 4.47) is higher than 0.05. It refers to the variability of concept attainment (dependent variable) being the same across both groups. Statistically, it can be shown CA Post XC-G p (0.408) > 0.05 based on the experimental group of female students and the control group of male students. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was computed to know the effect of constructivist pedagogy on the concept attainment (dependent variable) between experimental group of female students and the control group of male students (**CA post XC- G)**. The t-test verifies the null hypothesis that there is no significant difference in the mathematical concept attainment between the selected groups.

Two-Tailed Significance t-test between Female Experimental Group and Male Control Group of Concept Attainment

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Female Students of Concept Attainment	31.6363	2.7303	11	20	7.07097	Significant t > 2.09 at 0.05 level t > 2.84 at 0.01 level
Control Group of Male Students of Concept Attainment	20.7272	2.1489	11			

Table 4.48: t-test between Concept Attainment Scores of Female Students of Experimental Group and Male Students of Control Group

Table 4.48 clarified that the obtained t-value 7.07097 at df 20 is greater than the table value of the t-test, i.e., 2.09 at 0.05 level and 2.84 at 0.01 level. So, the result of the t-test shows that the female students of the experimental group taught through constructivist pedagogy have significantly higher mathematical concept attainment (M= 31.6363) than male students of the control group taught through the traditional teaching method (M= 20.7272). Therefore, the null hypothesis is not accepted.

4.10 OBJECTIVE: To compare anxiety in mathematics between experimental and control group students with respect to their gender

$\mathbf{H_0^{10}}$: There is a significant difference in mathematical anxiety between experimental and control group students with respect to their gender.

4.10.1 To compare mathematical anxiety between female experimental and female-control group students of class seventh

$\boldsymbol{H_0^{10.1}}$: There is no significant difference in mathematical anxiety between female experimental and female-control group students.

To compare the effect of constructivist pedagogy on the mathematical anxiety of class seventh between the female students of experimental and female students of control group, the t-test was used.

The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to

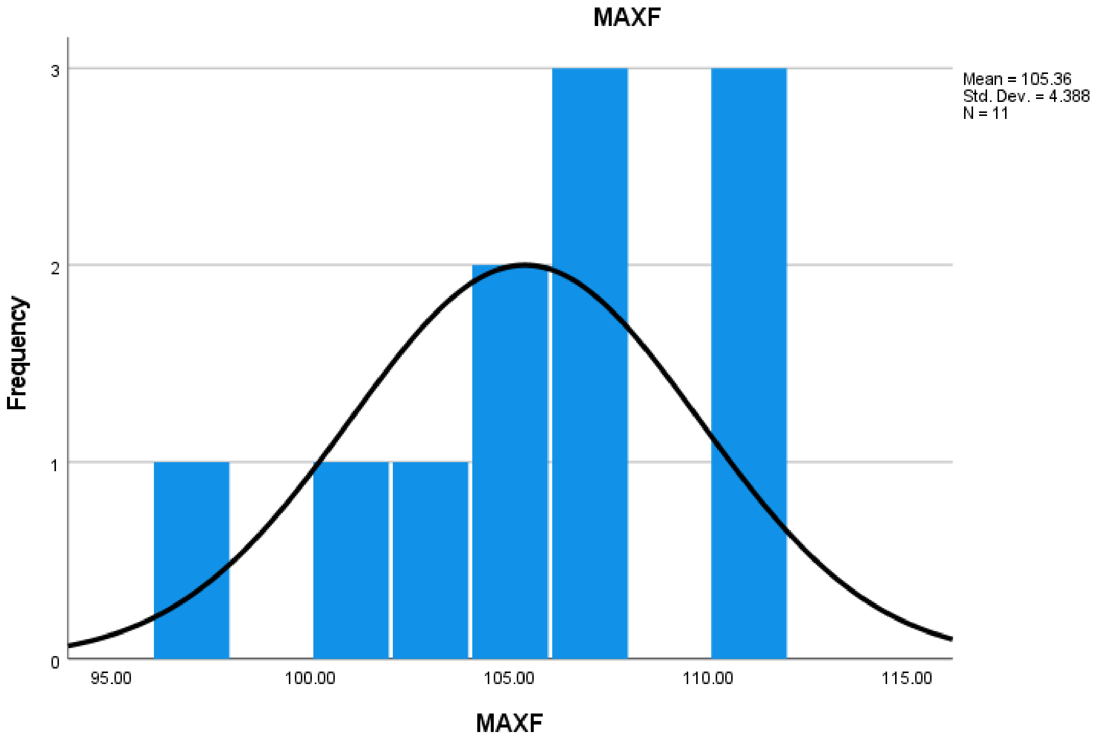
test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of mathematical anxiety (MA POST Gender-based) for the experimental group of female students and the control group of female students.

Tests of Normality							
	Gender	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
MA POST	**Female-C**	.141	9	.200*	.974	9	.925
	Female-X	.127	11	.200*	.951	11	.659
* This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.49: Kolmogorov-Smirnov and Shapiro-Wilk test between Mathematical Anxiety Scores of Female Students of Experimental Group and Female Students of Control Group

The above SPSS output window (table 4.49) shows the normality test results. It shows the p values 0.925 and 0.659 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the students' mathematical anxiety distribution across both groups i.e., mathematical anxiety distribution across experimental group of female students and the control group of female students are bell-shaped (normal) fig: 4.17.

NPC with Histogram Plot of The Raw Scores of Female Students of Experimental Group of Mathematical Anxiety



NPC with Histogram Plot of The Raw Scores of Female Students of Control Group of Mathematical Anxiety

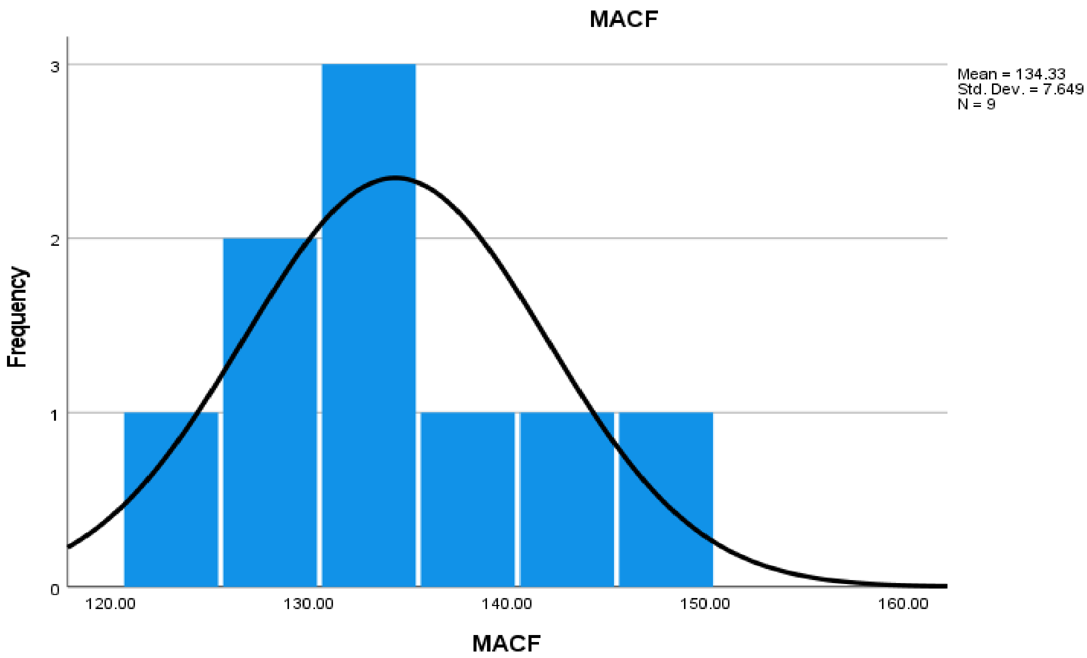


Fig. 4.17: NPC with Histogram Plot between Mathematical Anxiety Scores of Female Students of Experimental Group and Female Students of Control Group

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of mathematical anxiety i.e., one was the experimental group of female students and the other was the control group of female students. It tests the null hypothesis that the variance of the population is equal (define the homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST	**Based on Mean**	1.942	1	18	.180
	Based on Median	1.871	1	18	.188
	Based on Median and with adjusted df	1.871	1	13.937	.193
	Based on trimmed mean	1.917	1	18	.183

Table 4.50: Levene's test between Mathematical Anxiety Scores of Female Students of Experimental Group and Female Students of Control Group

The obtained value of Levene's test 0.183 (Table 4.50) is higher than 0.05. It refers to the variability of mathematical anxiety (dependent variable) is the same across both groups. Statistically, it can be shown MA Post XC-G p (0.183) > 0.05 based on the experimental group of female students and the control group of female students. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected samples. Therefore, a t-test was computed to know the effect of constructivist pedagogy on the mathematical anxiety (dependent variable) between the experimental group of female students and the control group of female students (**CA post X- G)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the selected groups.

Two-Tailed Significance t-test between Female Students of Experimental Group and Female Students of Control Group of Mathematical Anxiety

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Female Students of Mathematical Anxiety	105.36	4.388	11	18	7.09	Significant $t > 2.10$ at 0.05 level $t < 2.88$ at 0.01 level
Control Group of Female Students of Mathematical Anxiety	134.33	7.649	9			

Table 4.51: t-test between Mathematical Anxiety Scores of Female Students of Experimental Group and Female Students of Control Group

(Table 4.51) clarified that the obtained t-value 7.09 at df 18 is greater than the table value of the t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. So, the result of the t-test shows that the female students of the control group taught through the traditional teaching method have significantly high mathematical anxiety (M= 134.33) than female students of the experimental group taught through constructivist pedagogy (M= 105.36). Therefore, the null hypothesis is not accepted.

4.10.2 To compare mathematical anxiety between male experimental and male control group students of class seventh

$H_0^{10.2}$: There is no significant difference in mathematical anxiety between male experimental and male control group students.

To compare the effect of constructivist pedagogy on the mathematical anxiety of class seventh students between the male experimental and male control group, the t-test was used.

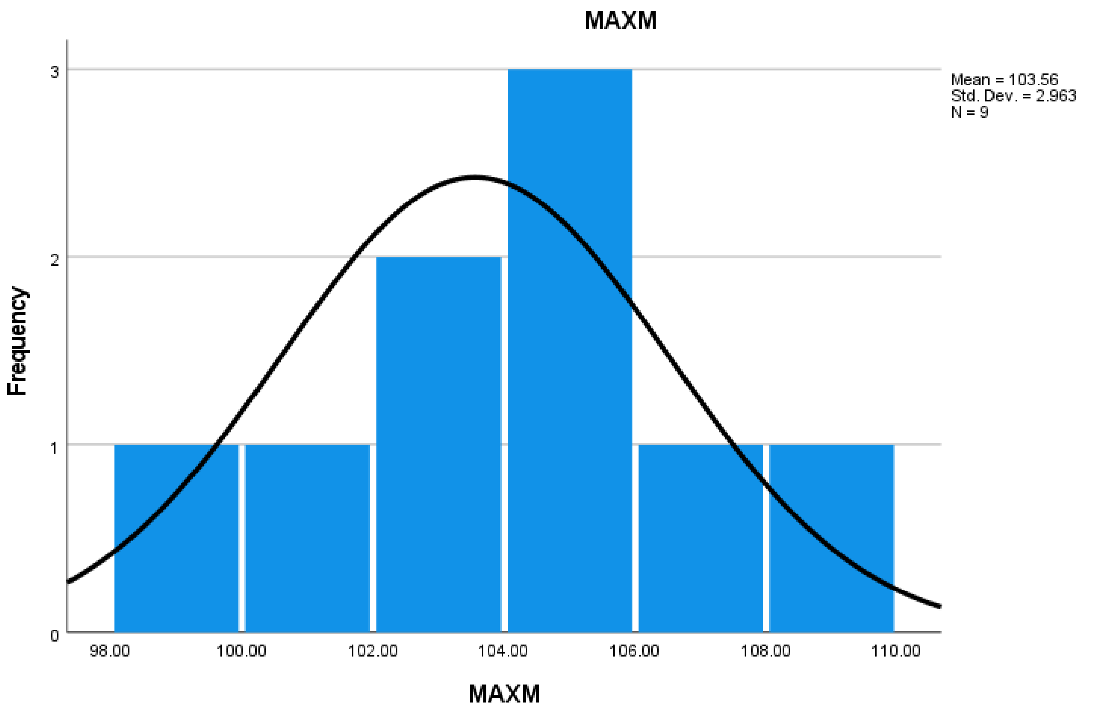
The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of mathematical anxiety (MA POST Gender-based) for the experimental group of male students and the control group of male students.

Tests of Normality							
	Gender	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
MA POST	**Male-C**	.136	11	.200*	.935	11	.463
	Male-X	.145	9	.200*	.979	9	.961
*This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.52: Kolmogorov-Smirnov and Shapiro-Wilk test between Mathematical Anxiety Scores of Male Students of Experimental Group and Male Students of Control Group

The above SPSS output window (table 4.52) displays the normality test results. It shows the p values 0.463 and 0.961 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the students' mathematical anxiety across both groups i.e., mathematical anxiety distribution across the experimental group of male students and the control group of male students are bell-shaped (normal) Fig. 4.18.

NPC with Histogram Plot of The Raw Scores of Male Students of Experimental Group of Mathematical Anxiety



NPC with Histogram Plot of the Raw Scores of Male Students of Control Group

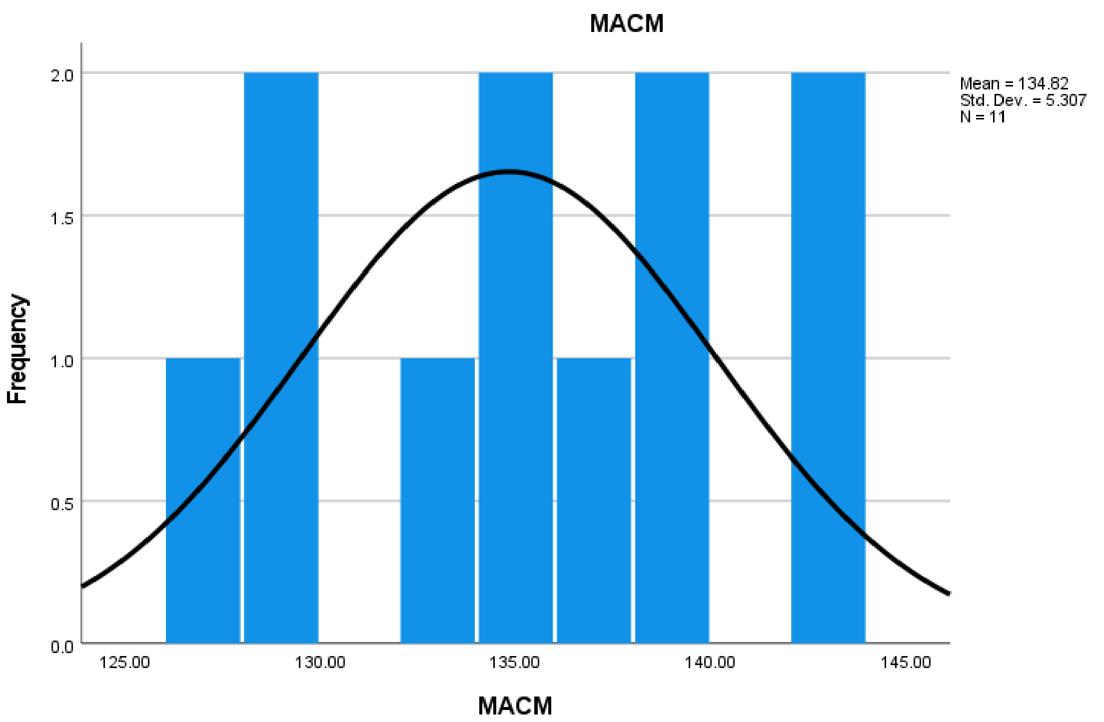


Fig. 4.18: NPC with Histogram Plot between Mathematical Anxiety Scores of Male Students of Experimental Group and Male Students of Control Group

Hereafter, the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of mathematical anxiety i.e., one was the experimental group of male students and the other was the control group of male students. It tests the null hypothesis that the variance of the population is equal (define the homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST	**Based on Mean**	3.935	1	18	.063
	Based on Median	3.237	1	18	.089
	Based on Median and with adjusted df	3.237	1	15.352	.092
	Based on trimmed mean	3.946	1	18	.062

Table 4.53: Levene's test between Mathematical Anxiety Scores of Male Students of Experimental Group and Male Students of Control Group

The obtained value of Levene's test 0.062 (Table 4.53) is higher than 0.05. It refers to the variability of mathematical anxiety (dependent variable) is the same across both groups. Statistically, it can be shown MA Post XC-G p (0.062) > 0.05 based on the experimental group of male students and the control group of male students. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was used to know the effect of constructivist pedagogy on the mathematical anxiety (dependent variable) between the experimental group of male students and the control group of male students (**MA post X- G)**. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the selected groups.

Two-Tailed Significance t-test between Male Students of Experimental Group and Male Students of Control Group of Mathematical Anxiety

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Male Students of Mathematical Anxiety	103.56	2.963	9	18	11.5	Significant t > 2.10 at 0.05 level t > 2.88 at 0.01 level
Control Group of Male Students of Mathematical Anxiety	134.82	5.307	11			

Table 4.54: t-test between Mathematical Anxiety Scores of Male Students of Experimental Group and Male Students of Control Group

Table 4.54 clarified that the obtained t-value 11.5 at df 18 is greater than the table value of the t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. So, the result of the t-test shows that the male students of the control group who were taught through the traditional teaching method had a significantly high mean score of mathematical anxiety of (M= 134.82) than the mean score of mathematical anxiety of the male students of experimental group those students who were taught through the constructivist pedagogy method (M= 103.56). Hence, the mathematical anxiety of the control or traditional group is significantly high than the mathematical anxiety of the treatment or experimental group. Therefore, the mean score of the post-test of the control or traditional group is significantly higher than the treatment or experimental group. Therefore, the null hypothesis is not accepted.

4.10.3 To compare mathematical anxiety between male experimental and female control group students of class seventh

$\mathbf{H_0^{10.3}}$**:** There is no significant difference in mathematical anxiety between male experimental and female control group students.

To compare the effect of constructivist pedagogy on the mathematical anxiety of class seventh students between the male experimental and female control group, the t-test was used.

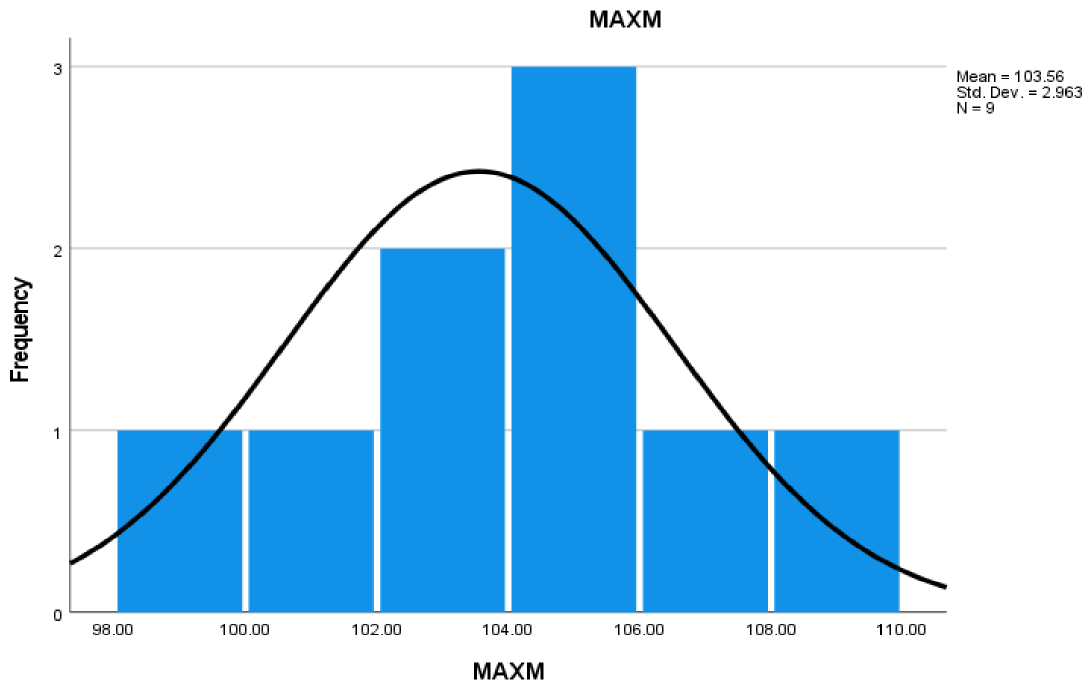
The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of mathematical anxiety (MA POST Gender-based) for the experimental group of male students and the control group of female students.

Tests of Normality							
		Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	Gender	**Statistic**	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
MA POST	**Female-C**	.141	9	.200*	.974	9	.925
	Male-X	.145	9	.200*	.979	9	.961
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.55: Kolmogorov-Smirnov and Shapiro-Wilk test between Mathematical Anxiety Scores of Male Students of Experimental Group and Female Students of Control Group

The above SPSS output window (table 4.55) displays the normality test results. It shows the p values 0.925 and 0.961 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the students' mathematical anxiety distribution across both groups i.e., mathematical anxiety distribution across the experimental group of male students and the control group of female students are bell-shaped (normal) Fig. 4.19.

NPC with Histogram Plot of The Raw Scores of Male Students of Experimental Group of Mathematical Anxiety



NPC with Histogram Plot of The Raw Scores of Female Student of Control Group of Mathematical Anxiety

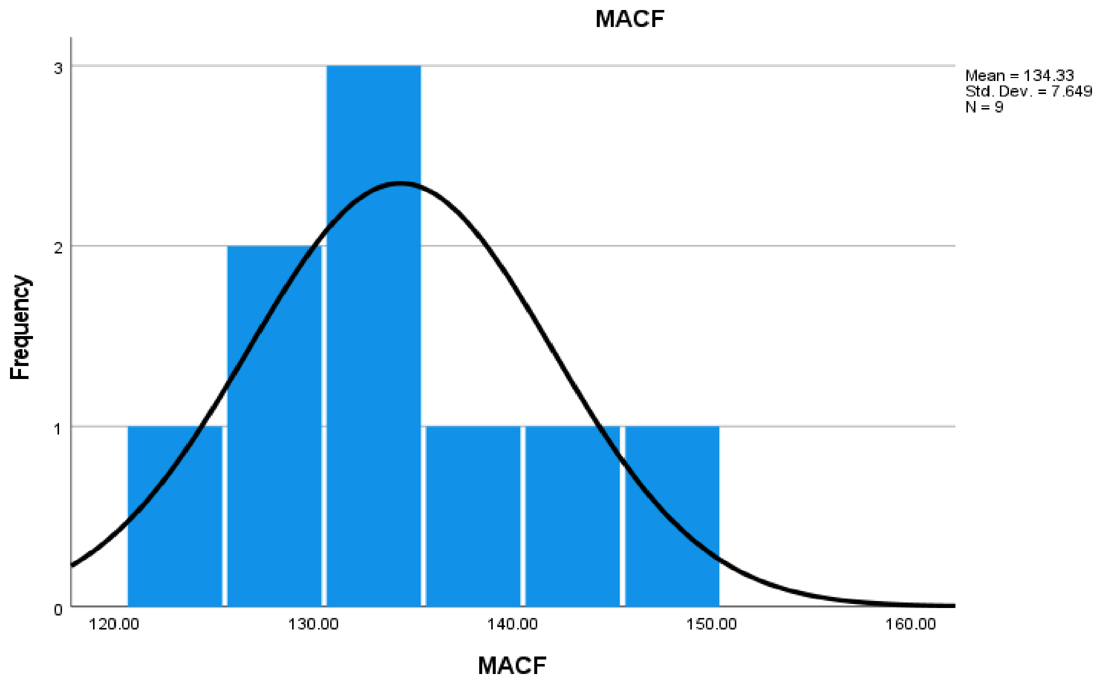


Fig. 4.19: NPC with Histogram Plot between Mathematical Anxiety Scores of Male Students of Experimental Group and Female Students of Control Group

Hereafter, the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of mathematical anxiety i.e., one was the experimental group of male students and the other was the control group of female students. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST	**Based on Mean**	4.262	1	16	.056
	Based on Median	4.116	1	16	.059
	Based on Median and with adjusted df	4.116	1	10.393	.069
	Based on trimmed mean	4.183	1	16	.058

Table 4.56: Levene's test between Mathematical Anxiety Scores of Male Students of Experimental Group and Female Students of Control Group

The obtained value of Levene's test 0.058 (Table 4.56) is higher than 0.05. It refers to the variability of mathematical anxiety (dependent variable) is the same across both groups. Statistically, it can be shown MA Post XC-G p (0.058) > 0.05 based on the experimental group of male students and the control group of female students**.** Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was used to know the effect of constructivist pedagogy on the mathematical anxiety (dependent variable) between the experimental group of male students and the control group of female students (**MA post X- G)**. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the selected groups.

Two-Tailed Significance t-test between Male Experimental Group and Female Control Group of Students of Mathematical Anxiety

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Male Students of Mathematical Anxiety	103.56	2.963	9	16	8.21	Significant t > 2.12 at 0.05 level t > 2.92 at 0.01 level
Control Group of Female Students of Mathematical Anxiety	134.33	7.649	9			

Table 4.57: t-test between Mathematical Anxiety Scores of Male Students of Experimental Group and Female Students of Control Group

Table 4.57 clarified that the obtained t-value 8.21 at df 16 is greater than the table value of the t-test, i.e., 2.12 at 0.05 level and 2.92 at 0.01 level. So, the result of the t-test shows that the mean score of mathematical anxiety of the female students of the control group who were taught through the traditional teaching method have significantly high (M= 134.33) than the mean score of the mathematical anxiety of those students who were taught through constructivist pedagogy of the male experimental group (M= 103.56). According to the mathematical anxiety scale, the mathematical anxiety of the control or traditional group is significantly high than the treatment or experimental group. Therefore, the mean score of the post-test of the control group is significantly higher than the treatment or experimental group. Therefore, the null hypothesis is not accepted.

4.10.4 To compare mathematical anxiety between female experimental and male control group students of class seventh

$\mathbf{H_0^{10.4}}$**:** There is no significant difference in mathematical anxiety between female experimental and male control group students.

To compare the effect of constructivist pedagogy on the mathematical anxiety of class seventh students between the female experimental and male control group, the t-test was used.

The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to

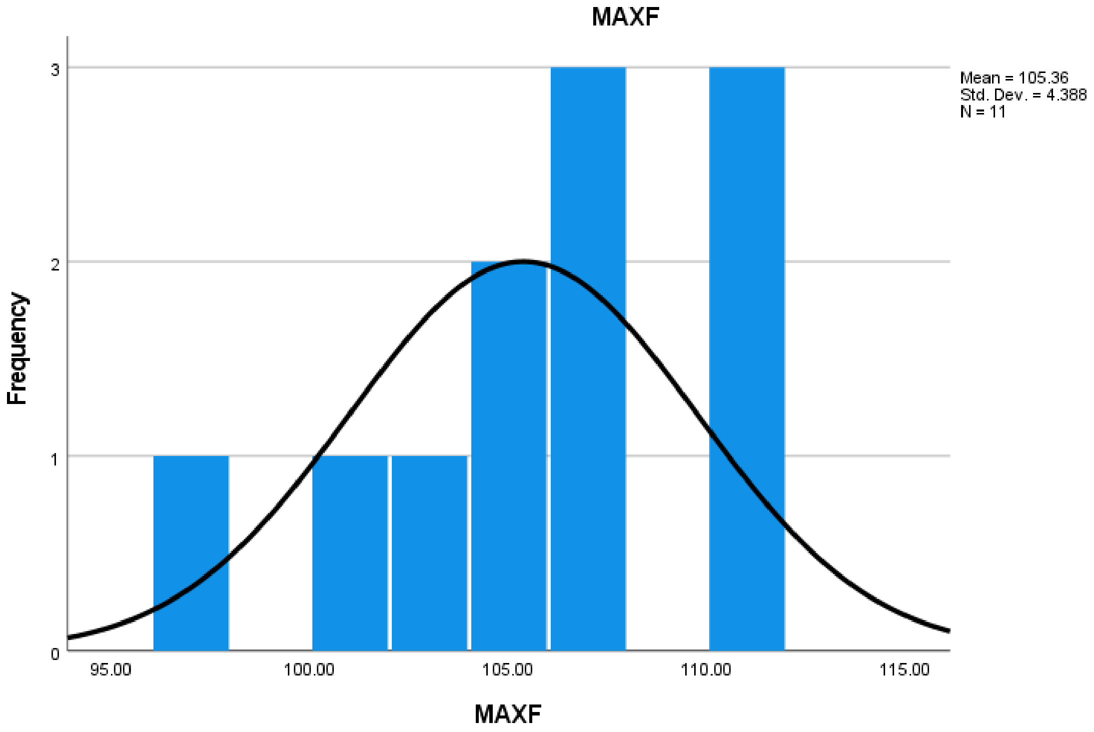
test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of mathematical anxiety (MA POST Gender-based) for the experimental group of female students and the control group of male students.

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Gender	Statistic	df	Sig.	Statistic	df	Sig.
MA POST	Female-X	.127	11	.200*	.951	11	.659
	Male-C	.136	11	.200*	.935	11	.463
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.58: Kolmogorov-Smirnov and Shapiro-Wilk test between Mathematical Anxiety Scores of Female Students of Experimental Group and Male Students of Control Group

The above SPSS output window (table 4.58) shows the normality test results. It shows the p values 0.659 and 0.463 from the Shapiro-Wilk test of normality both are greater than 0.05. This is indicated that the students' mathematical anxiety distribution across both groups i.e., mathematical anxiety distribution across the experimental group of female students and the control group of male students are bell-shaped (normal) Fig. 4.20.

NPC with Histogram Plot of The Raw Scores of Female Students of Experimental Group of Mathematical Anxiety



NPC with Histogram Plot of The Raw Scores of Male Students of Control Group of Mathematical Anxiety

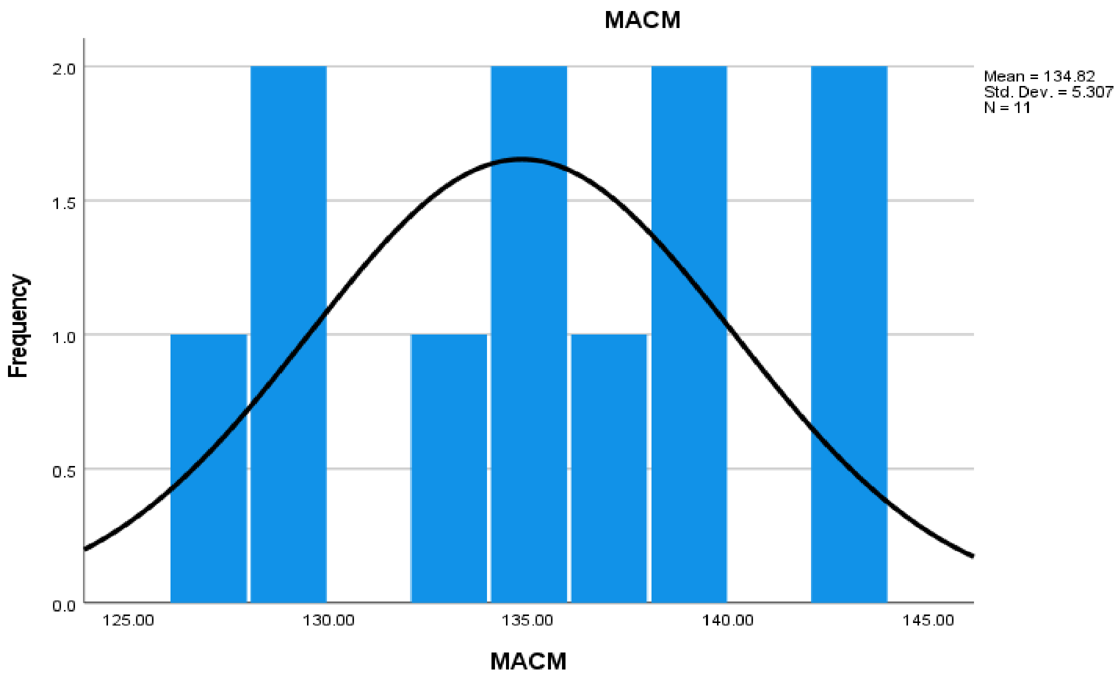


Fig. 4.20: NPC with Histogram Plot between Mathematical Anxiety Scores of Female Students of Experimental Group and Male Students of Control Group

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of mathematical anxiety i.e., one was the experimental group of female students and the control group of male students. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST	**Based on Mean**	.685	1	20	.418
	Based on Median	.566	1	20	.461
	Based on Median and with adjusted df	.566	1	19.812	.461
	Based on trimmed mean	.706	1	20	.411

Table 4.59: Levene's test between Mathematical Anxiety Scores of Female Students of Experimental Group and Male Students of Control Group

The obtained value of Levene's test 0.411 (Table 4.59) is higher than 0.05. It refers to the variability of mathematical anxiety (dependent variable) is the same across both groups. Statistically, it can be shown MA Post XC-G p (0.411) > 0.05 based on the experimental group of female students and the control group of male students. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was used to know the effect of constructivist pedagogy on the mathematical anxiety (dependent variable) between the experimental group of female students and the control group of male students (**MA post X-G)**. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the selected groups.

Two-Tailed Significance t-test between Female Students of Experimental Group and Male Students of Control Group of Mathematical Anxiety

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Female Students of Mathematical Anxiety	105.36	4.388	11	20	9.60	Significant $t > 2.09$ at 0.05 level $t < 2.84$ at 0.01 level
Control Group of Male Students of Mathematical Anxiety	134.82	5.307	11			

Table 4.60: t-test between Mathematical Anxiety Scores of Female Students of Experimental Group and Male Students of Control Group

Table 4.60 clarified that the obtained t-value 9.60 at df 20 is greater than the table value of the t-test, i.e., 2.09 at 0.05 level and 2.84 at 0.01 level. So, the result of the t-test shows that the mean score of mathematical anxiety of the male students of the control group who were taught through the traditional teaching method have significantly high (M= 134.82) than the mean score of the mathematical anxiety of those students who were taught through constructivist pedagogy of the female students of the experimental group (M= 105.36). According to the mathematical anxiety scale, the mathematical anxiety of the control or traditional group is significantly high than the treatment or experimental group. So, the mean score of the post-test of the control group is significantly higher than the treatment or experimental group. Therefore, the null hypothesis is not accepted.

4 (C) Analysis and Interpretation of Data on the Basis of Socio-Economic-Status (S.E.S.)

4.11 OBJECTIVE: To study the effect of constructivist pedagogy on concept attainment in mathematics among seventh class students on the basis of socio-economic status (S.E.S.)

$\boldsymbol{H_0^{11}}$**:** There is no significant difference in mathematical concept attainment of experimental group students on the basis of socio-economic status (S.E.S.).

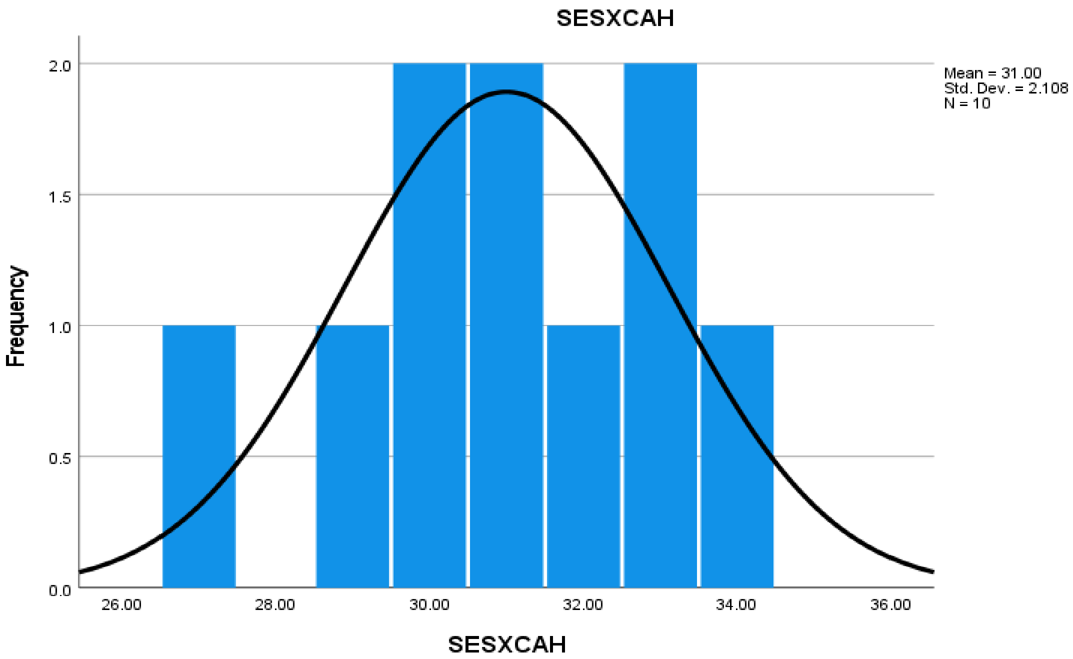
To find out the effect of constructivist pedagogy on the concept attainment in mathematics of class seventh students on the basis of socio-economic status (S.E.S.), the t-test was used. The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the first null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of concept attainment (CA POST -S.E.S. based) for the experimental group of high S.E.S. and experimental group of low S.E.S.

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	S.E.S.	Statistic	df	Sig.	Statistic	df	Sig.
CA POST	X-High	.129	10	.200*	.967	10	.865
	X- Low	.198	10	.200*	.935	10	.500
* This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.61: Kolmogorov-Smirnov and Shapiro-Wilk test between Experimental group and Control group of Concept Attainment on the basis of S.E.S.

The above SPSS output window (table 4.61) shows the normality test results. It shows the p values 0.865 and 0.500 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's concept attainment distributions across both groups i.e., the experimental group of high S.E.S. and experimental group of low S.E.S. are bell-shaped (normal) Fig. 4.21.

NPC with Histogram Plot of The Raw Scores of Experimental Group of Concept Attainment based on High Socio-Economic Status



NPC with Histogram Plot of The Raw Scores of Experimental Group of Concept Attainment based on Low Socio-Economic Status

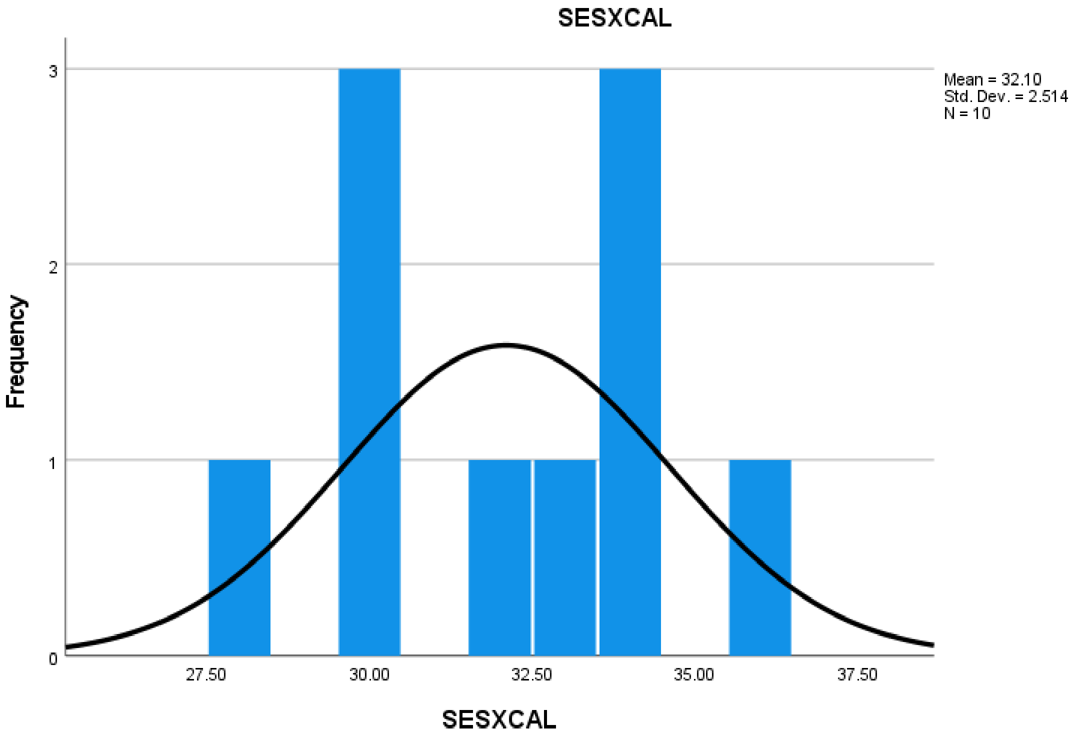


Fig. 4.21: NPC with Histogram Plot between Experimental group and Control group of Concept Attainment on the basis of S.E.S.

Hereafter, the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of concept attainment i.e., one was the experimental group of high S.E.S. and the other was the experimental group of low S.E.S. It tests the null hypothesis that the variance of the population is equal (define the homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA POST	**Based on Mean**	.827	1	18	.375
	Based on Median	.781	1	18	.388
	Based on Median and with adjusted df	.781	1	18.000	.388
	Based on trimmed mean	.800	1	18	.383

Table 4.62: Levene's test between the Experimental group and the Control group of Concept Attainment on the basis of S.E.S.

The obtained value of Levene's test 0.383 (Table 4.62) is higher than 0.05. It refers to the variability of concept attainment (dependent variable) is the same across the experimental group of high S.E.S. and the experimental group of low S.E.S. Statistically, it can be shown CA Post X-S.E.S. p (0.383) > 0.05 based on the S.E.S. (Socio-Economic Status) in the experimental group. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was computed to know the effect of constructivist pedagogy on the concept attainment (dependent variable) between the experimental group of high S.E.S. and the experimental group of low S.E.S. (**CA post X- S.E.S.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical concept attainment between the selected groups.

Two-Tailed Significance t-test between High Experimental Group of Concept Attainment and Low Experimental Group of Concept Attainment based on Socio-Economic Status (S.E.S.)

<table>
<tr><th>Group</th><th>Mean</th><th>SD</th><th>N</th><th>df</th><th>t-value</th><th>Significance</th></tr>
<tr><td>High Experimental Group of Concept Attainment based on Socio-economic Status (S.E.S.)</td><td>31</td><td>2.108</td><td>10</td><td rowspan="2">18</td><td rowspan="2">0.717</td><td rowspan="2">Not Significant
t < 2.10 at 0.05 level
t < 2.88 at 0.01 level</td></tr>
<tr><td>Low Experimental Group of Concept Attainment based on Socio-economic Status (S.E.S.)</td><td>32.1</td><td>2.5144</td><td>10</td></tr>
</table>

Table 4.63: t-test between Experimental group and Control group of Concept Attainment on the basis of S.E.S.

Table 4.63 clarified that the obtained t-value 0.717 at df 18 is not greater than the table value of the t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. So, the result of the t-test shows that the students of the experimental group of high S.E.S. taught through constructivist pedagogy have not significantly higher mathematical concept attainment (M= 31) than students of the experimental group of low S.E.S. taught through the constructivist pedagogy method (M= 32.1). Therefore, the null hypothesis is accepted.

4.12 OBJECTIVE: To study the effect of a constructivist pedagogy on anxiety in mathematics among seventh class students on the basis of socio-economic status

H_0^{12}: There is a significant difference in mathematical anxiety of experimental group students on the basis of Socio-Economic Status (S.E.S.).

To find out the effect of constructivist pedagogy on the mathematical anxiety of class seventh students on the basis of socio-economic status (S.E.S.), the t-test was used.

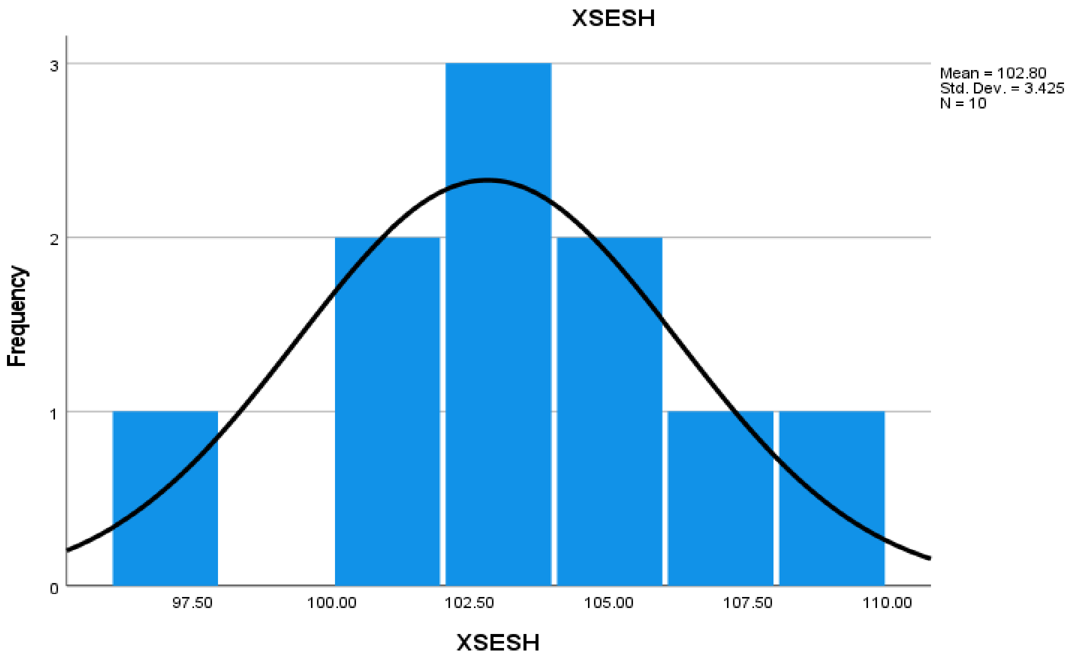
The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of mathematical anxiety (MA POST -S.E.S. based) for the experimental group of high S.E.S. and experimental group of low S.E.S.

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	S.E.S.	Statistic	df	Sig.	Statistic	df	Sig.
MA POST	X-H	.192	10	.200*	.961	10	.802
	X-L	.209	10	.200*	.798	10	.054
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.64: Kolmogorov-Smirnov and Shapiro-Wilk test between Experimental group and Control group of Mathematical Anxiety on the basis of S.E.S.

The above SPSS output window (table 4.64) shows the normality test results. It shows the p values 0.802 and 0.054 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's mathematical anxiety distributions across both groups i.e., the experimental group of high S.E.S. and the experimental group of low S.E.S. are bell-shaped (normal) Fig. 4.22.

NPC with Histogram Plot of The Raw Scores of Experimental Group of Mathematical Anxiety based on High Socio-Economic Status of Class Seventh Students



NPC with Histogram Plot of The Raw Scores of Experimental Group of Mathematical Anxiety based on Low Socio-Economic Status of Class Seventh Students

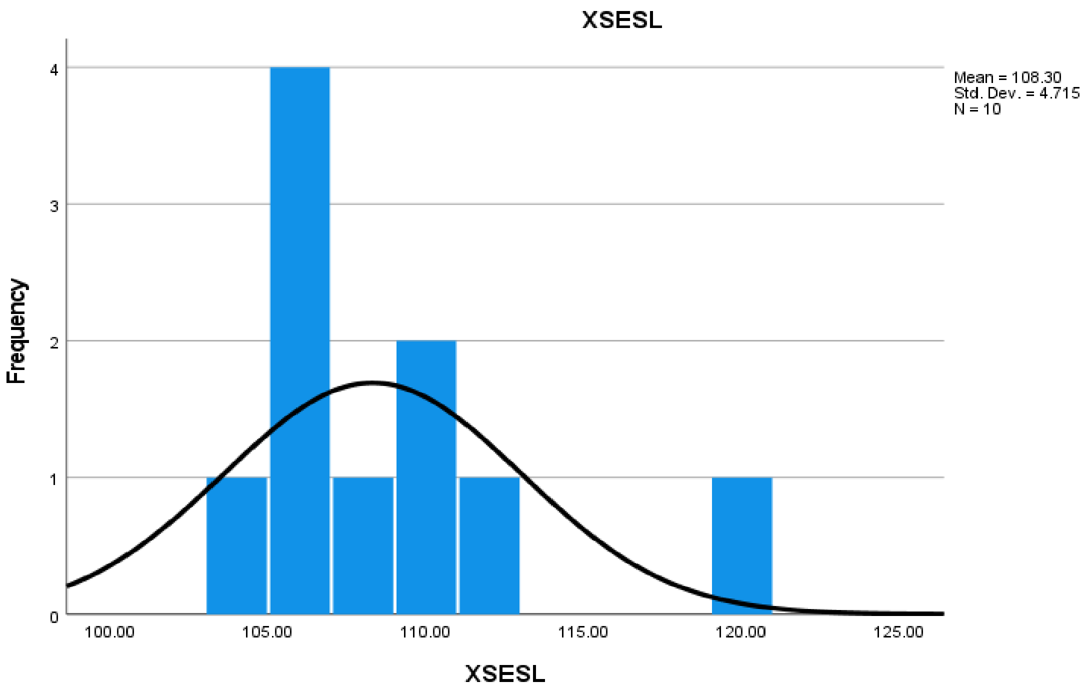


Fig. 4.22: NPC with Histogram Plot between Experimental group and Control group of Mathematical Anxiety on the basis of S.E.S.

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of mathematical anxiety i.e., one was the experimental group of high S.E.S. and the other was the experimental group of low S.E.S. It tests the null hypothesis that the variance of the population is equal (define the homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST	**Based on Mean**	.453	1	18	.510
	Based on Median	.231	1	18	.636
	Based on Median and with adjusted df	.231	1	15.194	.638
	Based on trimmed mean	.349	1	18	.562

Table 4.65: Levene's test between the Experimental group and the Control group of Mathematical Anxiety on the basis of S.E.S.

The obtained value of Levene's test 0.562 (Table 4.65) is higher than 0.05. It refers to the variability of mathematical anxiety (dependent variable) is the same across the experimental group of high S.E.S. and the experimental group of low S.E.S. Statistically, it can be shown MA Post X-S.E.S. p (0.562) > 0.05 based on the S.E.S. (Socio-Economic Status) in the experimental group**.** Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was computed to know the effect of constructivist pedagogy on the mathematical anxiety (dependent variable) between the experimental group of high S.E.S. and the experimental group of low S.E.S. (**CA post X- S.E.S.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the selected groups.

Two-Tailed Significance t-test between the High Experimental Group of Mathematical Anxiety and the Low Experimental Group of Mathematical Anxiety based on Socio-Economic Status (S.E.S.)

Group	Mean	SD	N	df	t-value	Significance
High Experimental Group of Mathematical Anxiety based on (S.E.S.)	102.80	3.425	10	18	2.027	Not Significant $t < 2.10$ at 0.05 level $t < 2.88$ at 0.01 level
Low Experimental Group of Mathematical Anxiety based on (S.E.S.)	108.30	4.715	10			

Table 4.66: t-test between Experimental group and Control group of Mathematical Anxiety on the basis of S.E.S.

Table 4.66 clarified that the obtained t-value 2.027 at df 18 is not greater than the table value of the t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. So, the result of the t-test shows that the experimental group students belonged to Low S.E.S. who were taught through the constructivist pedagogy method have not significantly high mean score of mathematical anxiety (M= 108.30) than the mean score of the mathematical anxiety of those students of the experimental group who were belonged to High S.E.S. and taught through constructivist pedagogy method students (M= 102.80). Hence, the mathematical anxiety of the control or traditional group is not significantly high than the treatment or experimental group. Therefore, the mean score of the post-test of the control group is not significantly higher than the treatment or experimental group. Therefore, the null hypothesis is accepted.

4.13 OBJECTIVE: To compare concept attainment in mathematics between experimental and control group students on the basis of socio-economic status

$\boldsymbol{H_0^{13}}$**:** There is a significant difference in mathematical concept attainment between experimental and control group students on the basis of Socio-Economic Status (S.E.S.).

4.13.1 To compare concept attainment in mathematics between high S.E.S. of the experimental group and high S.E.S. of control group students

$H_0^{13.1}$**:** There is a significant difference in mathematical concept attainment between high S.E.S. of the experimental group and high S.E.S. of control group students.

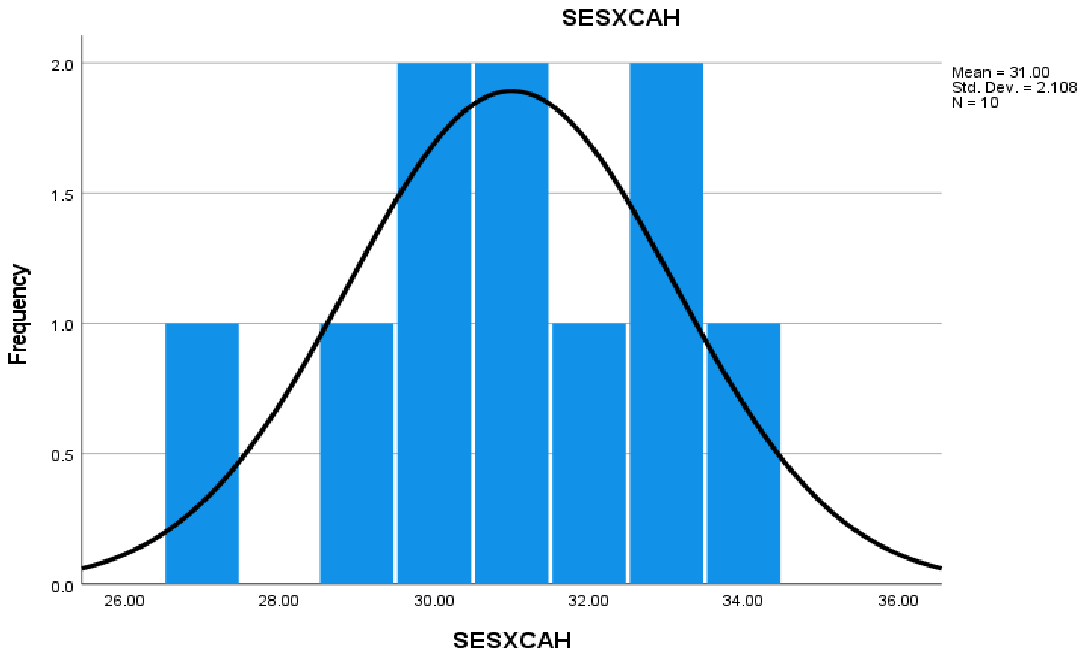
To find out the effect of constructivist pedagogy on the concept attainment in mathematics of class seventh students between high S.E.S. of the experimental group and high S.E.S. of control group students, the t-test was used. The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the first null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of concept attainment (CA POST -S.E.S. based) for high S.E.S. of the experimental group and high S.E.S. of the control group.

Tests of Normality							
		Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	S.E.S.	**Statistic**	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
CA POST	**C-High**	.123	10	.200*	.982	10	.974
	X-High	.129	10	.200*	.967	10	.865
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.67: Kolmogorov-Smirnov and Shapiro-Wilk test between High Experimental group and High Control group of concept attainment on the basis of S.E.S.

The above SPSS output window (table 4.67) shows the normality test results. It shows the p values 0.974 and 0.865 from the Shapiro-Wilk test of normality, both are greater than 0.05.

NPC with Histogram Plot of The Raw Scores of Experimental Group of Concept Attainment based on High Socio-Economic Status of Class Seventh Students



NPC with Histogram Plot of The Raw Scores of Control Group of Concept Attainment based on High Socio-Economic Status of Class Seventh Students

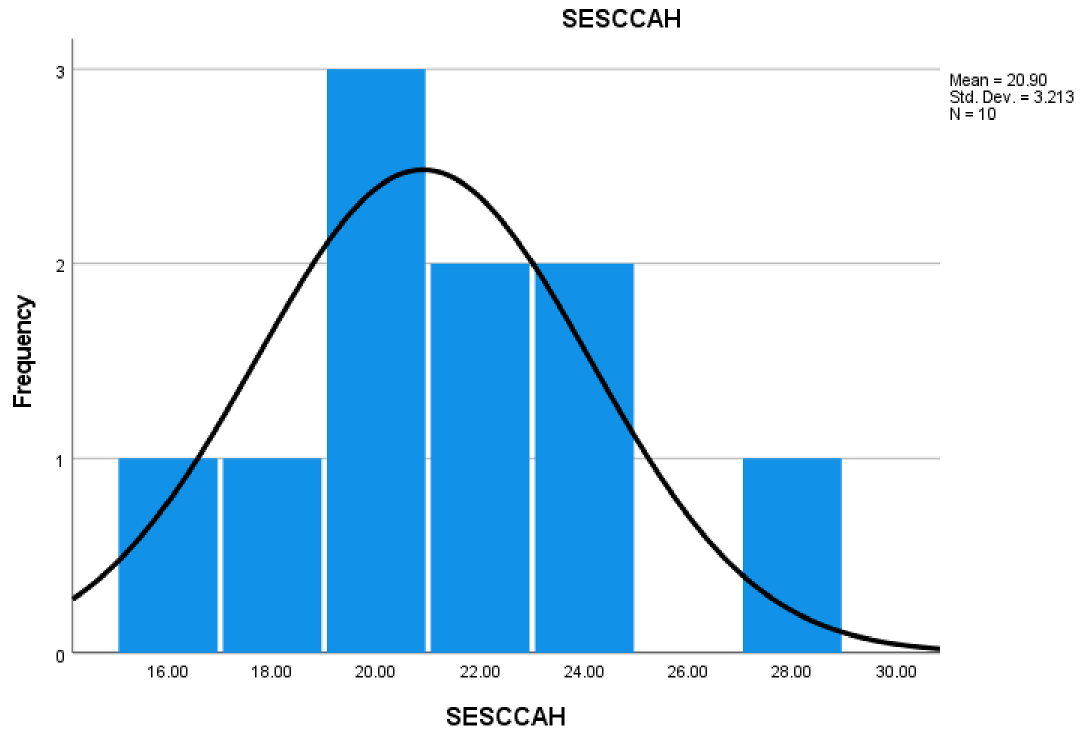


Fig. 4.23: NPC with Histogram Plot between High Experimental group and High Control group of concept attainment on the basis of S.E.S.

This is indicated that the student's concept attainment distribution across both groups i.e., the concept attainment distribution across high S.E.S. of the experimental group and high S.E.S. of the control group are bell-shaped (normal) Fig. 4.23.

After that, the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of concept attainment i.e., one was the experimental group of high S.E.S. and the other was the control group of high S.E.S. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA POST	**Based on Mean**	1.627	1	18	.218
	Based on Median	1.571	1	18	.226
	Based on Median and with adjusted df	1.571	1	15.736	.228
	Based on trimmed mean	1.597	1	18	.222

Table 4.68: Levene's test between the High Experimental group and the High Control group of concept attainment on the basis of S.E.S.

The obtained value of Levene's test 0.222 (Table 4.68) is higher than 0.05. It refers to the variability of concept attainment (dependent variable) is the same across the experimental group of high S.E.S. and the control group of high S.E.S. Statistically, it can be shown CA Post X-S.E.S. p (0.222) > 0.05 based on the experimental group of high S.E.S. (Socio-Economic Status) and the control group of high S.E.S. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was used to know the effect of constructivist pedagogy on the concept attainment (dependent variable) between the experimental group of high S.E.S. and the control group of high S.E.S. (**CA post XC-**

S.E.S.) of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical concept attainment between the selected groups.

Two-Tailed Significance t-test between High Experimental Group of Concept Attainment and High Control Group of Concept Attainment based on Socio-Economic Status (S.E.S.)

Group	Mean	SD	N	Df	t-value	Significance
Experimental Group of High Concept Attainment based on (S.E.S.)	31	2.1081	10	18	5.6999	Significant t > 2.10 at 0.05 level t > 2.88 at 0.01 level
Control Group of High Concept Attainment based on (S.E.S.)	20.9	3.212	10			

Table 4.69: t-test between High Experimental group and High Control group of concept attainment on the basis of S.E.S.

(Table 4.69) clarified that the obtained t-value 5.6999 at df 18 is greater than the table value of the t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. So, the result of the t-test shows that the students of the experimental group of high S.E.S. taught through constructivist pedagogy have significantly higher mathematical concept attainment (M= 31) than the students of the control group of high S.E.S. taught through the traditional teaching method (M= 20.9). Therefore, the null hypothesis is not accepted.

4.13.2 Objective: To compare concept attainment in mathematics between low S.E.S. of the experimental group and low S.E.S. of control group students

$\boldsymbol{H_0^{13.2}}$**:** There is a significant difference in mathematical concept attainment between low S.E.S. of the experimental group and low S.E.S. of control group students.

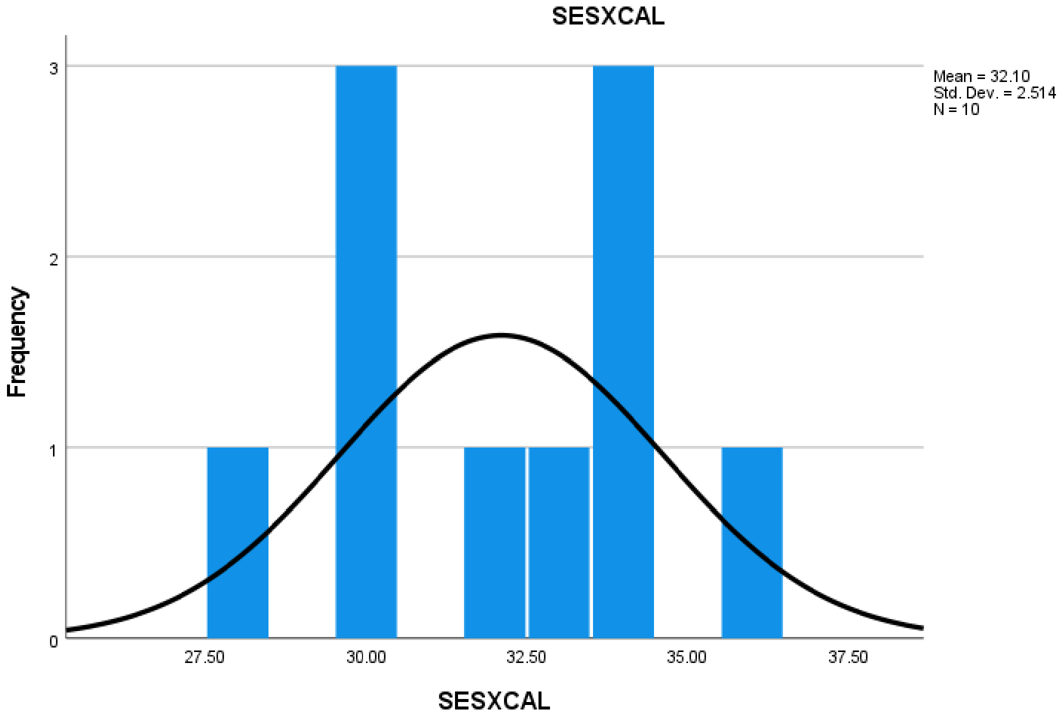
To find out the effect of constructivist pedagogy on the concept attainment in mathematics of class the seventh students between the low S.E.S. of the experimental group and low S.E.S. of control group students, the t-test was performed in this direction the null hypothesis was tested. The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of concept attainment (CA POST -S.E.S. based) for low S.E.S. of the experimental group and low S.E.S. of the control group.

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	**Statistic**	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
CA POST	**Low-C**	.261	10	.051	.910	10	.280
	Low-X	.198	10	.200*	.935	10	.500
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.70: Kolmogorov-Smirnov and Shapiro-Wilk test between Low Experimental group and Low Control group of concept attainment on the basis of S.E.S.

The above SPSS output window (table 4.70) shows the normality test results. It shows the p values 0.280 and 0.500 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student’s concept attainment distribution across both groups i.e., the concept attainment distribution across low S.E.S. of the experimental group and low S.E.S. of the control group are bell-shaped (normal) Fig. 4.24.

NPC with Histogram Plot of The Raw Scores of Experimental Group of Concept Attainment based on Low Socio-Economic Status of Class Seventh Students



NPC with Histogram Plot of The Raw Scores of Control Group of Concept Attainment based on Low Socio-Economic Status of Class Seventh Students

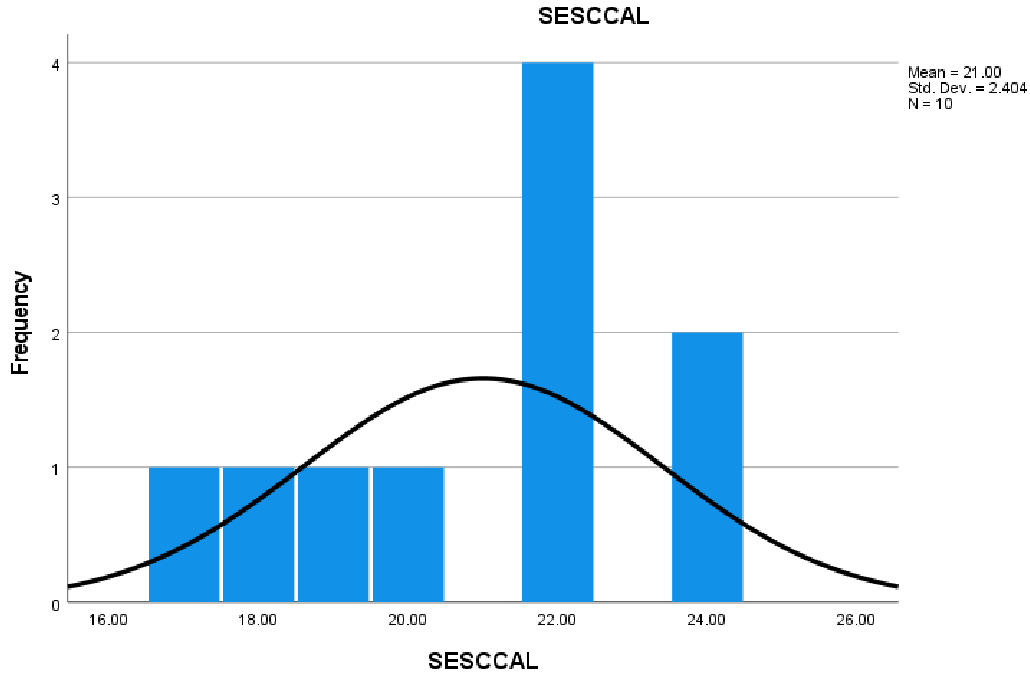


Fig. 4.24: NPC with Histogram Plot between Low Experimental group and Low Control group of concept attainment on the basis of S.E.S.

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of concept attainment i.e., one was the experimental group of low S.E.S. and the other was the control group of low S.E.S. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA POST	**Based on Mean**	.036	1	18	.851
	Based on Median	.184	1	18	.673
	Based on Median and with adjusted df	.184	1	16.081	.674
	Based on trimmed mean	.044	1	18	.836

Table 4.71: Levene's test between Low Experimental group and Low Control group of concept attainment on the basis of S.E.S.

The obtained value of Levene's test 0.836 (Table 4.71) is higher than 0.05. It refers to the variability of concept attainment (dependent variable) is the same across the experimental group of low S.E.S. and the control group of low S.E.S. Statistically, it can be shown CA Post X-S.E.S. p (0.836) > 0.05 based on the experimental group of low S.E.S. (Socio-Economic Status) and the control group of low S.E.S. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was computed to know the effect of constructivist pedagogy on the concept attainment (dependent variable) between the experimental group of low S.E.S. and the control group of low S.E.S. (**CA post-XC S.E.S.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical concept attainment between the selected groups.

Two-Tailed Significance t-test between Low Experimental Group of Concept Attainment and Low Control Group of Concept Attainment based on Socio-Economic Status (S.E.S.)

Group	Mean	SD	N	df	t-value	Significance
Low Experimental Group of Concept Attainment based on Socio-Economic Status (S.E.S.)	32.1	2.5144	10	18	6.80	Significant t > 2.10 at 0.05 level t > 2.88 at 0.01 level
Low Control Group of Concept Attainment based on Socio-Economic Status (S.E.S.)	21	2.4037	10			

Table 4.72: t-test between Low Experimental group and Low Control group of concept attainment on the basis of S.E.S.

Table 4.72 clarified that the obtained t-value 6.80 at df 18 is greater than the table value of the t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. So, the result of the t-test shows that the students of the experimental group of low S.E.S. taught through constructivist pedagogy have significantly higher mathematical concept attainment (M= 32.1) than the students of the control group of low S.E.S. taught through the traditional teaching method (M= 21). Therefore, the null hypothesis is not accepted.

4.13.3 To compare concept attainment in mathematics between low S.E.S. of the experimental group and high S.E.S. of control group students

$\boldsymbol{H_0^{13.3}}$**:** There is a significant difference in mathematical concept attainment between low S.E.S. of the experimental group and high S.E.S. of control group students.

To find out the effect of constructivist pedagogy on the concept attainment in mathematics of class seventh students between low S.E.S. of the experimental group and high S.E.S. of control group students, the t-test was used.

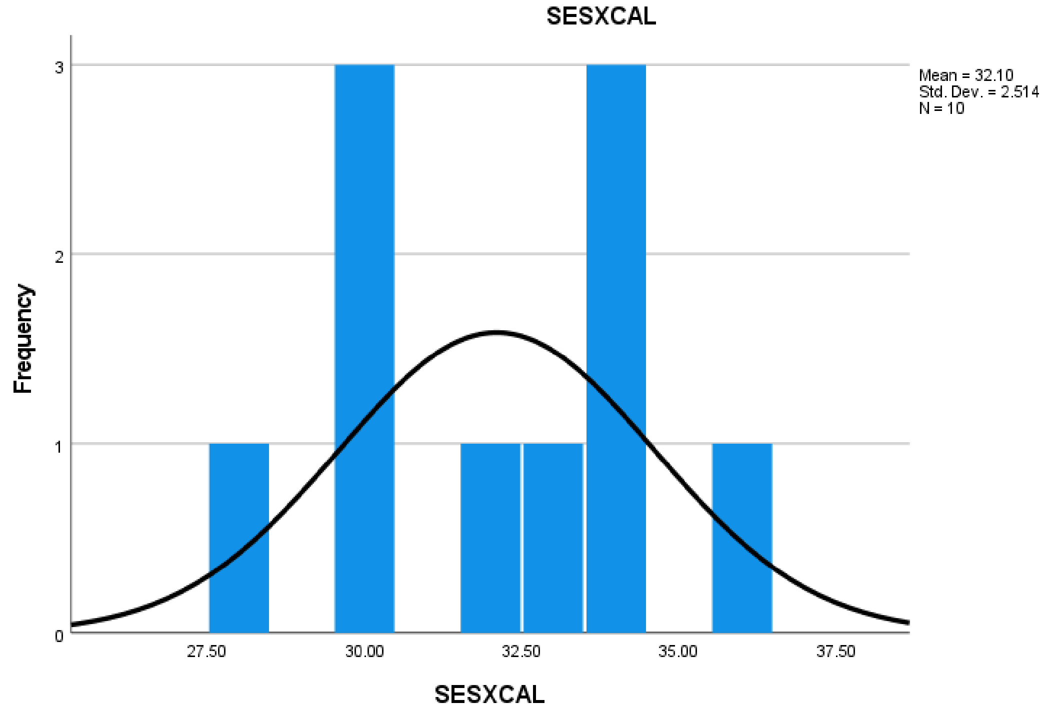
The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the first null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of concept attainment (CA POST -S.E.S. based) for low S.E.S. of the experimental group and high S.E.S. of the control group.

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
CA POST	High-C	.123	10	.200*	.982	10	.974
	Low-X	.198	10	.200*	.935	10	.500
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.73: Kolmogorov-Smirnov and Shapiro-Wilk test between Low Experimental group and High Control group of concept attainment on the basis of S.E.S.

The above SPSS output window (table 4.73) shows the normality test results. It shows the p values 0.974 and 0.500 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's concept attainment distribution across both groups i.e., the concept attainment distribution across low S.E.S. of the experimental group and high S.E.S. of the control group are bell shaped (normal) Fig. 4.25.

NPC with Histogram Plot of The Raw Scores of Experimental Group of Concept Attainment based on Low Socio-Economic Status of Class Seventh Students



NPC with Histogram Plot of The Raw Scores of Experimental Group of Concept Attainment based on High Socio-Economic Status of Class Seventh Students

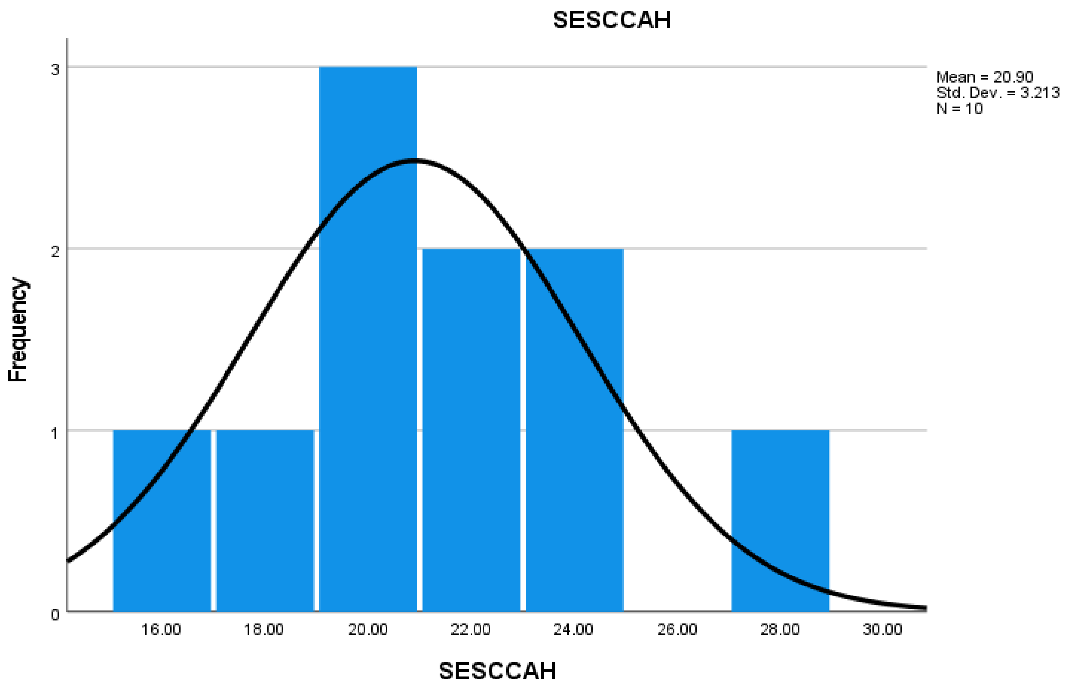


Fig. 4.25: NPC with Histogram Plot between Low Experimental group and High Control group of concept attainment on the basis of S.E.S.

After that, the researcher has used the Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of concept attainment i.e., one was the experimental group of low S.E.S. and the other was the control group of high S.E.S. It tests the null hypothesis that the variance of population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA POST	**Based on Mean**	.333	1	18	.571
	Based on Median	.310	1	18	.584
	Based on Median and with adjusted df	.310	1	15.736	.585
	Based on trimmed mean	.333	1	18	.571

Table 4.74: Levene's test between Low Experimental group and High Control group of concept attainment on the basis of S.E.S.

The obtained value of Levene's test 0.571 (Table 4.74) is higher than 0.05. It refers to the variability of concept attainment (dependent variable) is the same across the experimental group of low S.E.S. and the control group of high S.E.S. Statistically it can be shown CA Post X-S.E.S. p (0.571) > 0.05 based on the experimental group of low S.E.S. (Socio-Economic Status) and control group of high S.E.S. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution and homogeneity of variance were verified of the two selected dependent samples. Therefore, t-test was computed to know the effect of constructivist pedagogy on the concept attainment (dependent variable) between the experimental group of low S.E.S. and the control group of high S.E.S. (**CA post XC-S.E.S.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical concept attainment between the selected groups.

Two Tailed Significance t-test between Experimental Group of Concept Attainment based on Low Socio-economic Status (S.E.S.) and Control Group of Concept Attainment based on High Socio-economic Status (S.E.S.)

GROUP	MEAN	SD	N	df	t-value	Significance
Experimental Group of Concept Attainment based on Low Socio-economic Status (S.E.S.)	32.1	2.5144	10	18	5.869	Significant t > 2.10 at 0.05 level t > 2.88 at 0.01 level
Control Group of Concept Attainment based on High Socio-economic Status (S.E.S.)	20.9	3.2128	10			

Table 4.75: t-test between Low Experimental group and High Control group of concept attainment on the basis of S.E.S.

Table 4.75 clarified that the obtained t-value 5.869 at df 18 is greater than the table value of the t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. So, the result of the t-test shows that the students of the experimental group of low S.E.S. taught through constructivist pedagogy have significantly higher mathematical concept attainment (M= 32.1) than the students of the control group of high S.E.S. taught through the traditional teaching method (M= 20.9). Therefore, the null hypothesis is not accepted.

4.13.4 To compare concept attainment in mathematics between high S.E.S. of the experimental group and low S.E.S. of control group students

$\boldsymbol{H_0^{13.4}}$: There is a significant difference in mathematical concept attainment between high S.E.S. of the experimental group and low S.E.S. of control group students.

To find out the effect of constructivist pedagogy on the concept attainment in mathematics of class seventh students between high S.E.S. of the experimental group and low S.E.S. of control group students, the t-test was used.

The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to

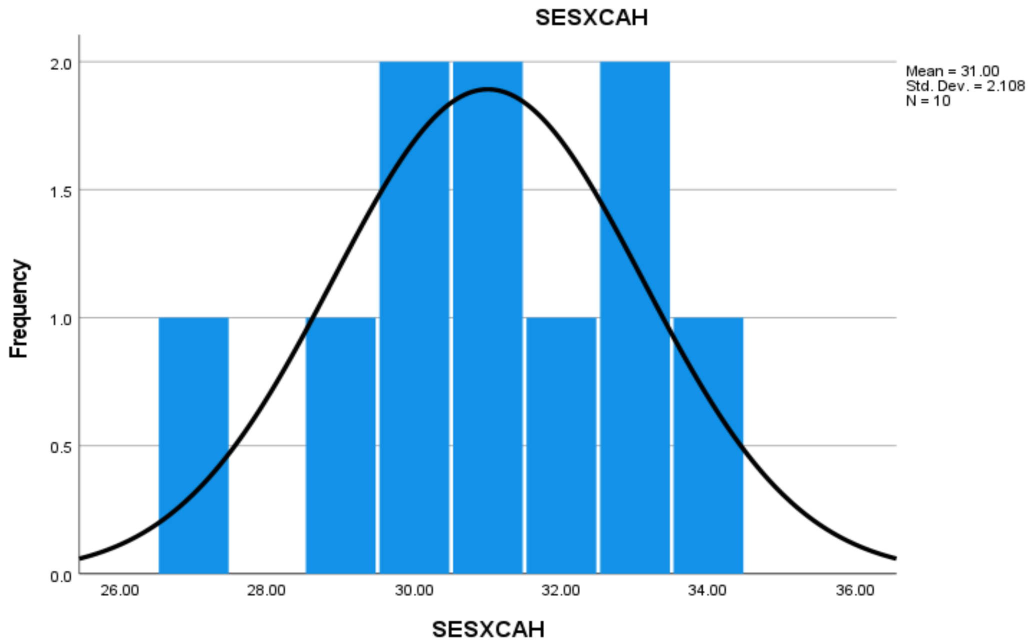
test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of concept attainment (CA POST -S.E.S. based) for high S.E.S. of the experimental group and low S.E.S. of the control group.

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
CA POST	High-X	.129	10	.200*	.967	10	.865
	Low-C	.261	10	.051	.910	10	.280
*This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.76: Kolmogorov-Smirnov and Shapiro-Wilk test between High Experimental group and Low Control group of concept attainment on the basis of S.E.S.

The above SPSS output window (table 4.76) shows the normality test results. It shows the p values 0.865 and 0.280 from the Shapiro-Wilk test of normality, both are greater than 0.05. This is indicated that the student's concept attainment distribution across both groups i.e., the concept attainment distribution across high S.E.S. of the experimental group and low S.E.S. of the control group are bell-shaped (normal) Fig. 4.26.

NPC with Histogram Plot of The Raw Scores of Experimental Group of Concept Attainment based on High Socio-Economic Status of Class Seventh Students



NPC with Histogram Plot of The Raw Scores of Control Group of Concept Attainment based on Low Socio-Economic Status of Class Seventh Students

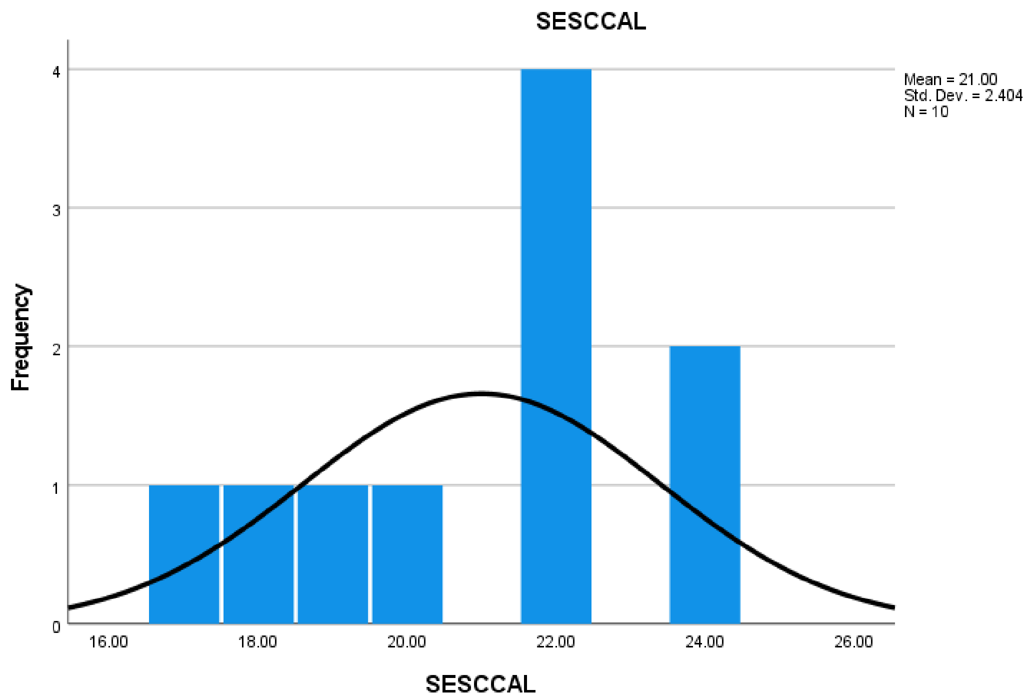


Fig. 4.26: NPC with Histogram Plot between High Experimental group and Low Control group of concept attainment on the basis of S.E.S.

Hereafter, the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of concept attainment i.e., one was the experimental group of high S.E.S. and the other was the control group of low S.E.S. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
CA POST	**Based on Mean**	.545	1	18	.470
	Based on Median	.082	1	18	.778
	Based on Median and with adjusted df	.082	1	16.081	.779
	Based on trimmed mean	.484	1	18	.496

Table 4.77: Levene's test between the High Experimental group and Low Control group of Concept Attainment on the basis of S.E.S.

The obtained value of Levene's test 0.496 (Table 4.77) is higher than 0.05. It refers to the variability of concept attainment (dependent variable) is the same across the experimental group of high S.E.S. and the control group of low S.E.S. Statistically, it can be shown CA Post X-S.E.S. p (0.496) > 0.05 based on the experimental group of high S.E.S. (Socio-Economic Status) and the control group of low S.E.S**.** Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of the subject, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was used to know the effect of constructivist on the concept attainment (dependent variable) between the experimental group of high S.E.S. and the control group of low S.E.S. (**CA post-XC S.E.S.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical concept attainment between the selected groups.

Two-Tailed Significance t-test between Experimental Group of Concept Attainment based on High Socio-economic Status (S.E.S.) and Control Group of Concept Attainment based on Low Socio-economic Status (S.E.S.)

GROUP	MEAN	SD	N	df	t-value	Significance
Experimental Group of Concept Attainment based on High Socio-economic Status (S.E.S.)	31	2.108	10	18	6.5359	Significant t > 2.10 at 0.05 level t > 2.88 at 0.01 level
Control Group of Concept Attainment based on Low Socio-economic Status (S.E.S.)	21	2.4037	10			

Table 4.78: t-test between High Experimental group and Low Control group of Concept Attainment on the basis of S.E.S.

Table 4.78 clarified that the obtained t-value 6.5359 at df 18 is greater than the table value of the t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. So, the result of the t-test shows that the students of the experimental group of low S.E.S. taught through constructivist pedagogy have significantly higher mathematical concept attainment (M= 31) than the students of the control group of high S.E.S. taught through the traditional teaching method (M= 21). Therefore, the null hypothesis is not accepted.

4.14 OBJECTIVE: To compare anxiety in mathematics between experimental and control group students on the basis of socio-economic status

$\boldsymbol{H_0^{14}}$**:** There is no significant difference in mathematical anxiety between experimental and control group students on the basis of Socio-Economic Status (S.E.S.).

4.14.1 To compare mathematical anxiety in mathematics between high S.E.S. of the experimental group and high S.E.S. of control group students

$\boldsymbol{H_0^{14.4}}$: There is no significant difference in mathematical anxiety between high S.E.S. of the experimental group and high S.E.S. of control group students.

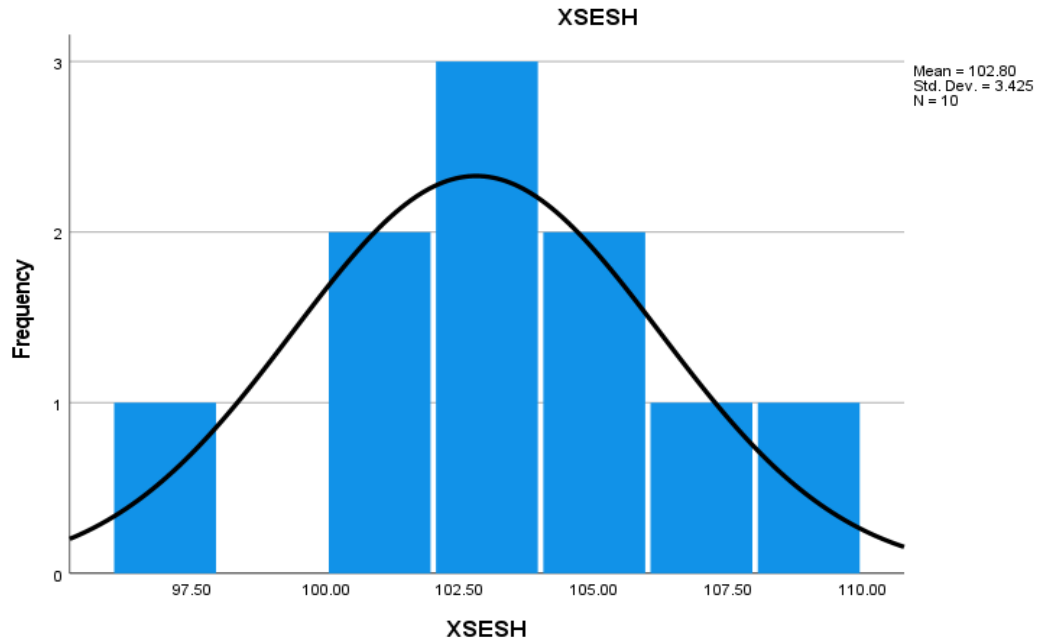
To find out the effect of constructivist pedagogy on the mathematical anxiety of class seventh students between high S.E.S. of the experimental group and high S.E.S. of control group students, the t-test was used. The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of mathematical anxiety (MA POST XC-S.E.S. based) for high S.E.S. of the experimental group and high S.E.S. of the control group.

Tests of Normality							
		Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	S.E.S.	**Statistic**	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
MA POST	**C-H**	.136	10	.200*	.938	10	.534
	X-H	.192	10	.200*	.961	10	.802
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.79: Kolmogorov-Smirnov and Shapiro-Wilk test between High Experimental group and High Control group of Mathematical Anxiety on the basis of S.E.S.

The above SPSS output window (table 4.79) shows the normality test results. It shows the p values 0.258 and 0.160 from the Shapiro-Wilk test of normality both are greater than 0.05. This is indicated that the student's mathematical anxiety distribution across both groups i.e., the mathematical anxiety distribution across high S.E.S. of the experimental group and high S.E.S. of the control group are bell-shaped (normal) Fig. 4.27.

NPC with Histogram Plot of The Raw Scores of Experimental Group of Mathematical Anxiety based on High Socio-Economic Status



NPC with Histogram Plot of The Raw Scores of Control Group of Mathematical Anxiety based on High Socio-Economic Status

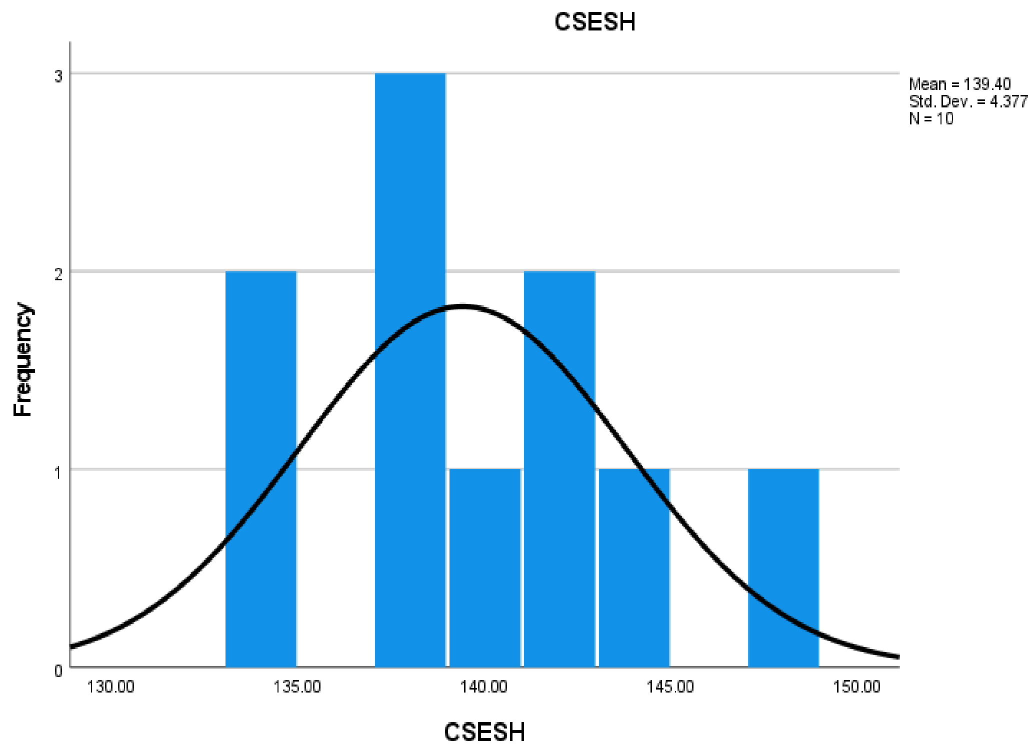


Fig. 4.27: NPC with Histogram between High Experimental group and High Control group of Mathematical Anxiety on the basis of S.E.S.

Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of mathematical anxiety i.e., one was the experimental group of high S.E.S. and the other was the control group of high S.E.S. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST	**Based on Mean**	.834	1	18	.373
	Based on Median	.754	1	18	.397
	Based on Median and with adjusted df	.754	1	17.862	.397
	Based on trimmed mean	.754	1	18	.397

Table 4.80: Levene's test between the High Experimental group and High Control group of Mathematical Anxiety on the basis of S.E.S.

The obtained value of Levene's test 0.397 (Table 4.80) is higher than 0.05. It refers to the variability of mathematical anxiety (dependent variable) is the same across the experimental group of high S.E.S. and the control group of high S.E.S. Statistically, it can be shown MA Post XC-S.E.S. p (0.397) > 0.05 based on the experimental group of high S.E.S. (Socio-Economic Status) and the control group of high S.E.S. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was computed now, to know the effect of constructivist pedagogy on the mathematical anxiety (dependent variable) between the experimental group of high S.E.S. and the control group of high S.E.S. (**MA post XC- S.E.S.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the selected groups.

Two-Tailed Significance t-test between Experimental Group of High Socio-economic Status (S.E.S.) and Control Group of High Socio-economic Status (S.E.S.) based on Mathematical Anxiety

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of High Socio-economic Status (S.E.S.) based on Mathematical Anxiety	102.80	3.425	10	18	14.076	Significant t > 2.10 at 0.05 level t > 2.88 at 0.01 level
Control Group of High Socio-economic Status (S.E.S.) based on Mathematical Anxiety	139.40	4.377	10			

Table 4.81: t-test between the High Experimental group and the High Control group of Mathematical Anxiety on the basis of S.E.S.

Table 4.81 clarified that the obtained t-value 14.076 at df 18 is greater than the table value of the t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. So, the result of the t-test shows that the control group of students belonged to High S.E.S., who were taught through the traditional teaching method have a significantly high mean score of mathematical anxiety (M= 139.40) than the mean score of the mathematical anxiety of those students of the experimental group who were belonged to High S.E.S. and taught through constructivist pedagogy method students (M= 102.80). Hence, the mathematical anxiety of the control or traditional group is significantly high than the treatment or experimental group. Therefore, the mean score of the post-test of the control group is significantly higher than the treatment or experimental group. Therefore, the null hypothesis is not accepted.

4.14.2 To compare mathematical anxiety in mathematics between Low S.E.S. of the experimental group and Low S.E.S. of control group students

$\boldsymbol{H_0^{14.2}}$**:** There is a significant difference in mathematical anxiety between Low S.E.S. of the experimental group and Low S.E.S. of control group students.

To find out the effect of constructivist pedagogy on the mathematical anxiety of class seventh students between Low S.E.S. of the experimental group and Low S.E.S. of control group students, the t-test was used.

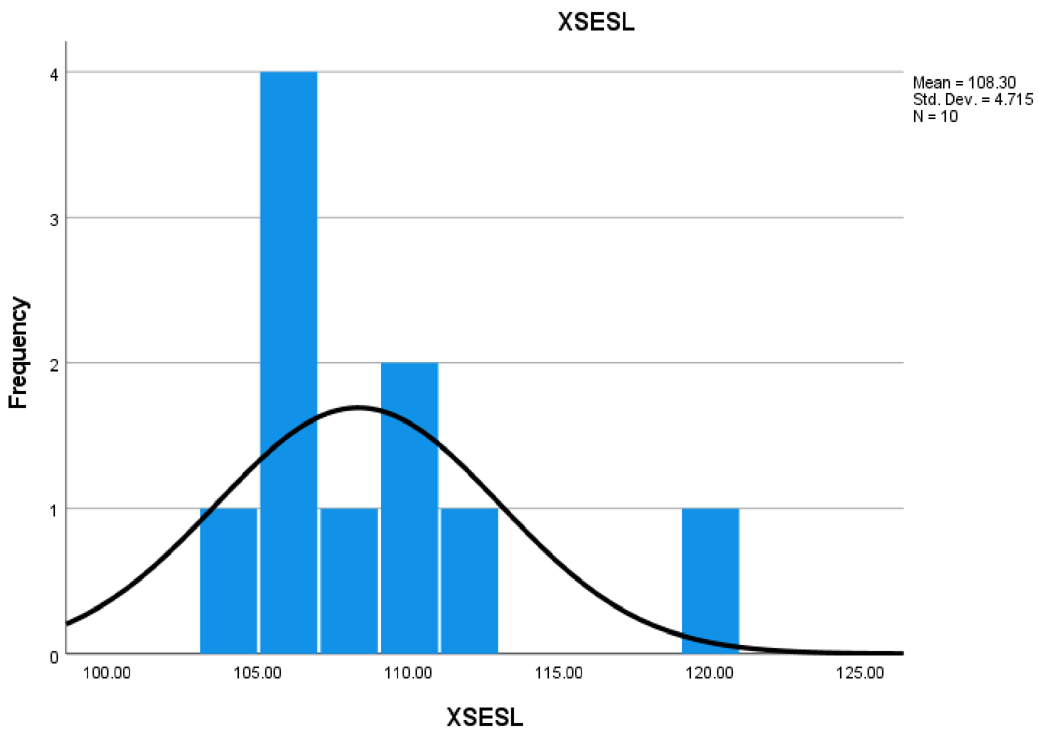
The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of mathematical anxiety (MA POST XC-S.E.S. based) for Low S.E.S. of the experimental group and Low S.E.S. of the control group.

Tests of Normality							
		Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	S.E.S.	**Statistic**	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
MA POST	**C-L**	.119	10	.200*	.968	10	.868
	X-L	.209	10	.200*	.798	10	.064
*This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.82: Kolmogorov-Smirnov and Shapiro-Wilk test between Low Experimental group and Low Control group of Mathematical Anxiety on the basis of S.E.S.

The above SPSS output window (table 4.82) displays the normality test results. It shows the p values 0.868 and 0.064 from the Shapiro-Wilk test of normality, both are greater than 0.05.

NPC with Histogram Plot of The Raw Scores of Experimental Group of Mathematical Anxiety based on Low Socio-Economic Status of Class Seventh Students



NPC with Histogram Plot of The Raw Scores of Control Group of Mathematical Anxiety based on Low Socio-Economic Status

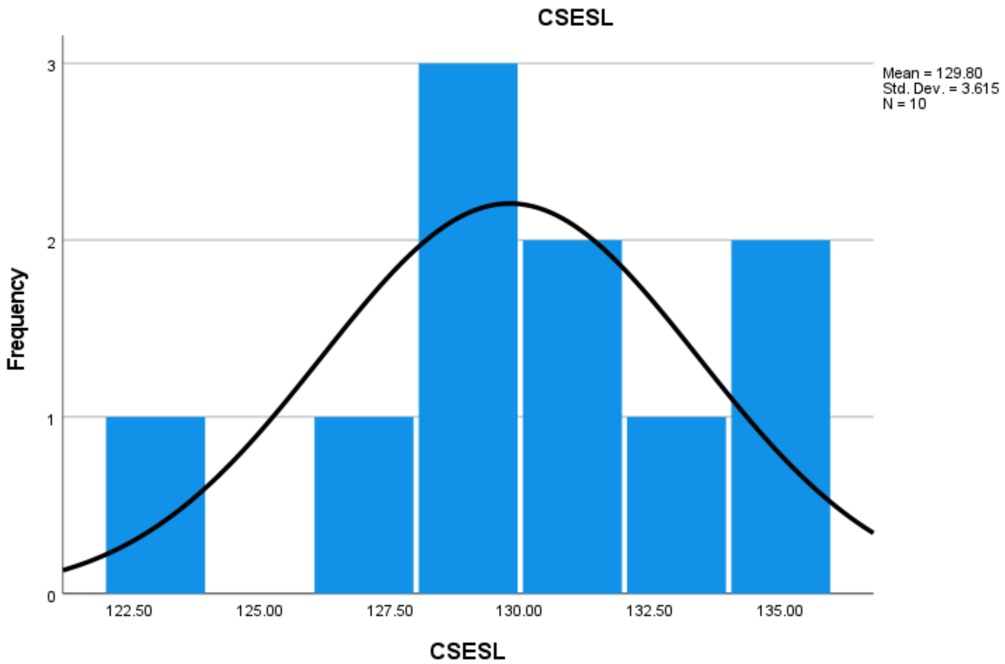


Fig. 4.28: NPC with Histogram Plot between Low Experimental group and Low Control group of Mathematical Anxiety on the basis of S.E.S.

This is indicated that the student's mathematical anxiety distribution across both groups i.e., the mathematical anxiety distribution across Low S.E.S. of the experimental group and Low S.E.S. of the control group are bell-shaped (normal) Fig. 4.28.

Hereafter, the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of mathematical anxiety i.e., one was the experimental group of Low S.E.S. and the other was the control group of Low S.E.S. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST	**Based on Mean**	.223	1	18	.642
	Based on Median	.046	1	18	.833
	Based on Median and with adjusted df	.046	1	13.871	.833
	Based on trimmed mean	.154	1	18	.700

Table 4.82: Levene's test between Low Experimental group and Low Control group of Mathematical Anxiety on the basis of S.E.S.

The obtained value of Levene's test 0.700 (Table 4.82) is higher than 0.05. It refers to the variability of mathematical anxiety (dependent variable) is the same across the experimental group of Low S.E.S. and the control group of Low S.E.S. Statistically, it can be shown MA Post XC-S.E.S. p (0.700) > 0.05 based on the experimental group of Low S.E.S. (Socio-Economic Status) and the control group of Low S.E.S. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of the subject, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was computed to know the effect of constructivist pedagogy on the mathematical anxiety (dependent variable) between the experimental group of Low S.E.S. and the control group of Low S.E.S. (**MA post XC- S.E.S.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the selected groups.

Two-Tailed Significance t-test between Experimental Group of Low Socio-economic Status (S.E.S.) and Control Group of Low Socio-economic Status (S.E.S.) based on Mathematical Anxiety

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Low Socio-economic Status (S.E.S.) based on Mathematical Anxiety	108.30	4.715	10	18	13.68	Significant t > 2.10 at 0.05 level t < 2.88 at 0.01 level
Control Group of Low Socio-economic Status (S.E.S.) based on Mathematical Anxiety	129.80	3.615	10			

Table 4.84: t-test between Low Experimental group and Low Control group of Mathematical Anxiety on the basis of S.E.S.

Table 4.84 clarified that the obtained t-value 13.68 at df 18 is greater than the table value of the t-test, i.e., 2.10 at 0.05 level and is 2.88 at 0.01 level. So, the result of the t-test shows that the Low S.E.S. students of the control group, who were taught through the traditional teaching method have not significantly high mean score of mathematical anxiety (M= 129.80) than the mean score of the mathematical anxiety of those students of experimental group who were from Low S.E.S. and taught through constructivist pedagogy method students (M= 108.30). Hence, the mathematical anxiety of the control or traditional group is significantly high than the treatment or experimental group. Therefore, the mean score of the post-test of the control group is significantly higher than the treatment or experimental group. Therefore, the null hypothesis is rejected.

4.14.3 To compare mathematical anxiety in mathematics between Low S.E.S. of the experimental group and High S.E.S. of control group students

$H_0^{14.3}$: There is a significant difference in mathematical anxiety between Low S.E.S. of the experimental group and High S.E.S. of control group students.

To find out the effect of constructivist pedagogy on the mathematical anxiety of class seventh students between Low S.E.S. of the experimental group and High S.E.S. of control group students, the t-test was used.

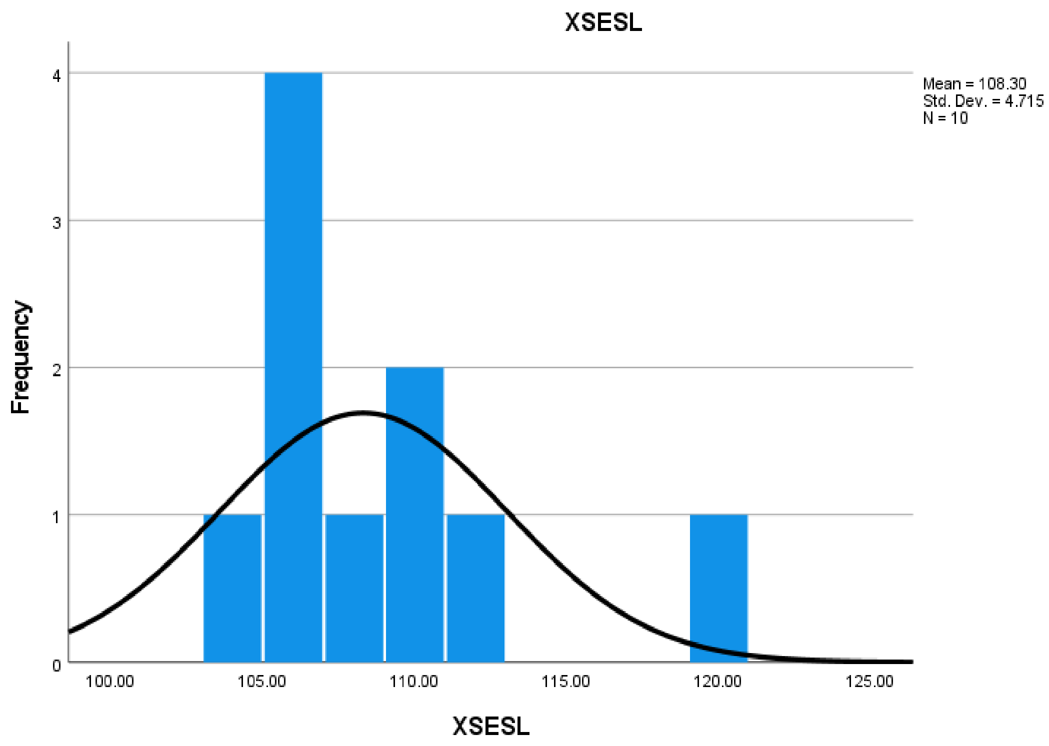
The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of mathematical anxiety (MA POST XC-S.E.S. based) for Low S.E.S. of the experimental group and High S.E.S. of the control group.

Tests of Normality							
		Kolmogorov-Smirnov			**Shapiro-Wilk**		
	S.E.S.	**Statistic**	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
MA POST	**C-H**	.136	10	.200*	.938	10	.534
	X-L	.209	10	.200*	.798	10	.064
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.85: Kolmogorov-Smirnov and Shapiro-Wilk test between Low Experimental group and High Control group of Mathematical Anxiety on the basis of S.E.S.

The above SPSS output window (table 4.85) shows the normality test results. It shows the p values 0.534 and 0.064 from the Shapiro-Wilk test of normality, both are greater than 0.05.

NPC with Histogram Plot of The Raw Scores of Experimental Group of Mathematical Anxiety based on Low Socio-Economic Status of Class Seventh Students



NPC with Histogram Plot of The Raw Scores of Control Group of Mathematical Anxiety based on High Socio-Economic Status of Class Seventh Students

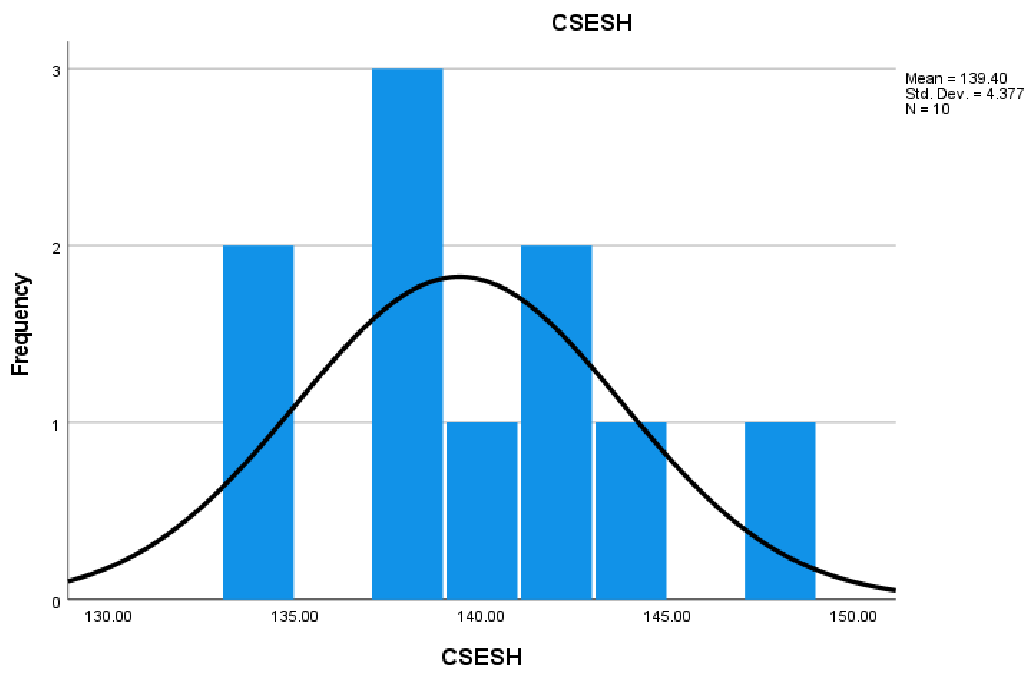


Fig. 4.29: NPC with Histogram Plot between Low Experimental group and High Control group of Mathematical Anxiety on the basis of S.E.S.

This is indicated that the student's mathematical anxiety distribution across both groups i.e., the mathematical anxiety distribution across Low S.E.S. of the experimental group and High S.E.S. of the control group are bell-shaped (normal) Fig. 4.29. Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of mathematical anxiety i.e., one was the experimental group of Low S.E.S. and the other was the control group of High S.E.S. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST	**Based on Mean**	.009	1	18	.924
	Based on Median	.040	1	18	.843
	Based on Median and with adjusted df	.040	1	15.984	.844
	Based on trimmed mean	.017	1	18	.898

Table 4.86: Levene's test between Low Experimental group and High Control group of Mathematical Anxiety on the basis of S.E.S.

The obtained value of Levene's test 0.898 (Table 4.86) is higher than 0.05. It refers to the variability of mathematical anxiety (dependent variable) is the same across the experimental group of Low S.E.S. and the control group of High S.E.S. Statistically, it can be shown MA Post XC-S.E.S. p (0.898) > 0.05 based on the experimental group of Low S.E.S. (Socio-Economic Status) and the control group of High S.E.S. It means the variability of scores of the two considered dependent sample existed in the limit of its significance i.e., the variability of scores of one sample does not vary more than the variability of the scores of the second dependent sample. Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was used to know the effect of constructivist pedagogy on the mathematical anxiety (dependent variable) between the experimental group of Low S.E.S. and the control group of High S.E.S. (**MA post XC- S.E.S.)** of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the selected groups.

Two-Tailed Significance t-test between Experimental Group of Low Socio-economic Status (S.E.S.) and Control Group of High Socio-economic Status (S.E.S.) based on Mathematical Anxiety

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of Low Socio-economic Status (S.E.S.) based on Mathematical Anxiety	108.30	4.715	10	18	10.264	Significant t > 2.10 at 0.05 level
Control Group of High Socio-economic Status (S.E.S.) based on Mathematical Anxiety	139.40	4.377	10			Significant t < 2.88 at 0.01 level

Table 4.87: t-test between Low Experimental group and High Control group of Mathematical Anxiety on the basis of S.E.S.

Table 4.87 clarified that the obtained t-value 10.264 at df 18 is greater than the table value of the t-test, i.e., 2.10 at 0.05 level, and is not greater than 2.88 at 0.01 level. So, the result of the t-test shows that the students of the control group with High S.E.S., who were taught through the traditional teaching method have a significantly high mean score of mathematical anxiety (M= 139.40) than the mean score of the mathematical anxiety of students of the experimental group with Low S.E.S. taught through constructivist pedagogy method students (M= 108.30). Hence, the mathematical anxiety of the control or traditional group is significantly high than the treatment or experimental group. So, the mean score of the post-test of the control group is significantly higher than the treatment or experimental group.

Therefore, the null hypothesis is rejected.

4.14.4. To compare mathematical anxiety in mathematics between High S.E.S. of the experimental group and Low S.E.S. of control group students

$H_0^{14.4}$: There is a significant difference in mathematical anxiety between High S.E.S. of the experimental group and Low S.E.S. of control group students.

To find out the effect of constructivist pedagogy on the mathematical anxiety of class seventh students between High S.E.S. of the experimental group and Low S.E.S. of control group students, the t-test was used.

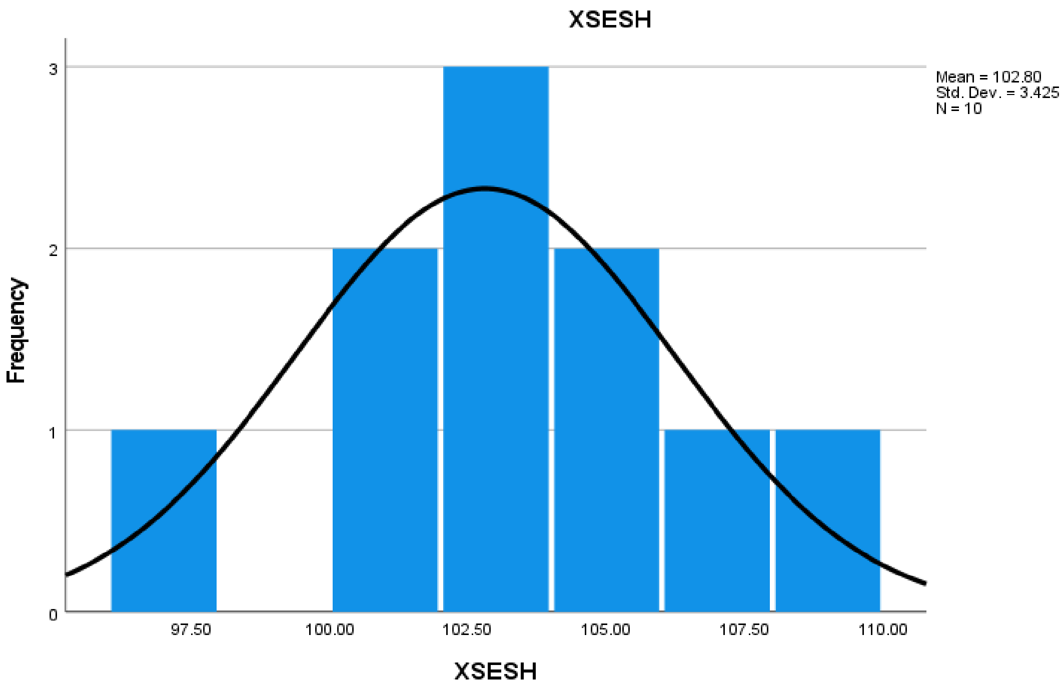
The IBM SPSS 28.0 (statistical package for social science version 28.0) was used to test the null hypothesis. The two-tailed significance t-test was calculated to test the significance of means between the two independent samples. Before testing the null hypothesis, it was necessary to verify all assumptions of the independent sample i.e., normality and homogeneity of the sample. For this the Kolmogorov-Smirnov and Shapiro-Wilk test (KSSWT) were used to test the normality of the two independent samples separately i.e., the tests were used to verify the normality between the post-test scores of mathematical anxiety (MA POST XC-S.E.S. based) for High S.E.S. of the experimental group and Low S.E.S. of the control group.

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	S.E.S.	Statistic	df	Sig.	Statistic	df	Sig.
MA POST	C-L	.119	10	.200*	.968	10	.868
	X-H	.192	10	.200*	.961	10	.802
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Table 4.88: Kolmogorov-Smirnov and Shapiro-Wilk test between High Experimental group and Low Control group of Mathematical Anxiety on the basis of S.E.S.

The above SPSS output window (table 4.88) shows the normality test results. It shows the p values 0.868 and 0.802 from the Shapiro-Wilk test of normality, both are greater than 0.05.

NPC with Histogram Plot of The Raw Scores of Experimental Group of Mathematical Anxiety based on High Socio-Economic Status



NPC with Histogram Plot of The Raw Scores of Control Group of Mathematical Anxiety based on Low Socio-Economic Status of Class Seventh Students

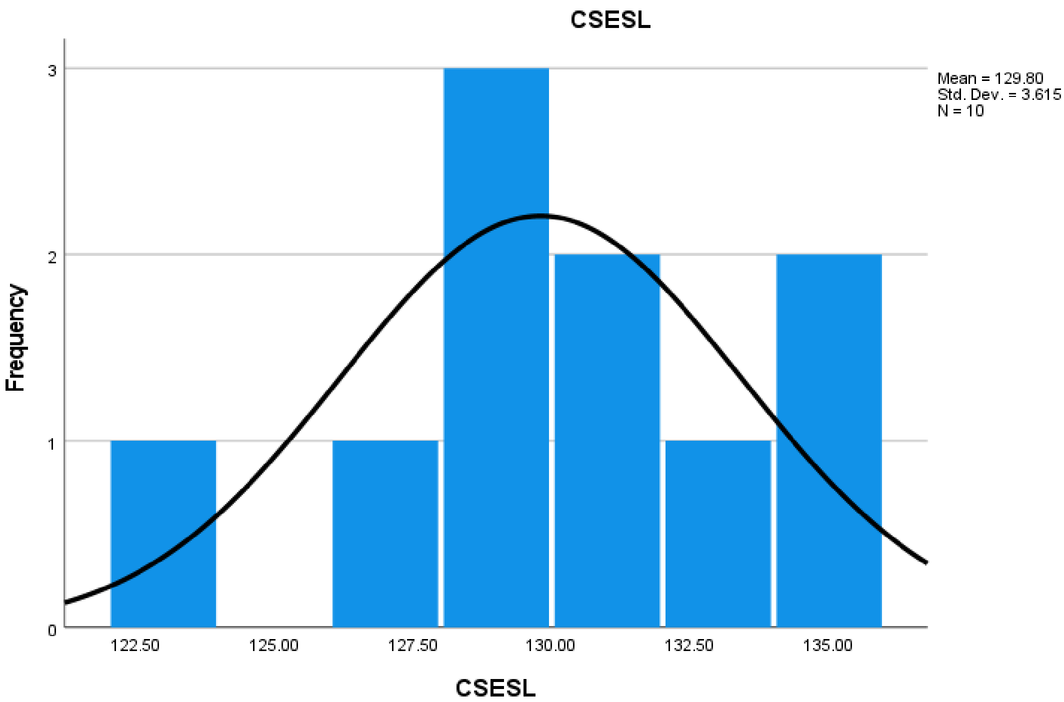


Fig. 4.30: NPC with Histogram Plot between High Experimental group and Low Control group of Mathematical Anxiety on the basis of S.E.S.

This is indicated that the student's mathematical anxiety distribution across both groups i.e., the mathematical anxiety distribution across High S.E.S. of the experimental group and Low S.E.S. of the control group are bell-shaped (normal) Fig. 4.30. Hereafter the researcher has used Levene's test to verify the homogeneity of variance between the two independent samples. Levene's test verifies the similarity of variance of every dependent variable for each other of the two groups of mathematical anxiety i.e., one was the experimental group of High S.E.S. and the other was the control group of Low S.E.S. It tests the null hypothesis that the variance of the population is equal (define as homogeneity of variance or homoscedasticity) in both groups.

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
MA POST	**Based on Mean**	.065	1	18	.801
	Based on Median	.152	1	18	.701
	Based on Median and with adjusted df	.152	1	17.597	.701
	Based on trimmed mean	.068	1	18	.798

Table 4.89: Levene's test between the High Experimental group and the Low Control group of Mathematical Anxiety on the basis of S.E.S.

The obtained value of Levene's test 0.798 (Table 4.89) is higher than 0.05. It refers to the variability of mathematical anxiety (dependent variable) is the same across the experimental group of High S.E.S. and the control group of Low S.E.S. Statistically, it can be shown as MA Post XC-S.E.S. p (0.798) > 0.05 based on the experimental group of High S.E.S. (Socio-Economic Status) and control group of Low S.E.S. (Socio-Economic Status)**.** Hence, the above two samples are considered homogeneous with respect to each other.

Since, all the three assumptions of the t-test i.e., random assignment of subjects, normality of distribution, and homogeneity of variance were verified of the two selected dependent samples. Therefore, a t-test was computed to know the effect of constructivist pedagogy on the mathematical anxiety (dependent variable) between the experimental group of High S.E.S. and the control group of Low S.E.S. (**MA post**

XC- S.E.S.) of the seventh grade students. The t-test verifies the null hypothesis that there is no significant difference in the mathematical anxiety between the selected groups.

Two-Tailed Significance t-test between Experimental Group of High Socio-economic Status (S.E.S.) and Control Group of Low Socio-economic Status (S.E.S.) based on Mathematical Anxiety

Group	Mean	SD	N	df	t-value	Significance
Experimental Group of High Socio-economic Status (S.E.S.) based on Mathematical Anxiety	102.80	3.425	10	18	10.30	Significant t > 2.10 at 0.05 level t > 2.88 at 0.01 level
Control Group of Low Socio-economic Status (S.E.S.) based on Mathematical Anxiety	129.80	3.615	10			

Table 4.90: t-test between High Experimental group and Low Control group of Mathematical Anxiety on the basis of S.E.S.

Table 4.90 clarified that the obtained t-value 10.30 at df 18 is greater than the table value of the t-test, i.e., 2.10 at 0.05 level and 2.88 at 0.01 level. So, the result of the t-test shows that the students with Low S.E.S. of the control group, who were taught through the traditional teaching method have a significantly high mean score of mathematical anxiety (M= 129.80) than the mean score of the mathematical anxiety of those students of the experimental group with High S.E.S. taught through constructivist pedagogy method (M= 102.80). Hence, the mathematical anxiety of the control or traditional group is significantly high than the treatment or experimental group. Therefore, the mean score of the post-test of the control group is significantly higher than the treatment or experimental group. Therefore, the null hypothesis is not accepted.

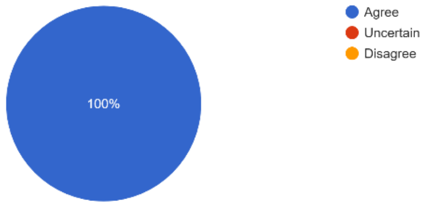
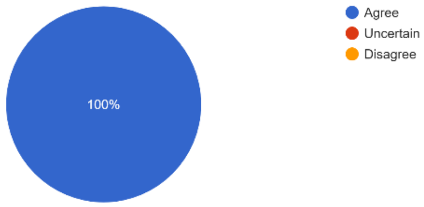
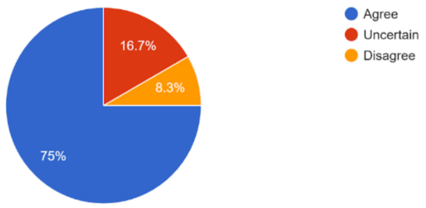
4 (D) Analysis of Data to Know the Students' Views on Constructivist Pedagogy

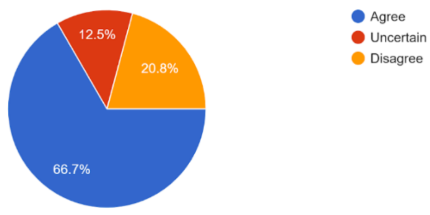
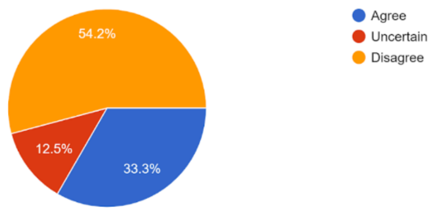
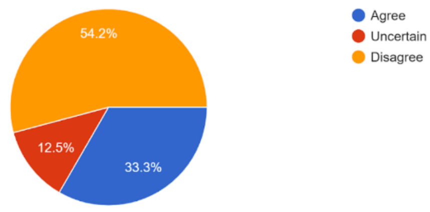
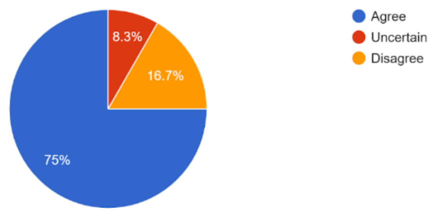
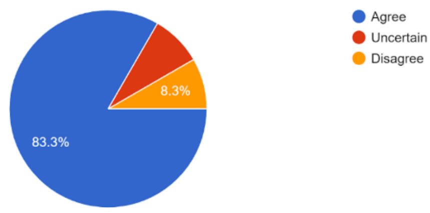
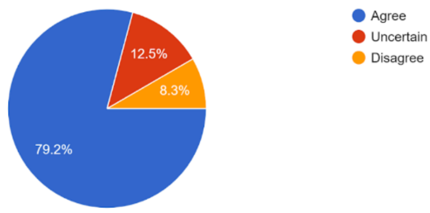
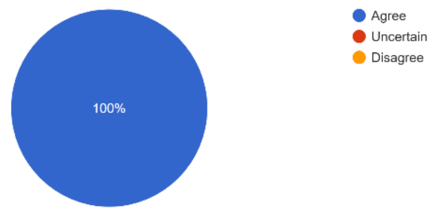
4.15 OBJECTIVE: To explore the opinion of students and teachers about the constructivist approach

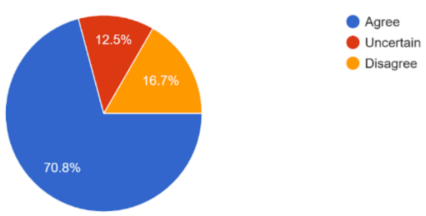
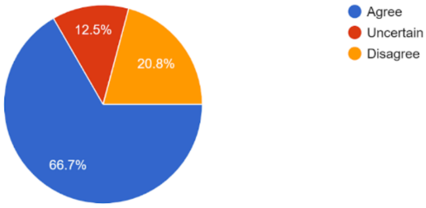
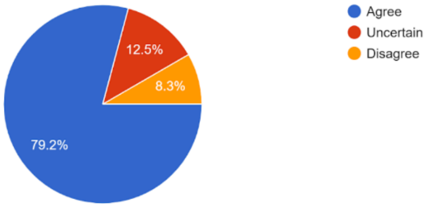
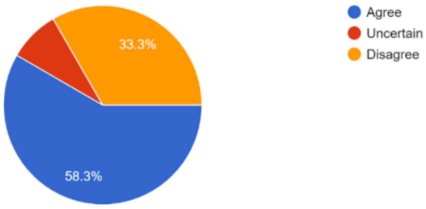
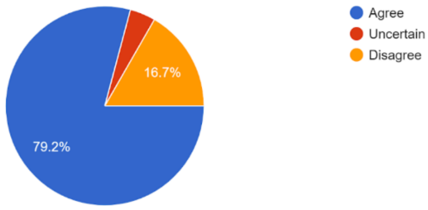
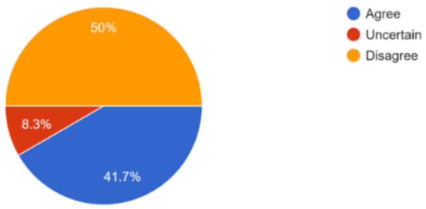
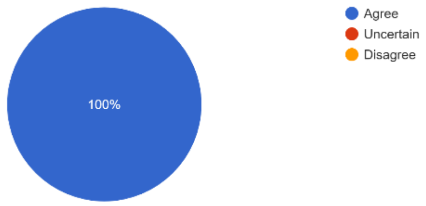
4.15.1 Students' Opinion about the Effect of Constructivist Pedagogy by Using "Constructivist Pedagogy Effectiveness Students' Opinionnaire"

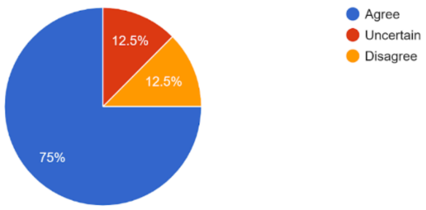
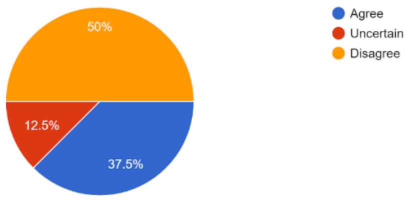
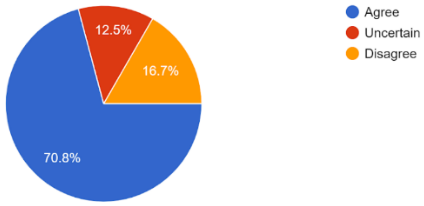
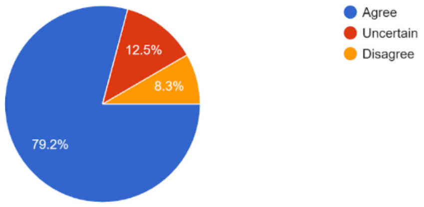
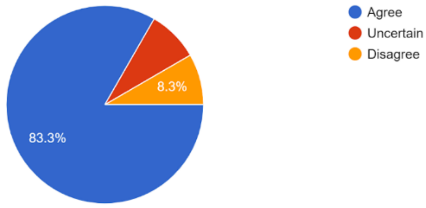
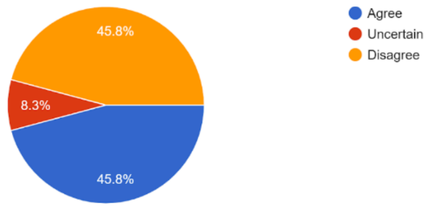
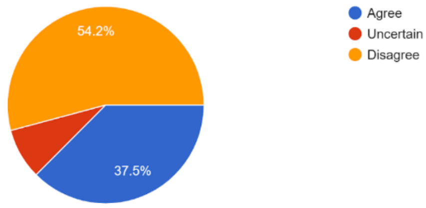
"Constructivist Pedagogy Effectiveness Students' Opinionnaire" on constructivist pedagogy was administered to the students of the experimental group to know their views about the constructivist pedagogy teaching method. The data on the opinionnaire from the experimental group's students were collected and then analyzed by using percentage, mentioned in the pie diagram in the category of agree, uncertain, and disagree about the statements, which are given as following table 4.91.

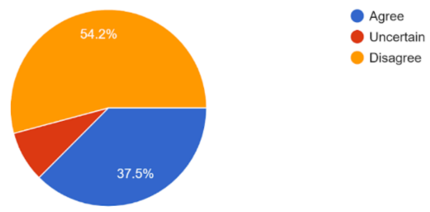
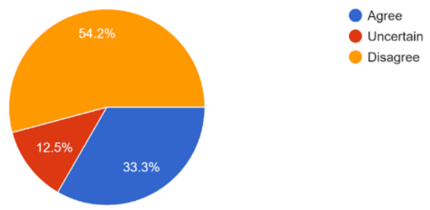
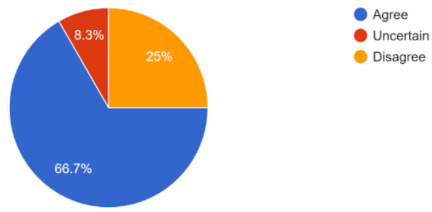
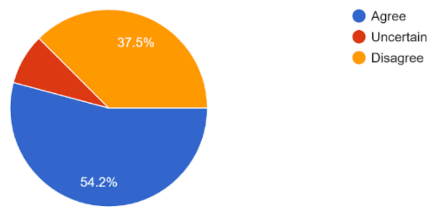
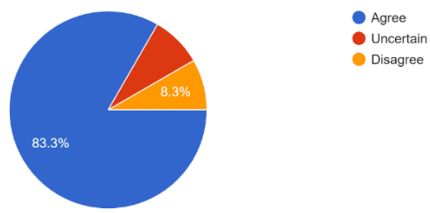
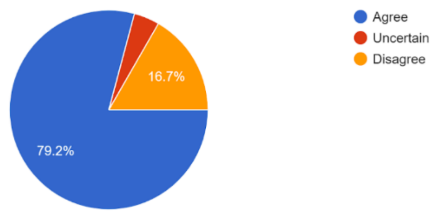
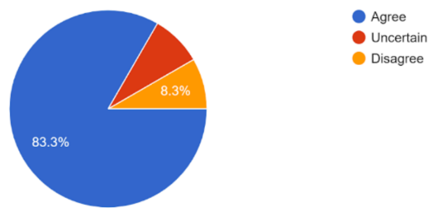
Table 4.91: Students' Opinion on Constructivist Pedagogy by using "Constructivist Pedagogy Effectiveness Students' Opinionnaire"

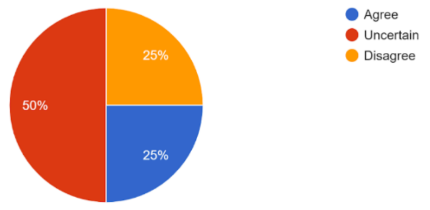
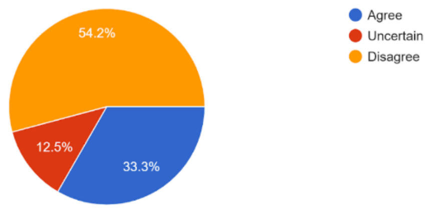
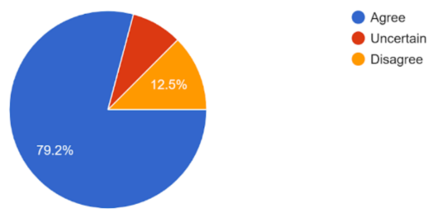
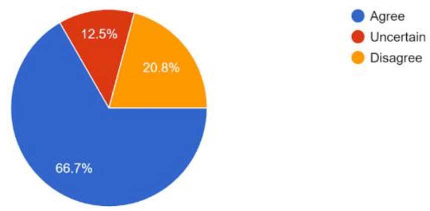
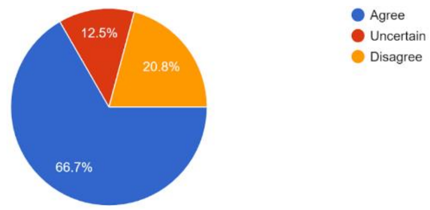
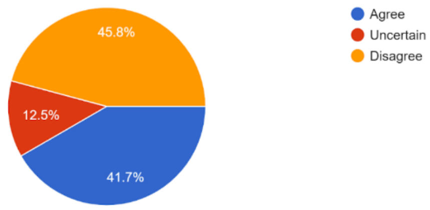
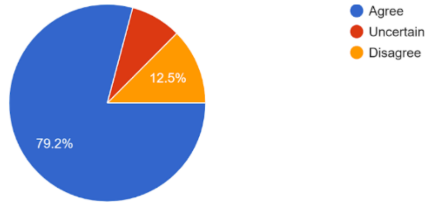
S.no.	Statements	Students' Responses
A.	**Constructivist Pedagogy**	**Pie-Diagram**
1.	The material was taught by relating your prior knowledge.	
2.	You tried to learn on your own in a constructivist class.	
3.	Teaching by the constructivist method increased your learning.	

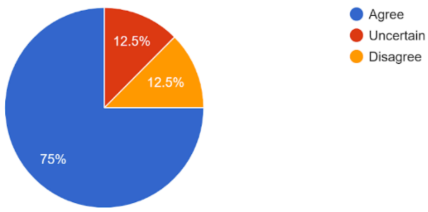
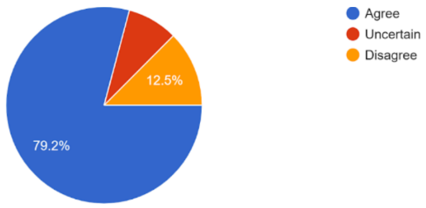
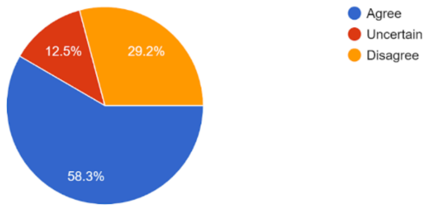
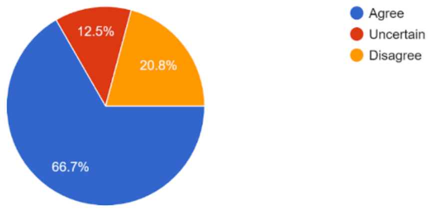
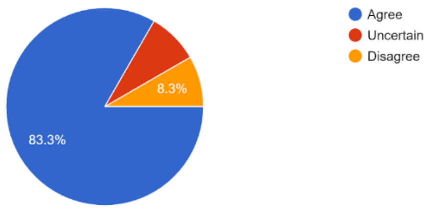
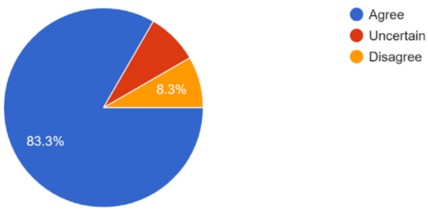
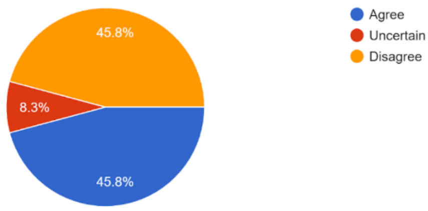
4.	You were excited to learn in the constructivist class.	
5.	The constructivist method made it difficult to learn.	
6.	Activity is not required to learn with constructivist method.	
7.	Tried to find answers to unknown questions in the constructivist class.	
8.	In constructivist class, you were working with less attention in the comparison to traditional class.	
9.	The constructivist classroom environment was appropriate for learning.	
10.	Learning with the constructivist method requires more diligence.	

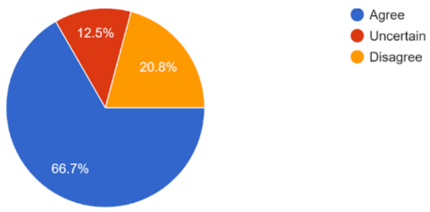
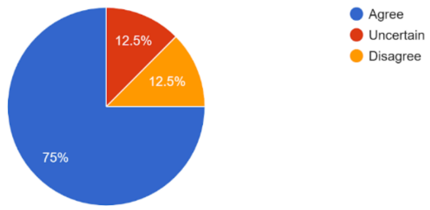
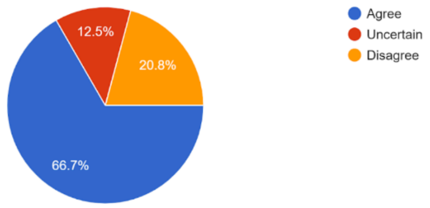
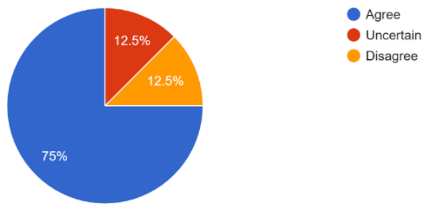
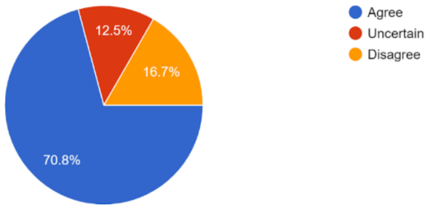
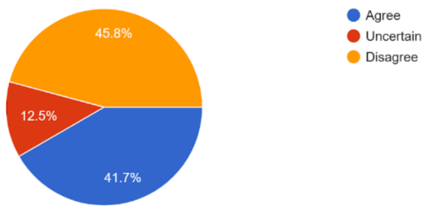
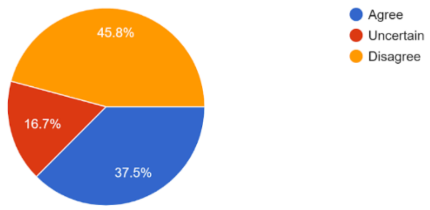
11.	By using constructivist method, you can learn more in less time.	
12.	You keep using the constructivist method to learn unknowingly	
13.	You learn as much as we get to learn in some way or the other according to constructivism.	
14.	If constructivist law becomes mandatory in school education, then the syllabus will have to be reduced to complete the syllabus in the stipulated time.	
B.	**Constructivist Pedagogy and Mathematics**	**Pie-Diagram**
1.	Constructivist classroom teaching motivates you to use mathematics in daily life.	
2.	Constructivist teaching method is less beneficial than the traditional teaching method for mathematics subject.	
3.	With constructivist pedagogy, you can achieve permanent learning in mathematics.	

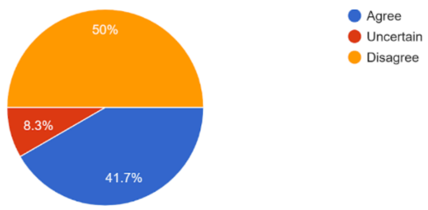
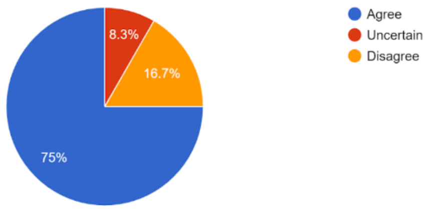
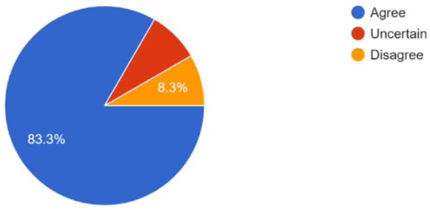
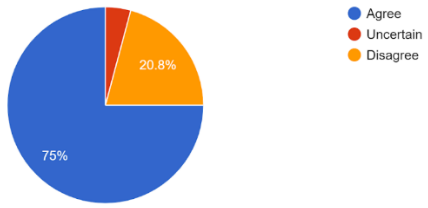
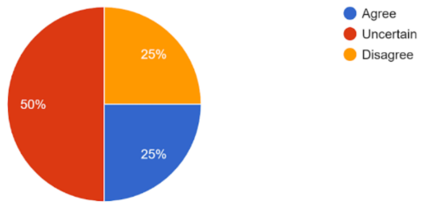
4.	Mathematics becomes an interesting subject with the help of constructivist method.	
5.	The constructivist method is not suitable for a mathematics study.	
6.	Constructivist teaching method makes you understand mathematical concepts easily.	
7.	In constructivist teaching method, correct answer can be obtained by using appropriate mathematical operations according to the question.	
8.	Using the constructivist method, mathematics can be made as general as any other subject, so that there is not much difference in difficulty level between mathematics and other subjects.	
9.	It is not necessary to use constructivist method in teaching mathematics of class-7.	
10.	There is no significant difference between the constructivist method and the traditional method in teaching mathematics.	

11.	The constructivist classroom was not learnable to mathematics.	
12.	Special dedication to education is necessary for learning through constructivist method as compared to traditional method.	
13.	The environment of the constructivist mathematical classroom was learnable.	
14.	You had to face more difficulty and effort when you learned mathematics from the constructivist method than the traditional method.	
15.	In teaching mathematics, you get more sustainable learning when you learn from the constructivist method than the traditional method.	
16.	The constructivist method seems to be more useful in teaching mathematics than other subjects.	
17.	Constructivist teaching method gives proper educational environment for learning mathematics.	

18.	Applying constructivist pedagogy in the classroom and studying regularly can be a daunting task.	
19.	Constructivist teaching method is ineffective in learning mathematics.	
C.	**Constructivist Pedagogy and Mathematical Anxiety**	**Pie-Diagram**
1.	Students can reduce nervousness towards mathematics, with the help of the constructivist method.	
2.	The fear of examination of mathematics can be eliminated by learning through constructivist method.	
3.	The concept that mathematics is difficult to study by constructivist method does not seem to be true.	
4.	It is difficult to understand mathematics through the constructivist method.	
5.	There is no fatigue in mathematics studying through the constructivist method..	

6.	Studying through constructivist method does not feel tired at all in the subject of mathematics.	
7.	My mental burden towards mathematics was reduced by studying through constructivist method.	
8.	In constructivist learning, the role of the classroom environment is negligible in reaching the expected learning of mathematics.	
9.	When I take the test of learning mathematics through the constructivist method, I do not feel a virtual void in my mathematics knowledge as before.	
10.	Mathematical questions can be practiced well with the help of constructivist method.	
11.	With the help of constructivist method, mathematical questions can be practiced a lot.	
D.	**Constructivist Pedagogy and Concept Attainment in Mathematics**	**Pie-Diagram**
1.	The constructivist method seems ineffective in the subject of mathematics.	

2.	With the help of constructivist method, various examples of mathematical concepts can be accurately estimated.	
3.	Mathematical concepts can be easily grasped through constructivist method as compared to traditional teaching method.	
4.	The mathematical concept adopted through the constructivist method is relatively more stable.	
5.	The mathematical concept taught through the constructivist method has a clearer mapping in the mind.	
6.	The mathematical concepts learned from the constructivist method can be easily applied in daily life.	
7.	Constructivist teaching method is not useful in understanding mathematical concepts.	
8.	No mathematical concept can be easily understood using the constructivist method.	

9.	Not all concepts related to Class seventh Mathematics curriculum are easily understood through constructivist method.	
10.	Through the constructivist method, I find mathematical concept acquisition relatively easy.	
11.	There is no better method for acquisition of mathematical concepts than constructivist teaching method.	
12.	Concepts taught in mathematical teaching in the constructivist method seem simple, which increases the eagerness to learn the next concept.	
13.	The constructivist method is accurate for simple mathematical concepts but not for difficult mathematical concepts.	

Description of Constructivist Pedagogy Effectiveness Students' Opinionnaire

In this Opinionnaire, there are positive and negative things about it. The students of the experimental group displayed their ideas about constructivist pedagogy in favor of various points such as their pre-knowledge, constructivist class, activities, classroom environment, schooling, mathematics, mathematical concepts and mathematics curriculum, nervousness, fatigue, concept He also expressed his views about attainment and mathematical courses, etc.

Description of Students' Opinion based on Students' Opinionnaire		
Responses	**Response's %**	**Effectiveness**
Agree with Positive Statements	77.46%	63.85% Effective
Disagree with Negative Statements	50.24%	
Agree with Negative Statements	44.84%	28.50% non-effective
Disagree with Positive Statements	12.17%	
Uncertain with Positive and Negative Statements	7.64%	

Table 4.92: Description of Students' Opinion based on Students' Opinionnaire

Table 4.92 shows that 77.46% of respondents were agreed with the positive statements and 50.24% respondents whose were disagree with negative items. Similarly, the table is expressed that 12.17% of respondents have disagreed with the positive items and 44.84% of respondents were agreed with the negative items, and 7.64% of students were uncertain about the positive and negative statements.

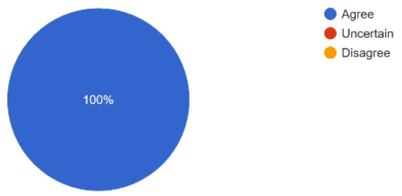
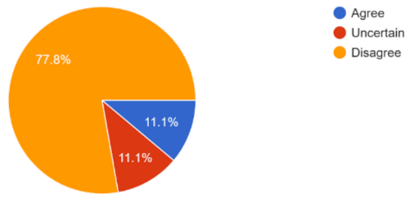
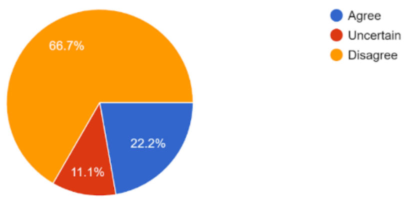
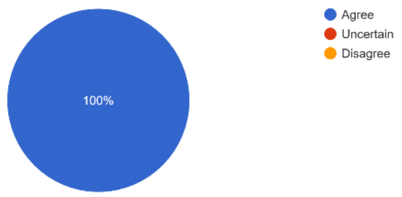
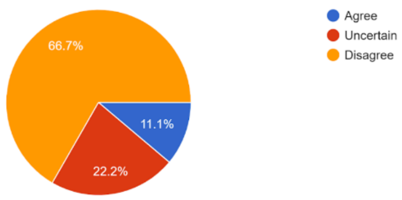
Therefore, by using the average of the positive responses on the positive items and negative responses on the negative items to find the positive effect of constructivist pedagogy and it was found to be 63.85%. Now by using the average of the negative responses on the positive items and the positive responses on the negative items researcher tried to find out the negative effect or non-effect of constructivist pedagogy and it was found to be 28.50%. Hence the constructivist pedagogy method is 63.85% effective and 28.50% non-effective according to the opinions of the students of the experimental.

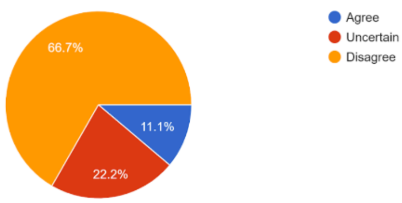
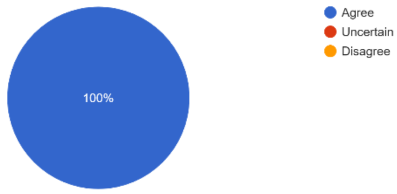
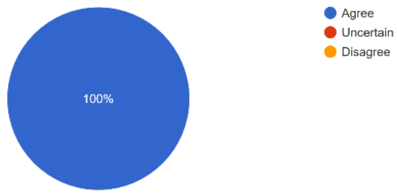
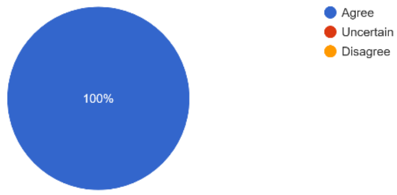
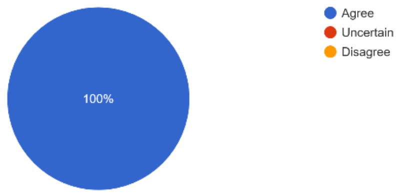
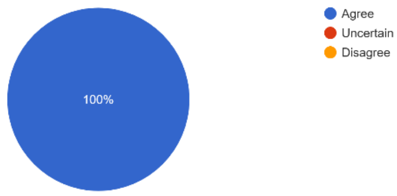
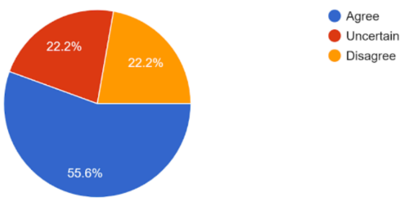
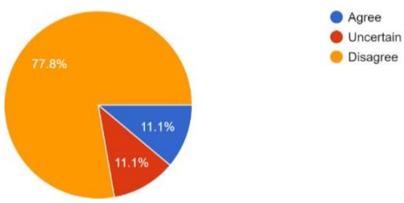
4(E) Analysis of Data to Know the Teachers' Views on Constructivist Pedagogy

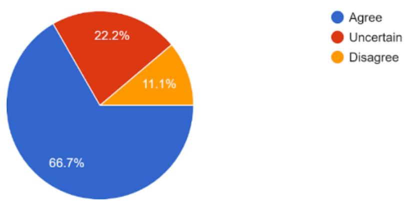
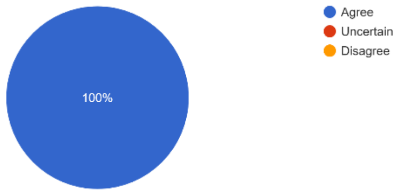
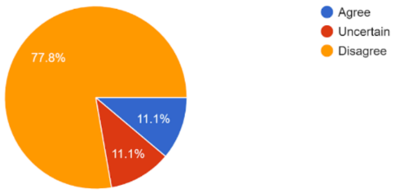
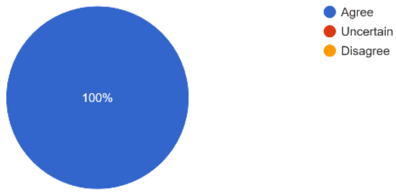
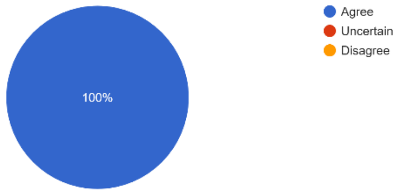
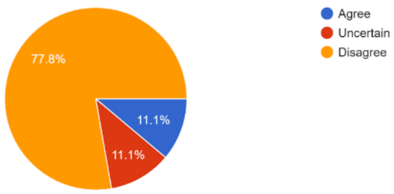
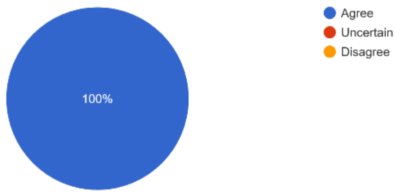
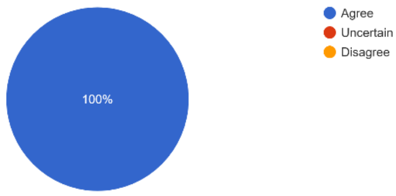
4.15.2 Teachers' Opinion about the Effect of Constructivist Pedagogy by Using "Constructivist Pedagogy Effectiveness Teachers' Opinionnaire"

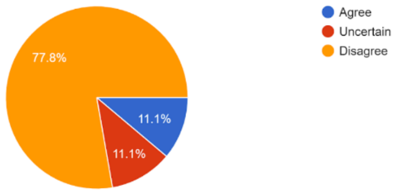
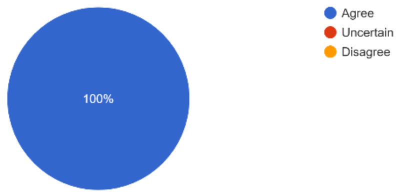
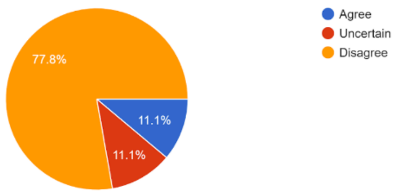
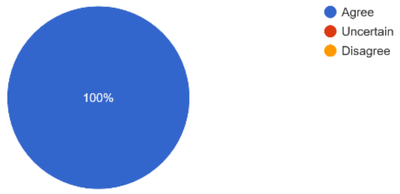
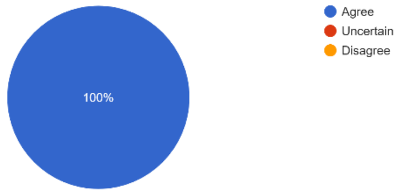
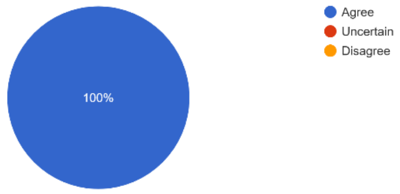
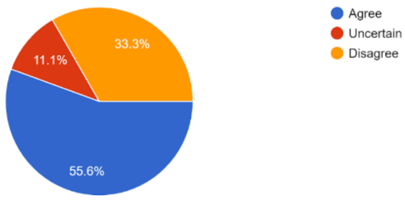
"Constructivist Pedagogy Effectiveness Teachers' Opinionnaire" was administered to know the views about constructivist pedagogy from the teachers of that school where the experiment was conducted. The data on the opinionnaire from the school's teachers were collected and then analyzed by using percentages which are mentioned in the pie diagram in the category of agreeing and disagree about the statements, which are given as following table 4.15.1(Teachers' Opinion on Constructivist Pedagogy).

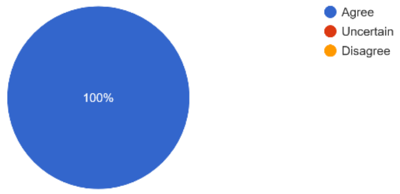
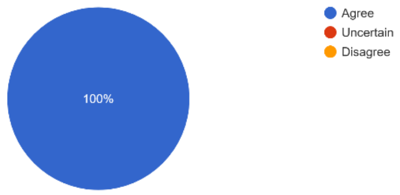
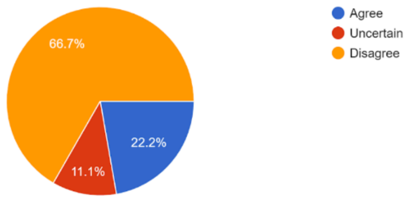
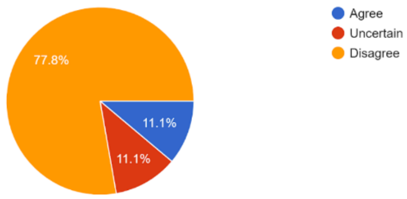
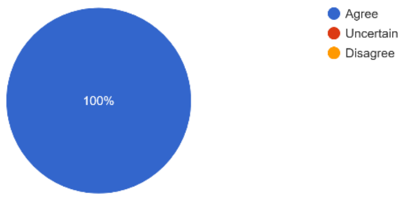
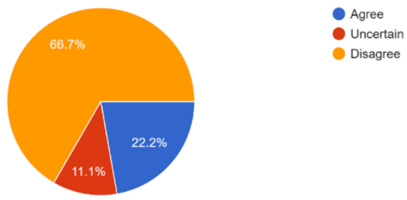
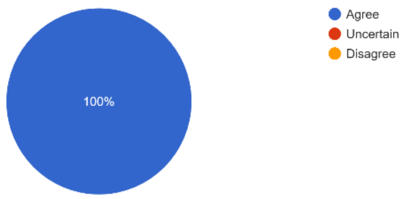
Table 4.93: Teachers' Opinion on Constructivist Pedagogy by "Constructivist Pedagogy Effectiveness Teachers' Opinionnaire"

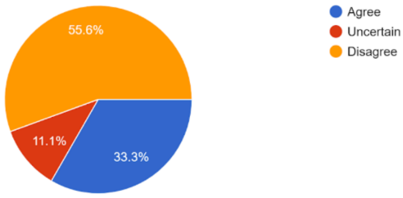
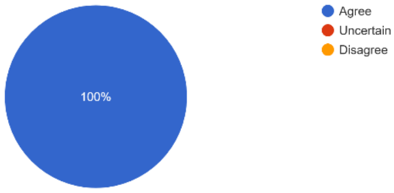
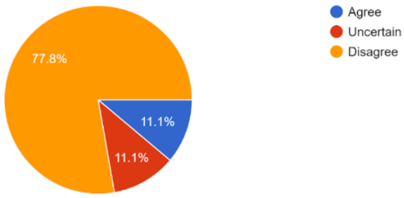
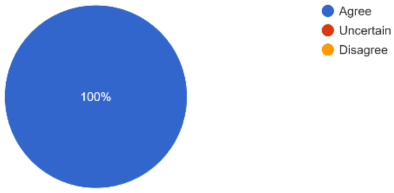
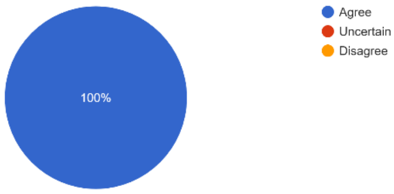
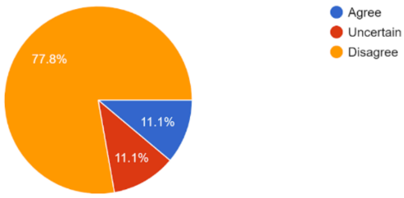
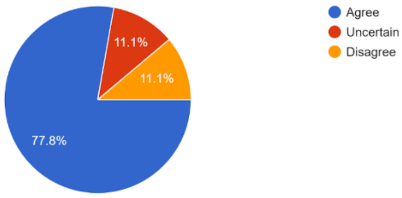
S.No.	Statements	Teachers' Responses
A.	**Constructivist Pedagogy**	**Pie-Diagram**
1.	Constructivist method increased the learning of the students.	
2.	Students cannot learn easily by constructivist method.	
3.	Students may be less active to learn through the constructivist method.	
4.	In the Constructivist class, the students can try to find answers to unknown questions himself.	
5.	The experience of teaching through constructivist method is not necessary for the teacher.	

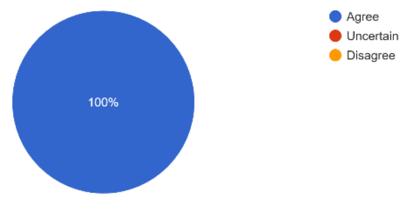
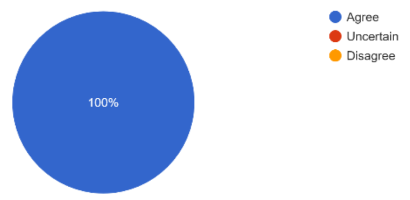
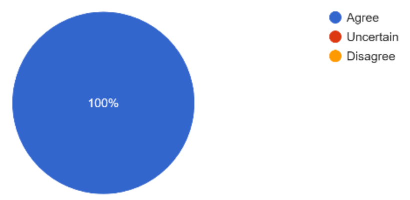
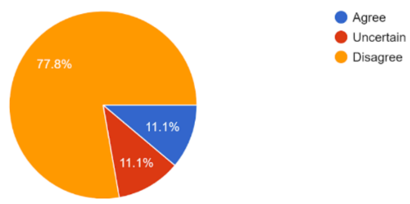
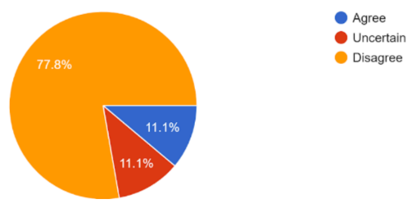
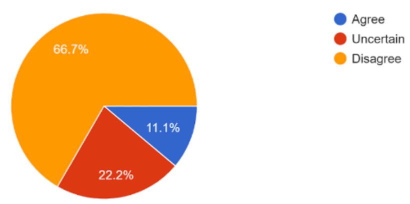
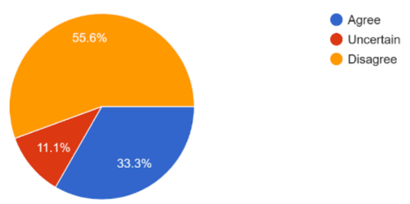
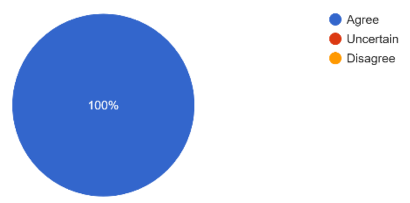
6.	Applying the constructivist method in the classroom is more difficult than applying the traditional method of teaching.	
7.	Constructivist method may require more dedication from both the teacher and the student.	
8.	Constructivist method should be used more in primary, pre-secondary, secondary and higher-secondary education in future time than in present time.	
9.	With the constructivist method, students can learn more in less time.	
10.	Students keep using the constructivist method in learning knowingly or unknowingly.	
11.	Students learn only as much as they get to learn in some way or the other according to the constructivist approach.	
12.	If the state government makes the constructivist method mandatory in school education, it may have to be reduced in view of the obligation to complete the syllabus in the stipulated time.	
13.	Constructivist teaching method does not have much impact on student learning.	

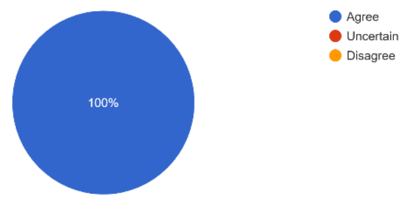
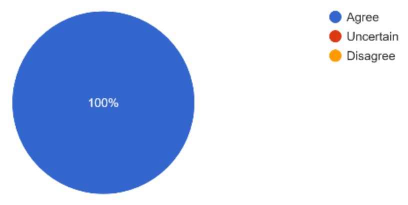
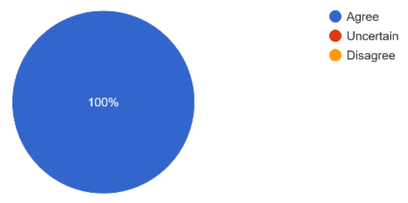
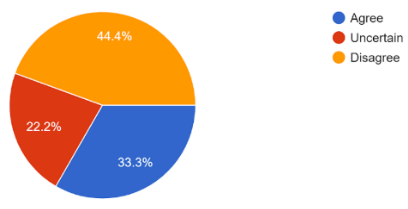
14.	Implementing constructivist teaching method in the classroom and doing regular teaching can be a challenging task for the teacher.	
B.	**Constructivist Pedagogy and Mathematics**	**Pie-Diagram**
1.	Constructivist classroom teaching motivates the student to use mathematics in daily life.	
2.	Constructivist teaching method is less beneficial than traditional teaching method for mathematics subject.	
3.	Most of the students get permanent learning in Mathematics by constructivist method.	
4.	Mathematics can be made an interesting subject with the help of constructivist method.	
5.	Constructivist method is unsuitable for teaching mathematics.	
6.	Mathematical concepts can be easily explained to the student through constructivist teaching method.	
7.	Using the constructivist method, mathematics can be made as general as any other subject so that students do not experience much difference in difficulty level between mathematics and other subjects.	

8.	Constructivist method should not be used in class seventh mathematics syllabus.	
9.	Seeing the use of constructivist method in teaching mathematics, you felt that this teaching-learning would be more than the traditional method.	
10.	There is no special difference between constructivist teaching method and traditional method of teaching.	
11.	In comparison to the traditional method, teaching-learning by constructivist method requires special dedication of both the teacher and the student towards education.	
12.	Questionnaire method seems to be more useful in teaching mathematics than other subjects.	
13.	Constructivist teaching method gives proper educational environment to the students for learning mathematics.	
14.	The teacher will have more difficulty in doing the teaching work in the subject of mathematics with the constructivist method than the traditional method.	

C.	**Constructivist Pedagogy and Mathematical Anxiety**	**Pie-Diagram**
1.	With the help of constructivist method, student's nervousness towards mathematics can be reduced.	
2.	Constructivist method can eliminate the fear of examination of mathematics in the students.	
3.	Constructivist method cannot change the students' concept of Mathematics as being difficult.	
4.	Constructivist method is not suitable for teaching mathematics.	
5.	Mathematical nervousness can be reduced by using the constructivist method.	
6.	When the constructivist method is used in teaching, students have more mental trouble in understanding the concepts of mathematics than the traditional method.	
7.	The mental burden of the student towards mathematics can be reduced by the use of constructivist method.	

8.	In teaching through constructivist method, the role of classroom environment is negligible in the expected learning of mathematics.	
9.	The constructivist method eliminates the virtual emptiness created in the student towards the mathematics examination at the time of mathematics examination.	
10.	With the help of constructivist method, students can practice solving mathematical problems a lot.	
11.	The relatively more stable learning achieved through the constructivist method increases the student's anxiety about mathematics.	
D.	**Constructivist Pedagogy and Concept Attainment in Mathematics**	**Pie-Diagram**
1.	By using the constructivist method, students achieve the best concept acquisition in mathematics.	
2.	The constructivist method is ineffective in understanding the subject of mathematics.	
3.	With the help of constructivist method, students can make accurate predictions of various examples of mathematical concepts.	

4.	The students attain mathematical concepts easily through constructivist method as compared to traditional teaching method.	
5.	The mathematical concepts adopted through the constructivist method are relatively more stable.	
6.	The mathematical concept taught through the constructivist method has clearer mapping in the mind.	
7.	The mathematical concept acquired through constructivist method is of no use in the daily life of the student.	
8.	Constructivist teaching method for class seventh student is useless in understanding mathematical concepts.	
9.	Constructivist teaching method for class seventh student is useless in understanding mathematical concepts.	
10.	Through the constructivist method, all the concepts related to their mathematics-curriculum cannot be easily explained to the student of class seventh.	
11.	The acquisition of mathematical concepts through the constructivist method is relatively simple.	

12.	There is no better method for acquisition of mathematical concepts than constructivist teaching method.	
13.	The mathematical concern of the student is reduced by the acquisition of mathematical concepts in teaching in the constructivist method.	
14.	The mathematical concept taught in mathematical teaching by using the constructivist method makes it easy for the students to learn the upcoming concept.	
15.	The constructivist method is accurate for simple mathematical concepts but not for difficult mathematical concepts.	

Description of Teachers' Opinion

In the teacher's opinionnaire, there are positive and negative items about constructivist pedagogy at various points such as constructivist class, activities, mathematical concepts, classroom environment, mathematics curriculum, nervousness, fatigue, schooling, Concept Acquisition, and Mathematical Syllabus, etc. Table 4.94 shows that 99.26% of the respondents agreed with the affirmative statements and 67.13% of the respondents disagreed with the negative items. Similarly, the table expressed that 0.37% of the respondents disagreed with the positive items and 21.62% of the respondents agreed with the negative items. 5.81% of teachers were unsure of how to express their response with positive and negative statements from the Opinionnaire.

Description of Teachers' Opinion based on Teachers' Opinionnaire		
Responses	**Response's %**	**Effectiveness**
Agree with Positive Statements	99.26%	83.19% Effective
Disagree with Negative Statements	67.13%	
Agree with Negative Statements	21.62%	10.99% non-effective
Disagree with Positive Statements	0.37%	
Uncertain with Positive and Negative Statements	5.81%	

Table 4.94: Description of Teachers' Opinion based on Teachers' Opinionnaire

Therefore, by using the average of the positive responses on the positive items and negative responses on the negative items to find out the positive effect of constructivist pedagogy and it was found to be 83.19%. In this continuation, by using the average of the negative responses on the positive items and the positive responses on the negative items to find out the negative effect or non-effect of constructivist pedagogy and it was found to be 10.99%. Hence the constructivist pedagogy method is 83.19% effective and 10.99% non-effective according to the responses of the teachers of the school while 5.81% of teachers were uncertain with positive and negative items.

4(F) Fulfillment of the Auxiliary Objectives of the Study

4.16.1 Researcher and supervisor have developed the 'instructional material' based on the constructivist pedagogy. There are created the 10 modules on the basis of the 7-E constructivist model for mathematics teaching for the students of the seventh class. The instructional material is attached in the Appendix-I.

4.16.2 Researcher and supervisor have constructed and standardized the 'Concept Attainment Test' to measure the selected mathematical concept for seventh-class students. The final draft of the scale is attached in the Appendix-II.

4.16.3 Researcher and supervisor have constructed and standardized the 'Mathematical Anxiety Scale' to measure the anxiety in mathematics of seventh-class students. The final draft of the scale is attached in the Appendix-III.

4.16.4 Researcher and supervisor have constructed the 'Students' Opinionnaire' to know the views of students about the constructivist pedagogy. The students' opinionnaire is also attached in the Appendix-IV.

4.16.5 Researcher and supervisor have constructed the 'Teachers' Opinionnaire' to explore the views of teachers on constructivist pedagogy. The teachers' opinionnaire is attached in the Appendix-V.

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CHAPTER 5

FINDINGS, CONCLUSION, EDUCATIONAL IMPLICATIONS AND SUGGESTION

5.1 Findings and Conclusion of the Study

After analysis and interpretation of the data the findings of the study are as follows:

Finding- 1

In the context of the null hypothesis H_0^1 of Objective-1, it was found that the students of the experimental group have significantly higher concept attainment than the students of the control group.

Conclusion- 1

In the two equivalent groups, the experimental group which was taught mathematics using constructivist pedagogy the concept attainment of the group was significantly higher than that of the control group, which was taught the same mathematical content from the traditional method. The constructivist pedagogy proved to be very useful and effective for the student's learning of mathematics. Therefore, due to this child-centered teaching-learning by various activities through teaching modules based on the 7-E constructivist model, the students tried to learn on their own in the constructivist class. In which necessary and possible facilities were provided by the teacher. The result showed that the concept attainment was increased due to a strong desire for interest of the experimental group students.

Finding- 2

In the context of the null hypothesis H_0^2 of Objective-2, it was found that the students of the control group have significantly higher mathematical anxiety than the students of the experimental group.

Conclusion- 2

In the group which was taught mathematics using constructivist pedagogy, the mathematical anxiety of that group was low than that of the control group, which was taught the same mathematical content from the traditional method. Students in the experimental group were found to have less mathematical anxiety as they got the opportunity to perform a variety of activities and learn at their own pace. In the control group variety of mathematical concepts were taught on the board by the teacher along with practice questions but they did not participate in any mathematical activity in his own way and the change of ideas related to the concept was practically absent. Due to this those students showed less interest in mathematics and their mathematical concern was found to be very high.

Finding- 3

In the context of the null hypothesis H_0^3 of Objective-3, it was found that there is no significant difference in concept attainment between the high I.Q. and low I.Q. students of the experimental group.

Conclusion- 3

In the present study, the low intelligence and high intelligence students of the experimental group were taught through the constructivist teaching method, in which every effort was made for mostly child-centered education. The students tried to learn on their own according to their learning ability and they found the solution to the given problem. Students in the lower I.Q experimental group did a variety of activities and used different tactics to find a solution to a mathematical problem with the higher I.Q experimental group students as they tried to find a solution to the mathematical problem. As result of which even students with low I.Q unconsciously started using different ideas and tricks to solve the given mathematical question. As a result, despite having a low I.Q, he achieved high concept attainment in mathematics. This leads to the conclusion that an experimental group of students with low I.Q can also get the approximately same concept of mathematics as students with high I.Q if their mathematical education is based on constructivist pedagogy.

Finding- 4

In the context of the null hypothesis H_0^4 of Objective-4, it was found that there is no significant difference in mathematical anxiety between the high I.Q. and low I.Q. students of the experimental group.

Conclusion- 4

The low I.Q. students of the experimental group were taught through a process of learning constructivist pedagogy. During this process, when the lower I.Q. students in the experimental group communicated with the higher I.Q. students in the experimental group about mathematical problems, the lower I.Q. students in the experimental group became aware of their interest and motivation in mathematics, Due to which his confidence increased. By learning mathematics tips and tricks from constructivist pedagogy, they also learned the best ways to solve mathematics problems, which reduced their nervousness and anxiety about mathematics.

Finding- 5.1

In the context of the null hypothesis $H_0^{5.1}$ of Objective-5, it was found that students with low I.Q. in the experimental group had significantly higher concept attainment than students with low I.Q. in the control group.

Conclusion- 5.1

Students in both the experimental and control groups had low I.Q. but students of low I.Q. of the experimental group were taught through special treatments of constructivist pedagogy in which students were engaged in healthy conversations in a constructivist environment and they did different activities. They attempted to solve the problem with a low I.Q. that helped them to increase the concept attainment while the low I.Q. control group was taught through traditional teaching methods that greatly reduced their mathematical concept attainment.

Finding- 5.2

In the context of the null hypothesis $H_0^{5.2}$ of Objective-5, it was found that students with high I.Q. in the experimental group had significantly higher concept attainment than students with high I.Q. in the control group.

Conclusion- 5.2

In the experimental group of high I.Q. students and the control group of high I.Q. students, there were students who have almost the same I.Q. but the students of the experimental group of high I.Q. were taught through the constructivist pedagogy method. In the child-centered mathematical activities were conducted by the students. The students were given different math-based problems by showing flashcards in the constructivist class which the students solved in different ways according to their ability. Hence, the concept attainment in mathematics of the students of high I.Q. of the experimental group was significantly increased. While the control group of students of high I.Q. was taught through simple traditional teaching methods. In which they did not learn math in their own ways independently. So, their mathematical concept attainment was found to be low from the experimental group of students with high I.Q.

Finding- 5.3

In the context of the null hypothesis $H_0^{5.3}$ of Objective-5, it was found that students with low I.Q. in the experimental group had significantly higher concept attainment than students of high I.Q. of the control group.

Conclusion- 5.3

The low I.Q. students of the experimental group were taught through constructivist pedagogy in which keeping in mind the ability of the students the sum concept was presented in front of the child again and again through different attractive ways during these activities regarding math learning due to which their interest in mathematics was increased and they started paying more attention in the class, so that increased their concept attainment in mathematics. The students of high I.Q. of the control group were taught through the traditional teaching method in which different types of concepts and questions were explained to them on the board, but they were not given any type of treatment. Due to which the mathematical concept attainment of these students has been constant and there has been no increase of any kind.

Finding- 6.1

In the context of the null hypothesis $H_0^{6.1}$ of Objective-6, it was found that students with high I.Q. in the control group had significantly higher mathematical anxiety than the students of the experimental group with high I.Q.

Conclusion- 6.1

The students of the experimental group of high I.Q. were taught the selected math concepts based on the constructivist pedagogy method. In which they learned mathematics according to their learning ability. They performed various activities based on mathematical concepts related to their daily life. In which they learned the concepts in their own easy way, therefore the mathematical anxiety was reduced in the students of the experimental group of high I.Q. The students of the control group were taught according to the traditional teaching method based on the textbook of Mathematics. In which the concepts were explained by presenting examples on the board according to the book. Thus, the mathematical anxiety of these students was found to be higher than the students of high I.Q. of the experimental group.

Finding- 6.2

In the context of the null hypothesis $H_0^{6.2}$ of Objective-6, it was found that students with low I.Q. in the control group had significantly higher mathematical anxiety than the students of the experimental group with low I.Q.

Conclusion- 6.2

The students of the experimental group with low I.Q. were taught through constructivist pedagogy in which the students were given various mathematics-based questions in the form of activities and they solved mathematics problems by doing these activities. Because of this, they discovered the concept with the help of the facilitator/teacher. They didn't even realize that they were learning a mathematics chapter or that a mathematics chapter was being taught. In this way, they learned mathematics concepts and they didn't feel tired, which made their mathematics anxiety less likely. High I.Q. students of the control group were taught through traditional teaching methods, a variety of mathematics concepts were taught on the board by the teacher, along with practice questions. But they did not participate in any mathematical activities in their own way and the change of ideas related to the concept was practically absent. Due to which those students showed less interest in mathematics and their mathematical concern was found to be very high.

Finding- 6.3

In the context of the null hypothesis $H_0^{6.3}$ of Objective-6, it was found that students with high I.Q. in the control group had significantly higher mathematical anxiety than the students of the experimental group with low I.Q.

Conclusion- 6.3

The low I.Q. students of the experimental group were taught by the constructivist pedagogy method. These students reached the mathematical concepts in their own way by using various learning materials through the necessary guidance of the facilitator /teacher. They learned mathematical concepts in their own way with the help of provided facilities by the teacher which reduced their mathematical anxiety whereas the high I.Q. students of the control group were taught by the traditional teaching methods in which all the questions asked of the students were answered by the teacher. Due to not giving the opportunity to the students to learn on their own. Therefore, the mathematical anxiety of the high I.Q. students of the control group was found to be very high.

Finding- 7

In the context of the null hypothesis H_0^7 of Objective-7, it was found that there is no significant difference in concept attainment between the female students and the male students of the experimental group.

Conclusion- 7

The reason for this is that the students have participated in the same activities in the same constructivist class environment. Therefore, it can be said that the use of constructivist pedagogy in mathematics significantly increased the concept attainment of both female and male students of the experimental group.

Finding- 8

In the context of the null hypothesis H_0^8 of Objective-8, it was found that there is no significant difference in mathematical anxiety between the female students and the male students of the experimental group.

Conclusion- 8

The reason is that no discrimination was followed between the male and female students of the experimental group during the treatment. Both were taught in the same educational environment. As a result, no difference was found in their mathematical anxiety.

Finding- 9.1

In the context of the null hypothesis $H_0^{9.1}$ of Objective-9, it was found that the female students of the experimental group have significantly higher concept attainment than female students of the control group.

Conclusion- 9.1

The female students of the experimental group were taught using constructivist pedagogy methods. The students did different types of activities using different learning materials, in which they could solve the given mathematical problem and learned the math concept by adopting various self-made tricks and techniques which had increased the mathematical concept attainment of the female students of the experimental group. The female students of the control group were taught through the traditional teaching method. The various math concepts and related questions were solved on the board and they were not given any kind of extra treatment. Due to which they could not be involved in mathematical learning completely. Therefore, their mathematical concept attainment was found below.

Finding- 9.2

In the context of the null hypothesis $H_0^{9.2}$ of Objective-9, it was found that the male students of the experimental group had significantly higher concept attainment than male students of the control group.

Conclusion- 9.2

The male students of the experimental group were taught by the constructivist pedagogy method. In which the students discussed mutually presented problems and solved the math problem according to their own pace by using the learning material presented by the teacher/ instructor. Gradually they understood the mathematics concept and they learned. From which their mathematical concept attainment was found higher than the male students of the control group whereas the male students of the control group were taught through the traditional teaching method. In which they were not given any kind of treatment. They were not given permission by the teacher to talk to each other on the presented mathematics problem in the class. Due to which they could not interact with each other and they were not given any such task so that all those students of the control group could not do some practical work based on mathematics. Due to which they could not involve themselves in mathematics learning. Hence, their mathematical concept attainment was found to be very low.

Finding- 9.3

In the context of the null hypothesis $H_0^{9.3}$ of Objective-9, it was found that the male students of the experimental group had significantly higher concept attainment than female students of the control group.

Conclusion- 9.3

The male students of the experimental group were taught through constructivist pedagogy in which various types of activities were done by the students and teacher through teaching-learning material. Due to which the mathematical concept attainments of the male students of the experimental group were increased. Whereas the female students of the control group were taught the mathematics concepts through traditional teaching methods and no additional learning enhancement material was used. As a result, they obtained lower mathematical concept attainment than the male students of the experimental group.

Finding- 9.4

In the context of the null hypothesis $H_0^{9.4}$ of Objective-9, it was found that the female students of the experimental group had significantly higher concept attainment than male students of the control group.

Conclusion- 9.4

The female students of the experimental group were taught through constructivist pedagogy in which various types of math's-based activities were done by the student and teacher through teaching-learning material. Due to which the mathematical concept attainments of the female students of the experimental group were increased whereas the male students of the control group were taught the mathematical concepts through traditional teaching methods and no additional learning enhancement material was used. As the result, they obtained lower mathematical concept attainment than the female students of the experimental group.

Finding- 10.1

In the context of the null hypothesis $H_0^{10.1}$ of Objective-10, it was found that the female students of the control group had significantly higher mathematical anxiety than female students of the experimental group.

Conclusion- 10.1

Generally, most of the girl students take interest in the study of Hindi, Home Science, and other social subjects and less in Mathematics. The students of the experimental group were taught through the constructivist pedagogy method in which they used the teaching material presented by the teacher according to their creativity with the help of the teacher and they were given the opportunity to do various mathematical activities independently according to their ability. Mathematical concepts boosted their confidence and interest in mathematics so that they could learn mathematics on their own through so many easy activities, that's why their math anxiety was found to be very less.

Girls in the control group were taught through traditional teaching methods that did not use any activity-based learning materials. The teacher answered all the questions asked by the students. In which students were learning mathematics with the help of their teacher and not on the basis of their own ability and their own efforts, due to which these students were more afraid of mathematics subject and teacher. As a result, his mathematical concern was found to be very high.

Finding- 10.2

In the context of the null hypothesis $H_0^{10.2}$ of Objective-10, it was found that the male students of the control group had significantly higher mathematical anxiety than male students of the experimental group.

Conclusion- 10.2

The boys' students of the experimental group were taught through a constructivist pedagogy method, in which they used the teaching material presented by the teacher according to their creativity, they were given the opportunity to do various mathematical activities independently with the help of the teacher and their mathematics skills. Their confidence and interest in mathematics grew as did their ability to find concepts. Their mathematical anxiety was found to be very low as they learned mathematics on their own through such easy activities.

The male students in the control group were taught through the traditional method of teaching in which they did not use any activity-based learning material. The students were learning from the teacher. The teacher answered all the questions asked by the students in which the students were learning mathematics in a teacher-centered environment. Due to which the fear of mathematics subjects and teacher was more in these students. As a result, their mathematical concern was found to be very high.

Finding- 10.3

In the context of the null hypothesis $H_0^{10.3}$ of Objective-10, it was found that the female students of the control group had significantly higher mathematical anxiety than male students of the experimental group.

Conclusion- 10.3

Generally, most of the girl students take interest in the study of Hindi, Home Science, and other social subjects and less in Mathematics. The male students of the experimental group were taught through the constructivist pedagogy method. In which he used the teaching material presented by the teacher according to his creativity. Given the opportunity to do various mathematical activities independently with the help of the teacher, their confidence and interest in mathematics have increased according to their ability to discover the concept of mathematics. Due to this, their mathematics concern was found to be very less.

The female students of the control group were taught through the traditional teaching method. In which no activity-based teaching material was used. The teacher mentioned answers to all the questions asked by the students. In which the students were learning mathematics with the help of their teacher, not on the basis of their ability and their own efforts. Due to which the fear of the mathematics subject was found to be high among these students. As the result, their mathematical anxiety was found to be very high.

Finding- 10.4

In the context of the null hypothesis $H_0^{10.4}$ of Objective-10, it was found that the male students of the control group had significantly higher mathematical anxiety than female students of the experimental group.

Conclusion- 10.4

The female students of the experimental group were taught through the constructivist pedagogy method in which they used learning material presented by the teacher according to their creativity. With the help of the teacher were given the opportunity to do various mathematical activities independently according to their ability to search the mathematics concept increased their confidence and interest in mathematics, due to this their math anxiety was reduced highly.

The male students of the control group were taught through the traditional teaching method. In which no activity-based teaching material was used. the students were learning mathematics in a teacher-centered environment. Due to this fear towards mathematics subject were increased. As the result, their mathematical anxiety was found to be very high.

Finding- 11

In the context of the null hypothesis H_0^{11} of Objective-11, It was found that no significant difference in concept attainment between high S.E.S. and low S.E.S. students of the experimental group.

Conclusion- 11

There was no significant difference in concept attainment in mathematics between the students of high S.E.S. and low S.E.S. of the experimental group. This is because the students of the experimental group of high S.E.S. and low S.E.S. were taught using the constructivist pedagogy and during the various activities, they interacted with each other to solve a given mathematical problem by concluding their various ideas. So, this did not reflect any significant difference between their concept attainment in mathematics. Similarly, no significant difference was observed in the concept attainment between the students of high S.E.S. and low S.E.S. of the experimental group.

Finding- 12

In the context of the null hypothesis H_0^{12} of Objective-12, It was found that no significant difference in mathematical anxiety between high S.E.S. and low S.E.S. students of the experimental group.

Conclusion- 12

There was no significant difference in mathematical anxiety between the students of high S.E.S. and low S.E.S. of the experimental group. This is because the students of the experimental group of high S.E.S. and low S.E.S. were taught using the constructivist pedagogy and during the various activities, they interacted with each other to solve a given mathematical problem by concluding their various ideas. So, this did not reflect any significant difference between their mathematical anxiety. Similarly, no significant difference was observed in the mathematical anxiety between the students of high S.E.S. and low S.E.S. of the experimental group.

Finding- 13.1

In the context of the null hypothesis $H_0^{13.1}$ of Objective-13, it was found that the high S.E.S. students of the experimental group had significantly higher concept attainment than the high S.E.S. students of the control group.

Conclusion- 13.1

The high S.E.S. students of the experimental group were taught by constructivist pedagogy. In this, they performed math-based activities according to their learning ability and searched the concept themselves with the help of the instructor/ teacher. Due to which the concept attainment of the high S.E.S. students of the experimental group was found to be high. While the high S.E.S. students of the control group were taught through the traditional teaching method. In which the teacher explained the math concept to them. The teacher explained examples of each concept with various questions on the board. Due to which the students of the control group did not assess the math concept themselves. Therefore, their concept attainment was reduced.

Finding- 13.2

In the context of the null hypothesis $H_0^{13.2}$ of Objective-13, it was found that the low S.E.S. students of the experimental group had significantly higher concept attainment than the low S.E.S. students of the control group.

Conclusion- 13.2

The low S.E.S. students of the experimental group were taught through a constructivist pedagogy method in which they did many activities to solve mathematical problems and interact with each other. This type of learning environment helped them to open their mind and they gradually did academic work and their hesitation decreased. Their concept realization increased due to participation and collaboration. The low S.E.S. students in the control group were taught with the traditional teaching method. In this, the students did not solve the mathematical problem according to their convenience and ability, due to which they could not present themselves mentally in the learning situations. As the result, their mathematical concept was found below.

Finding- 13.3

In the context of the null hypothesis $H_0^{13.3}$ of Objective-13, it was found that the low S.E.S. students of the experimental group had significantly higher concept attainment than the high S.E.S. students of the control group.

Conclusion- 13.3

The student of the experimental group with low S.E.S. was taught through the constructivist pedagogy method. In which the students performed different types of math activities with other students of the group and made various efforts to learn math on their own. These students obtained more concept attainment due to being acclimatized in the class environment. The students of the control group with high S.E.S. students were taught with traditional teaching methods in which they have not found the opportunity to learn according to their ability due to which they were not able to fully utilize their learning ability. So, the concept attainment of the student was found below.

Finding- 13.4

In the context of the null hypothesis $H_0^{13.4}$ of Objective-13, it was found that the high S.E.S. students of the experimental group had significantly higher concept attainment than the low S.E.S. students of the control group.

Conclusion- 13.4

The students of the high S.E.S. of the experimental group were taught through the constructivist pedagogy method. In which they taught concepts on the basis of prior knowledge. The various activities were given to them, that they completed together with all the students of that group and tried to find out the facts or concepts which one taught in which the teacher/ facilitator also helped them. Therefore, the concept attainment of the student was found to be high. The control group of the students of low S.E.S. were not given any kind of treatment and taught through the traditional teaching method that did not do any work related to the math concept in collaboration with the other students of the group. Hence, the mathematical concept attainment of these students was found to below.

Finding- 14.1

In the context of the null hypothesis $H_0^{14.1}$ of Objective-14, it was found that the high S.E.S. students of the control group had significantly higher mathematical anxiety than the high S.E.S. students of the experimental group.

Conclusion- 14.1

The students of the experimental group of high S.E.S. were taught through the constructivist pedagogy method in which teaching modules were used which were made on the basis of the previous knowledge of the students. Based on these in the direction of learning mathematics, the student tried to reach the concept themselves with the help of teachers' guidance and using learning materials in which the students interacted with each other and performed various tasks in the group. With the facilities and help provided by the teacher, they used their creativity to learn mathematics in the process. They were using their intellectual qualities in an innovative way which reduced their nervousness towards mathematics. They felt that they could learn mathematics in the same way with their own effort. This reduced the mathematical anxiety of the high S.E.S. students of the experimental group. The high S.E.S students of the control group were taught through the traditional teaching method in which they neither did any practical work nor did they interact with any math concept with other students of the group so that they were not able to ask the question from the teacher which would help them in learning mathematics. Due to not being able to dedicate themselves as necessary to learning. The mathematical anxiety of these students increased very high.

Finding- 14.2

In the context of the null hypothesis $H_0^{14.2}$ of Objective-14, it was found that the low S.E.S students of the control group had significantly higher mathematical anxiety than the low S.E.S students of the experimental group.

Conclusion- 14.2

The students in the experimental group of the low S.E.S were taught through a constructivist pedagogy methodology using teaching modules that were made on the previous knowledge of the students. Based on these in the direction of learning mathematics, the student tried to reach the concept themselves with the help of teachers' guidance and using learning materials in which the students interacted with each other and performed various tasks in the group. With the facilities and help provided by the teacher, they used their creativity to learn mathematics in the process. They were using their intellectual qualities in an innovative way which reduced their nervousness towards mathematics. They felt that they could learn mathematics in the same way with their own effort. This reduced the mathematical anxiety of the low S.E.S students of the experimental group. The low S.E.S students of the control group were taught through the traditional teaching method in which they neither did any practical work nor did they interact with any math concept with other students of the group so that they were not able to ask the question from the teacher which would help them in learning mathematics. Due to not being able to dedicate themselves as necessary to learning the mathematical anxiety of these students increased very high.

Finding- 14.3

In the context of the null hypothesis $H_0^{14.3}$ of Objective-14, it was found that the high S.E.S. students of the control group had significantly higher mathematical anxiety than the low S.E.S. students of the experimental group.

Conclusion- 14.3

The students of the experimental group of low S.E.S. were taught through the constructivist pedagogy method in which teaching modules were used which were made on the basis of the previous knowledge of the students. Based on these in the direction of learning mathematics, the student tried to reach the concept themselves with the help of teachers' guidance and using learning materials in which the students interacted with each other and performed various tasks in the group. With the facilities and help provided by the teacher, they used their creativity to learn mathematics in the process. They were using their intellectual qualities in an innovative way which reduced their nervousness towards mathematics. They felt that they could learn mathematics in the same way with their own effort. This reduced the mathematical anxiety of the low S.E.S students of the experimental group. The high S.E.S students of the control group were taught through the traditional teaching method in which they neither did any practical work nor did they interact with any math concept with other students of the group so that they were not able to ask the question from the teacher which would help them in learning mathematics. Due to not being able to dedicate themselves as necessary to learning. The mathematical anxiety of these students found very high.

Finding- 14.4

In the context of the null hypothesis $H_0^{14.4}$ of Objective-14, it was found that the low S.E.S students of the control group had significantly higher mathematical anxiety than the high S.E.S students of the experimental group.

Conclusion- 14.4

The students of the experimental group of high S.E.S. were taught through the constructivist pedagogy method in which teaching modules were used which were made on the basis of the previous knowledge of the students. Based on these in the direction of learning mathematics, the student tried to reach the concept themselves with the help of teachers' guidance and using learning materials. In which the students interacted with each other and performed various tasks in the group. With the facilities and help provided by the teacher, they used their creativity to learn mathematics in the process. They were using their intellectual qualities in an innovative way which reduced their nervousness towards mathematics. They felt that they could learn mathematics in the same way with their own effort. This reduced the mathematical anxiety of the high S.E.S students of the experimental group.

The low S.E.S students of the control group were not given any opportunity to interact with each other on the basis of the taught math concept. The students of the control group with low S.E.S who was taught through the traditional teaching method and they were unable to openly share their thoughts with other students. There is also a slight tension on them from their home situation. Due to which sometimes they were not able to use their full intellectual ability in study and learning. So, they did not being able to dedicate themselves as necessary to learning. The mathematical anxiety of these students found very high.

Finding- 15

The finding of objective-15 is based on the views of the students and teachers on the Effectiveness of Constructivist Pedagogy.

Finding-15.1: Views of Students on "Constructivist Pedagogy Effectiveness Students' Opinionnaire"

About 77.46% of the students expressed their positive views on constructivist pedagogy in the constructivist class, teaching-materials, schooling, teaching-learning, mathematics education, classroom-environment, anxiety reduction, alleviating the fear of mathematics, reducing, mental the reduction of the burden, elimination of virtual void at the time of examination mainly showed in favor of achievement of better concept acquisition whereas 12.17% students did not agree on the above points. Similarly, 50.24% of students disagree with the difficulty of constructivist pedagogy, the lack of activities in student learning, the low effectiveness, uselessness, and inappropriateness of constructivist pedagogy, while 44.84% agree. Constructivist pedagogy is 63.85% effective, 28.50% non-effective and 7.64% uncertain as expressed by the students.

Finding-15.2: Views of Teachers on "Constructivist Pedagogy Effectiveness Teachers' Opinionnaire"

About 99.26% of teachers expressed their positive views on constructivist pedagogy in favor of implementation in teaching-learning material, constructivist class, and students' curiosity to find answers, classroom environment, importance, and rigor, hard work from teacher and students, usefulness in the classroom Shown. Primary and Junior High School, Comparison with Traditional Teaching Method, Constructivist Pedagogy in Mathematics, Mathematics Curriculum, Mathematical Concept Acquisition, Mathematical Concept Mapping. Whereas 0.37% of teachers disagree with these points. Similarly, 67.13% of teachers disagree with constructivist pedagogy in favor of rigidity of learning, passivity, boredom, accessibility, the rigidity of implementation, and unsuitability for mathematics education. Whereas 21.62% of teachers have agreed on the above points regarding constructivist pedagogy and 5.81 percent of teachers have expressed nothing about it. Constructivist pedagogy is 83.19% effective, while it was found to be 10.99% non-effective as expressed by the teachers.

5.2 Educational Implications of the Study

5.2.1 For Students

- The present study is an example of the significant use of constructivist pedagogy to facilitate and enhance mathematics learning and to reduce the mathematical anxiety of the students.
- Using constructivist pedagogy like the study can increase students' ability to learn mathematical concepts.
- By using constructivist pedagogy, the anxiety can be reduced of the students relative to other subjects.
- The concept attainment of the student related to the other subjects like science and geography can be increased by making proper use of constructivist pedagogy in the teaching-learning process.

5.2.2 For Teachers

- Teachers can use constructivist pedagogy in mathematics teaching to increase the mathematical concept attainment and reduce the mathematical anxiety of learners.
- Teachers can use teaching modules in their teaching-learning process which was developed by the researcher in the present study.
- Teachers can reduce students' anxiety by systematically using constructivist pedagogy in other subjects like Science, Biology, Physics, Geography. History etc., and also increases the concept attainment of students related to these subjects.
- Based on the teaching models in the present study teachers can make constructivist pedagogy-based teaching modules of other subjects to enhance the quality of teaching-learning.
- Teachers can practice to make constructivist pedagogy-based teaching modules on the various topics so that if needed in the teaching-learning process that can immediately make constructivist pedagogy-based teaching-learning planning in an abstract way on the chapter related to the selected subject and administer it in their class.

5.2.3 For School/Educational Institution

- Students of class seventh can be taught through constructivist pedagogy using all the 10 modules which are developed by the investigator to attend the good concept attainment in mathematics and reduce the mathematical anxiety of the students.
- School administrators should encourage the teacher to use constructivist pedagogy in the teaching-learning process. So that they can be able to diagnose various known and unknown problems related to the learning of the students.
- School administrators should make available various constructivist pedagogy-based teaching-learning materials in the school. So that teachers can use them when needed for enhancing teaching-learning.

5.2.4 For Government

- The entire mathematical chapters should be made constructivist pedagogical of primary and upper primary class. So that the mathematical textbook can become more student-centric, learnable, simple, and meaningful for mathematics practices.
- Constructivist pedagogy-based teacher training and workshops can be organized by the government to train the teachers.
- Textbook lessons of other subjects like Science, History, Geography, etc., can be made simpler and more understandable for the student by making it constructivist pedagogy based.
- The government should organize various encouraging programs for Teachers for the use of constructivist pedagogy in classroom teaching-learning.

5.2.5 In Global Perspective

- Developed and standardized the ‘Concept Attainment Test’ can be used to measure the mathematical concept attainment of class seventh students.
- Developed and standardized the ‘Mathematical Anxiety Scale’ can be used to measure the mathematical anxiety of class seventh students.

5.3 Limitations of the Research

- Developed instructional material intended for use by class seventh students, results may be different when it applied on the students of other grades.
- Developed and standardized 'Concept Attainment Test' is only for knowing the mathematical concept attainment of class seventh students. Results may be different when applied to the test on the students of another grade.
- Developed and standardized 'Mathematical Anxiety Scale' is only for knowing the mathematical anxiety of class seventh students. Results can differ when applied to the scale of the students of another grade.
- The effect of constructivist pedagogy is analyzed on the concept attainment and anxiety in mathematics among the students of seventh grade only. Applying the same experiment on the students of the other grade the obtained result may differ.

5.4 Suggestions for Further Research

Based on the findings and conclusion of this study, the investigator submits the following suggestions for further researches-

- The present study may be replicated taking a large sample of the students from C.B.S.E., I.C.S.E., and another board.
- The present study may be replicated taking the students of other educational levels.
- Similar studies can be taken by considering other variables.
- Similar studies can be taken by considering other teaching techniques.
- The present study may be replicated to teach other subjects.

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APPENDICES

APPENDIX- I: Instructional Material (Teaching Modules) Final Draft

APPENDIX- II: Constructed and standardized **"**Concept Attainment Test" (CAT) Final Draft

APPENDIX- III: Constructed and Standardized **"**Mathematical Anxiety Scale" (M.A.S.) Final Draft in Hindi and English

APPENDIX- IV: **"**Constructivist Pedagogy Effectiveness Students' Opinionnaire" Final Draft in Hindi and English

APPENDIX- V: **"**Constructivist Pedagogy Effectiveness Teachers' Opinionnaire" Final Draft in Hindi and English

.**APPENDIX- VI:** **"**Group Test of General Mental Ability" (Hindi Modified 72) by Dr. Shyamswaroop Jalota

APPENDIX- VII: **"**Socio-Economic Status Scale" (SESS) by Dr. Sunil Kumar

APPENDIX- VIII: **"**Concept Attainment Test" (CAT) by Dr. Anuradha Joshi and Dr. Ratnamala Arya

APPENDIX- IX: **"**Mathematical Anxiety Scale- India" (MAS-I) by Dr. Ayatollah Karimi and Prof. S. Venkatesan

APPENDIX – I

Constructivist Pedagogical Instructional Material

(TEACHING MODULES)

(Final Draft)

APPENDIX – I

Confidential *(For Only Research)*

Constructivist Pedagogical Instructional Material (Tecahing Modules)

FOR GRADE VII STUDENTS

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MODULE: 1

Subject: Mathematics **Date:** ………………

Topic: Exponent **Period**: …………….

Sub-topic: Introduction

Instructional Objectives:

Knowledge

1. Students will be able to identify the exponents.
2. Students will be able to define exponents.

Understanding

1. Students will be able to find out the value of the exponent.
2. Students will be able to solve the problems related to the exponent.

Application

1. Students will be able to give examples of the exponent.
2. Students will be able to write a numerical value into the exponent form.

Material Required- Coins, notes of 5 and 10 rupee, flowers, small rectangle paper blocks, colored smiley face, blocks, charts, etc.

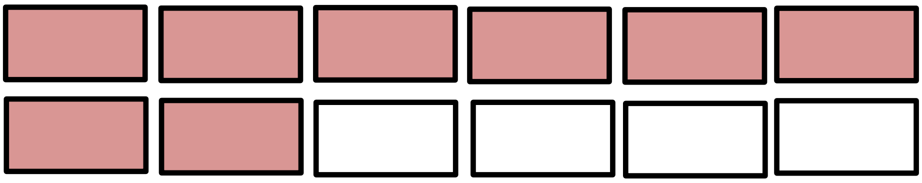
Teaching Process in Constructivist classroom

1. **Elicit:**

S.no.	Teacher's Questions	Students' Response
1.	What are the math operations you have learned?	$+, -, \times, \div$
2.	$4 \times 2 =$……	8
3.	Define the number multiplied by two times we have obtained 4.	2×2
4.	Write 2×2 in a different form.	No response.

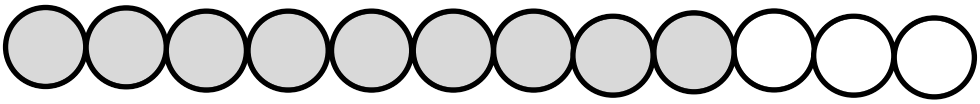
2. **Engage**
   Activity-1

   The teacher will give some paper blocks to the students and ask how many paper blocks are there? Students will be asked to color the blocks to define the value of $2 \times 2 \times 2$.



$2 \times 2 \times 2 =$..............Coloured Blocks

Activity-2: How many circles you will be filled with shade to express the value of 3×3.



$3 \times 3 =$.................Shaded Circle

Activity-3: How many flowers will you pick up to define the value of 5×5.

$5 \times 5 =$.................

The teacher will ask the students how can you write to $2 \times 2 \times 2$, 3×3, 5×5 in short form?

3. Exploration

 2^0  2^1  2^2

 2^3

 3^0  3^1

 3^2

3^3

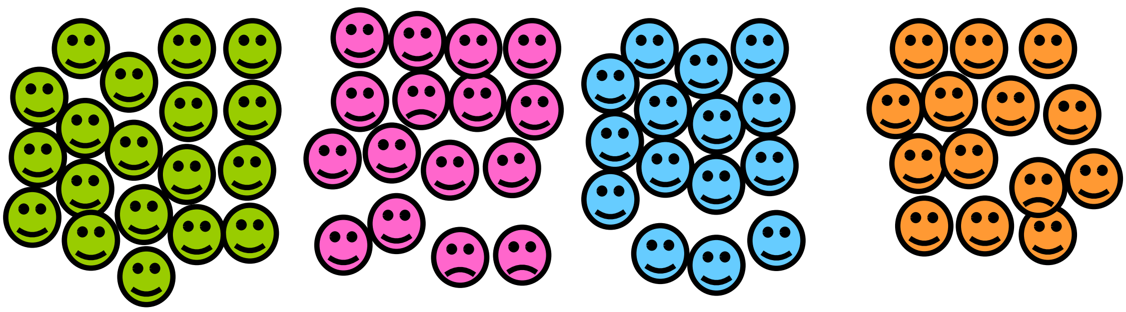
 4^0  4^1

4^2

The teacher may repeat the activity according to the wish of the students. The teacher will say to the students to write the conclusions in their notebook and draw them in any other creative way.

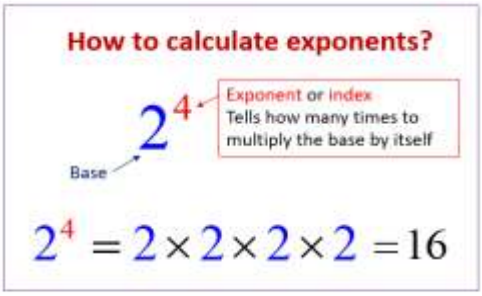
4. **Explanation**: The teacher will divide students into groups and then give activities to each group which they must complete in a given time.

   Activity: The teacher will give these smiley face blocks to each group of students and shall say create an exponent of any number and find the value of that exponent and paste these blocks of the smiley face on your notebook which should be equal to the result obtained by you. After completing the activity, the teacher will tell each group to present the entire activity of that group in class, one representative student from each group will come and present their activity in front of the class.



The teacher will correct the deficiencies in the presentation of the groups and each group will write their results group wise on the blackboard after that the teacher will explain the basic principle of exponentiation to the students.+ many times is ×

× many times is power



5. **Elaboration:** The teacher will be elaborate on the sub-topic from the textbook with the help of teaching material and will ask questions.

6. **Evaluation:**

1. 4^2 =……..×……...
2. 6^4 =……..×……...×……...×……...
3. 4^2 =……..×……...
4. 5^4 = Base…….
   Exponent……………
5. 7^9 = Base…….
   Exponent……………

Find Value-

6. 3^5 =……..……...
7. 6^3 =……..×……...×………
8. Count and write the value in exponential form-

7. **Extend:**
    1. Students can use the exponent to define the big numerical value into short form.
    2. Students can count easily the large number of objects and students with help of multiplication of the same number with the help of row and column trick of the exponent.

****

MODULE: 2

Subject: Mathematics **Date:** ………………

Topic: Exponent **Period**: …………….

Sub-topic: Square

Instructional Objectives:

Knowledge

1. Students will be able to know the square of numbers.
2. Students will be able to define the square.
3. Students will be able to identify the square.

Understanding

1. Students will be able to find out the square of any given number.
2. Students will be able to find the value of the square.

Application

1. Students will be able to give examples of the square.
2. Students will be able to solve the problems based on the square.

Material Required- Direction indicator, pic of traffic light and three ideal monkeys, white beads, bangles, red ribbon, colored plastic blocks, chart papers, match sticks, green peas, etc.

Teaching Process in Constructivist classroom

1. **Elicit:**

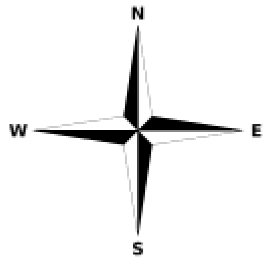
S.no.	Teacher's Questions	Students' Response
1.	How many legs does a cow have?	4 legs
2.	Express 4 in an exponential way	2^2
3.	How will you pronounce the 2^2	2 raised to the power of 2
4.	What else can we say?	No response.

2. **Engage:**
Activity-1

The teacher will give some pics of eyes to the students and shall say count the number of eyes and find the value of the square of that number.

Activity-2

The teacher will give pic of the direction to the students and shall say count and write the number of directions and express it in square form.



Activity-3

The teacher will give the pic of the traffic light to the students to count and find the value of the square of the total number of lights.

3. Explore:

The teacher performs various activities to explore the topic that is better understood by the students. The teacher will be showing the various pictures and questions ask them base on their recent knowledge and square. The teacher will do the following activities-

Activity-1

$3 + 3 + 3 = 9$

$= 3^2$ (Three square)

(The value of three square is 9)

Activity-2

12 + 12 + 12 + 12 + 12 + 12 + 12

12 + 12 + 12 + 12 + 12 = 144

$= 12 \times 12 = 12^2$

Activity-3

9 + 9 + 9 = 27

9 + 9 + 9 = 27

9 + 9 + 9 = 27

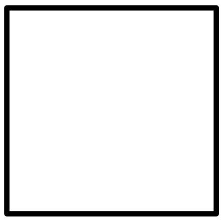
27 27 + 27 = 81

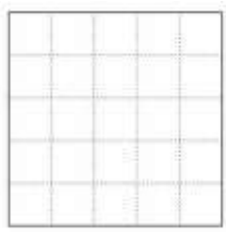
81 = 9^2

4. Explain: The teacher will divide the students into various groups and will give each group an activity regarding the topic.

Activity-1

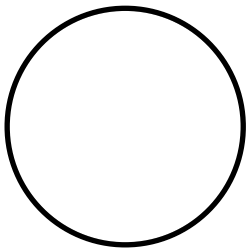
Cut the paper the equal part of 4^2 and write the serial number on every part of the paper then paste it on a chart.

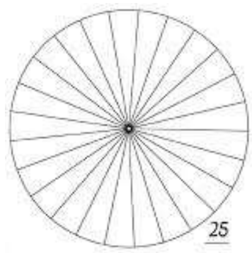




Activity-2

Divide the circle into the equal parts of 5^2 then paste on a chart in a sequence.





Activity-3

Cut the ribbon into the equal part of 6^2 and paste all parts on the given chart paper.

Activity-4

Joint these blocks and count, find the square value of the number obtained.


After completing the activity, a representative student of each group will present the activity of his own group. The teacher will collect all the charts after the group presentation of the students and explain the topic by using teaching material.

5. Elaborate:

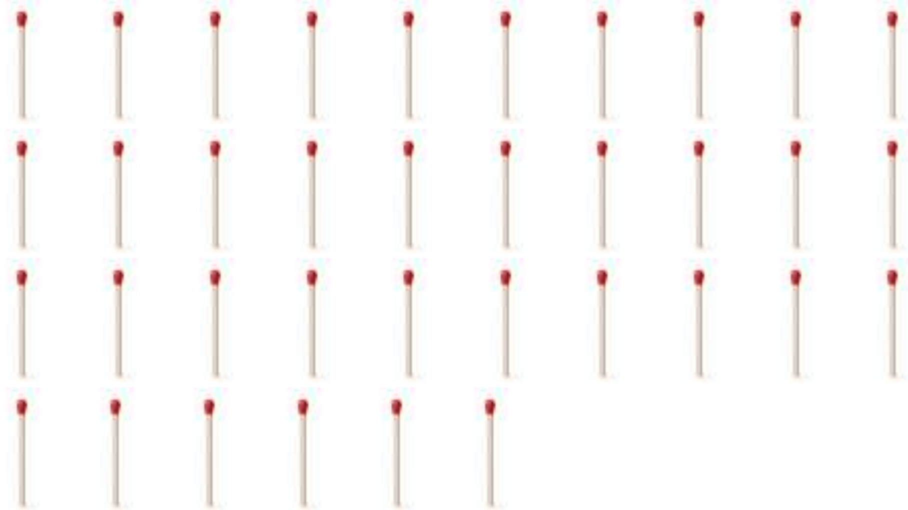
The teacher will teach the topic from the textbook in detail as well as possible and give the flashcard to the students then the teacher will ask the questions given in the flashcard from every student and clear the doubts of all students regarding the topic.

Table of Squares from 1 - 25

$1^2 = 1$	$6^2 = 36$	$11^2 = 121$	$16^2 = 256$	$21^2 = 441$
$2^2 = 4$	$7^2 = 49$	$12^2 = 144$	$17^2 = 289$	$22^2 = 484$
$3^2 = 9$	$8^2 = 64$	$13^2 = 169$	$18^2 = 324$	$23^2 = 529$
$4^2 = 16$	$9^2 = 81$	$14^2 = 196$	$19^2 = 361$	$24^2 = 576$
$5^2 = 25$	$10^2 = 100$	$15^2 = 225$	$20^2 = 400$	$25^2 = 625$

6. Evaluate:

1. 19^2= ……………………
2. 10000 is a square value of ……………. square.
3. Count the matchsticks and write the value in the form of the square.



4. Count the peas and write the value in the form of the square.

 × 

………. ……….

7. Extend:

The teacher will say to the students to create a story based on the pictures and write the title of your story. The teacher will say to Write the name and number of all living and non-living things which are displayed in the presented picture and find the square of those numbers.

Square can be used……

1. To find the area of a surface.
2. To calculate the number of living and non-living things.
3. To solve mathematical problems.
4. To make an easy calculation like multiplication and division.

****

MODULE: 3

Subject: Mathematics **Date:** ……………

Topic: Exponent **Period**: ………….

Sub-topic: Cube

Instructional Objectives:

Knowledge

1. Students will be able to know the cube of numbers.
2. Students will be able to define the meaning of the cube.
3. Students will be able to identify the cube.

Understanding

1. Students will be able to find out the cube of any given number
2. Students will be able to find the value of the cube.

Application

1. Students will be able to give examples of cubes.
2. Students will be able to solve the problems based on the cube.

Material Required- Toffee, bangles, stars, wall watch, apples, accessories, matchsticks, biscuits, rupee of 10 and 100, rupee 5 coins, etc.

Teaching Process in Constructivist classroom

1. **Elicit:**

S.no.	Teacher's Questions	Students' Response
1.	How many candies are here? 	8 candies
2.	Exponentially express the number of candies.	2^3
3.	How will you pronounce the 2^3	2 raised to the power of 3
4.	What else can we say?	No response.

2. **Engage:** The teacher will engage the students in the activities which will be related to finding the cube of miscellaneous numbers.

Activity-1

The teacher will say to the students to count these bangles and find out the cube of obtained value.

Activity-2

The teacher will say to the students to count these stars and define the obtained value into cube form.

Activity-3

The teacher will say to the students to write the time shown in the clock in the form of the cube.

3. Explore

 ×  ×  =  ^{3}

1 1 1 1^3

 ×  ×  =  ^{3}

2 2 2 2^3

 ×  ×  =  ^{3}

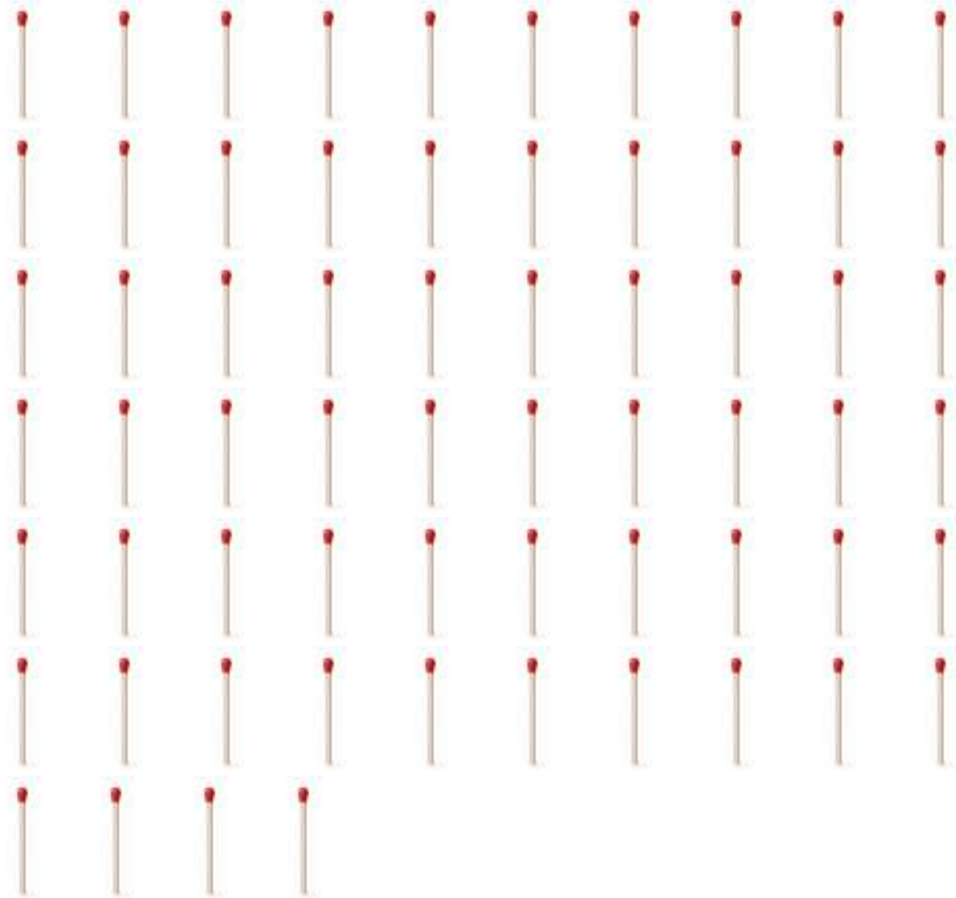
3 3 3 3^3

4. Explanation

The teacher will divide the students into different groups and will give different activities related to each group cube. The teacher will say to the students to count these decorative accessories and paste them on a chart in a sequence. The teacher will also say to the students to present their activities on the chart and define the title of the activity and which number of the cube represents the obtained value?

Activity-1

Activity-2



Activity-3

Activity-4

Every group will present their task and give a description of the result obtained. The teacher will collect the chart after the group presentation and correct the understanding of the students about the topic if required. The teacher will explain the topic by using the activities and teaching material and clear the doubts of the students.

1	+ of many times is ×
2	× in many times is Power
3	Power in many time is called Exponent

5. Elaboration

The teacher will teach the topic from the textbook and elaborate the topic in detail by the description of previous activities and all other techniques as per as possible.

Cubes From 1 to 30

There are cubes from 1 to 30 as below.

Number	Cubes of Number	Number	Cubes of Number	Number	Cubes of Number
1	1	11	1331	21	9261
2	8	12	1728	22	10648
3	27	13	2197	23	12167
4	64	14	2744	24	13824
5	125	15	3375	25	15625
6	216	16	4096	26	17576
7	343	17	4913	27	19683
8	512	18	5832	28	21952
9	729	19	6859	29	24369
10	1000	20	8000	30	9000

The teacher will give the flashcard based on the problems of cubes to students and will ask the questions from students and explain the result in front of the whole class.

Find the cube of the given number on the flash card.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

6. Evaluation

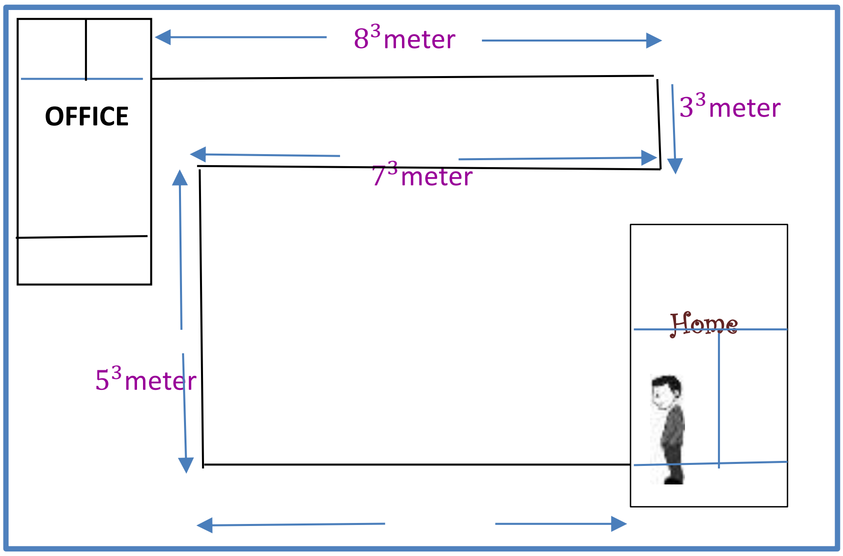
Answer the following questions:

1. What is the cube?
2. 9^3 =……………
3. 13^3 =……………
4. $1025 = \ldots\ldots\ldots\ldots.^3$
5. Match the following

A	B
125	4^3
3^3	8^3
64	5^3
10^3	27
512	1000

7. Extend

Create a story according to the picture by writing all the numbers in a simple form.



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MODULE: 4

Subject: Mathematics **Date:** …………………

Topic: Exponent **Period**: ………………

Sub-topic: Numbers in the form of Exponent.

Instructional Objectives:

Knowledge

1. Students will be able to know the form of exponent of various numbers.
2. Students will be able to differentiate between big and small exponents.
3. Students will be able to find the value of multiplication of the same rational number many times.

Understanding

1. Students will be able to write the big numbers into short form.
2. Students will be able to compare the two or more exponents.

Application

1. Students will be able to give examples of the exponential form of numbers.
2. Students will be able to solve the problems when a number is presented in its exponential form.
3. Students will be able to use the exponent in daily life situations when they need to write a big number into short form.

Material Required- Artificial stars, flowers, half beads, full white beads, pipes, and images of earth, sun, moon, etc.

1. Elicit:

S.no.	Teacher's Questions	Students' Response
1.	+ of many times is…….	Multiplication
2.	Multiplication in many times is…….	Power
3.	Power in many times is called…….	Exponent
4.	How will write you 64 in the form of exponent?	No response.

2. Engage: The teacher will facilitate the same activities for all the students of the class. The teacher will give various things according to the number of activities to the students.

Activity-1

The teacher will give some artificial stars to the students. The students will make groups of stars in which every group has the same number of stars. Students will paste the things on the given chart paper and will count to the artificial stars find value and Write the value in exponential form.

Activity-2

Paste these flowers on a chart in the following mathematical way.

……………×…………×…………=… … … … … …^{3}

Activity-3

The teacher will say express to the 3 raised to the power of 4 by making a diagram of these sticks.

Activity-4

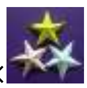
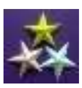
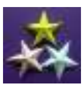
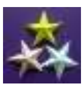
The teacher will say to the students take these beads equal to the number of 2^5 and paste on the given chart.

3. Explore

Activity-1

 $=2^7$

Activity-2

 ×  ×  ×   ×  ×  ×  ×  $= 3^9$

Activity-3

 ×  ×  ×  ×  ×  ×

 ×  ×  ×  ×  $= 4^{11}$

Activity-4

 ×  ×  ×  ×  ×

 ×  ×  ×  ×  ×

 ×  ×  ×  ×  $= 6^{15}$

4. **Explain**

The teacher will divide the students into groups and will say that show the given exponent with the help of these following things based on previous activities.

Activity-1

Show 4^3 on a chart with the help of the flowers

Activity-2

Show 2^6 on a chart with the help of the white beads.

Activity-3

Show 3^4 on a chart with the help of these colored beads

Activity-4

Show 5^6 on a chart with the help of these half-beads.

The representative student of each group will present their group activity in class. After the group presentation teacher will correct the understanding of students regarding the topic and will give suggestions about it. The teacher will explain the concept by using instructional material and asking the question to the students.

5. Elaborate

The teacher will teach through the textbook and explain the concept in detail. The teacher will give the question-based flashcards to the students and students will solve the problem in front of the whole class.

1. 6 multiplied in 3 times=.......
2. 3 multiplied in 5 times=........
3. $1000=10^{\cdots\cdots}$
4. ....×.......×........= 11
5. ....×.......×.......×.......×.......× ....×=7

6. Evaluate

1. $10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10^{\cdots\cdots\cdots}$
2. $8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 = \ldots\ldots\ldots.^{8}$
3. $64= 4^{\cdots\cdots\cdots}$
4. 5^6 =.......×.......×.......×.......×.......×............
5. Find the value of 7^5
6. Make the sign of < or >

5^6……..5^9

7. **Extend**

Mass of Earth is 6.68$\times 10^{25}$ kg

Diameter of Sun is 1.4 $\times 10^{9}$meter.

Mass of the Moon is 7.34 $\times 10^{22}$ kg

****

MODULE: 5

Subject: Mathematics **Date:** …………………

Topic: Exponent **Period**: ………………

Sub-topic: Negative Exponent

Instructional Objectives:

Knowledge

1. Students will be able to know the negative exponent.
2. Students will be able to differentiate between power and base of negative exponent.
3. Students will be able to identify the negative exponent.

Understanding

1. Students will be able to find out the negative exponent.
2. Students will be able to compare the two or more negative exponents.

Application

1. Students will be able to give examples of negative exponents.
2. Students will be able to solve the problems based on negative exponent.

Material Required- Pencil color, chart papers, orange, guava, apple, color-wheel, flag, the image of a window, fan, table, floor, pentagonal, fabric, etc.

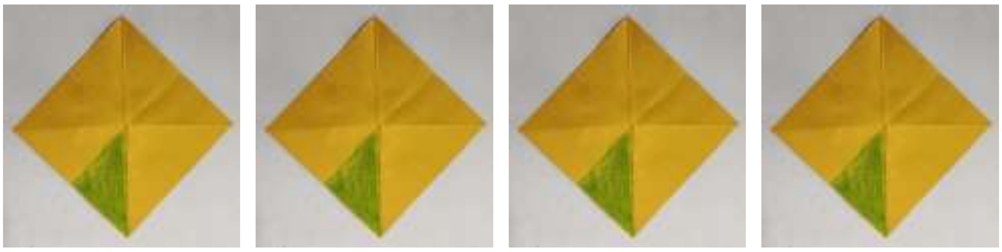
Teaching Process in Constructivist classroom

1. Elicit:

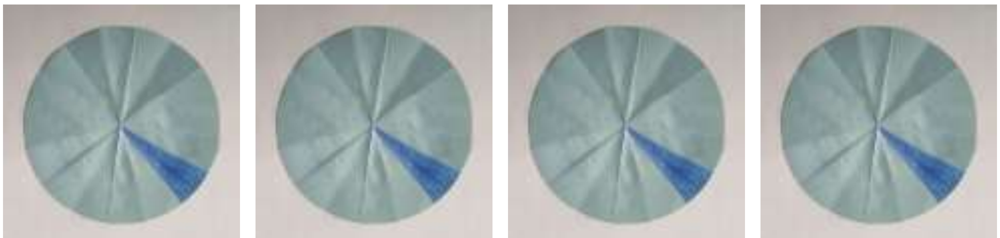
S. no.	Teacher's Questions	Students' Response
1.	What did you study tomorrow?	Cube
2.	What is the exponent of the cube of any number?	3
3.	A circle is divided into three parts, write the mathematical value of one part.	1/3
4.	How will you write 1/3 in exponent form?	No response.

2. **Engage**: The teacher will give the paper of some different shapes and sizes to the students which were folded in a different way so that the paper is divided into many parts. Each paper sheet had a part that was shaded. The students will count all parts of the given paper sheet and find the value of the shaded part and write the value in exponential form.

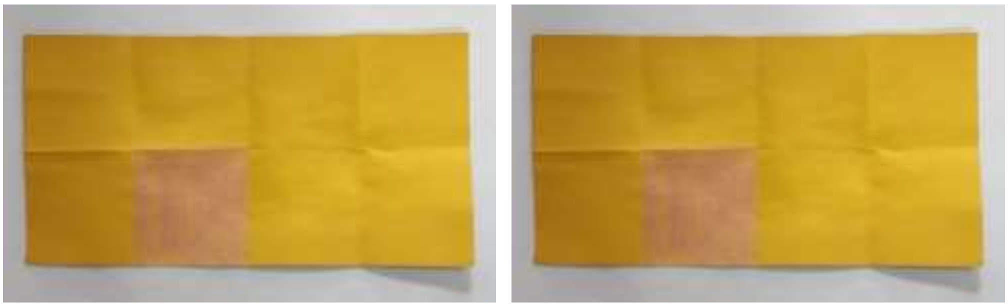
Activity-1



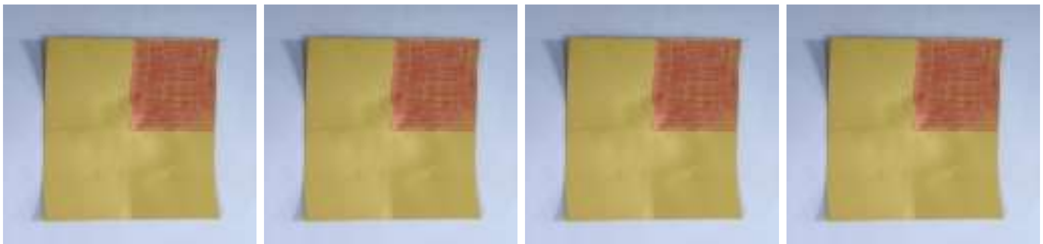
Activity-2



Activity-3

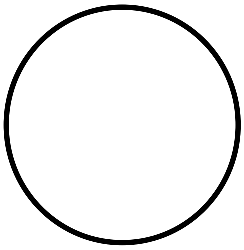


Activity-4

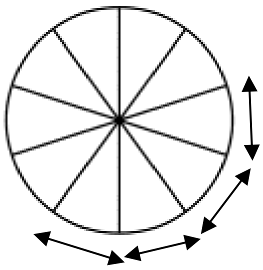


3. **Explore:** The teacher will represent various activities that are related to the negative exponent. Students will write down the result of these activities and draw it according to their own understanding in their notebooks.

Activity-1



1 Circle

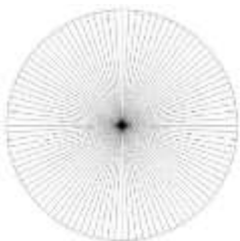


$\frac{1}{10} = 10^{-1}$ (Numerical value of 1 part)

Negative Exponent

Each part is 1/10

The circle divided into 10 parts



$\frac{1}{100} = \frac{1}{10^2} = 10^{-2}$ (Numerical value of 1 part)

Negative Exponent

Each part is 1/100

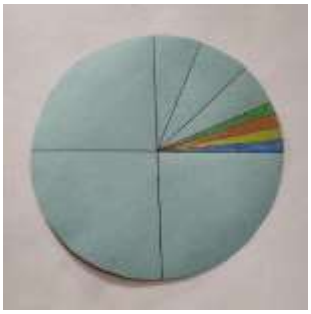
The 10 parts divided into 10 parts again

Activity-2

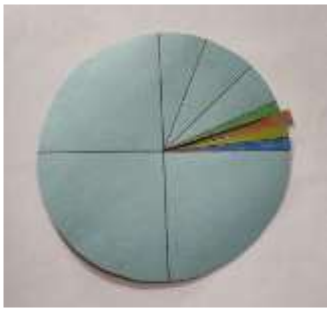
$\frac{1}{1} = 1^1$

$\frac{1}{4} = 4^{-1}$

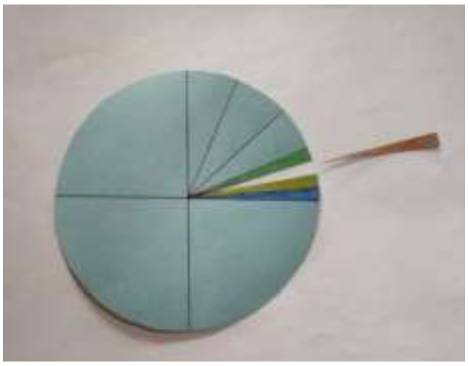
$\frac{1}{4\times4} = \frac{1}{4^2} = 4^{-2}$



$\frac{1}{4\times4\times4} = \frac{1}{4^3} = 4^{-3}$



$\frac{1}{4\times4\times4} = \frac{1}{4^3} = 4^{-3}$



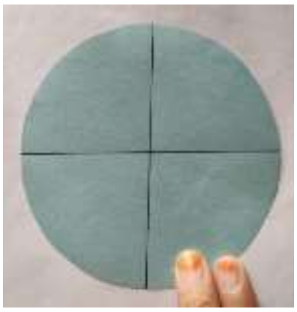
$\frac{1}{4\times4\times4} = \frac{1}{4^3} = 4^{-3}$(the value of cut part)

4^{-1} 4^{-2} 4^{-3}

Negative Exponent

Activity-3

$\frac{1}{1} = 1^1$



$\frac{1}{4} = \frac{1}{2\times2} = 2^{-2}$

$\frac{1}{2} = 2^{-1}$

$\frac{1}{8} = \frac{1}{2\times2\times2} = 2^{-3}$

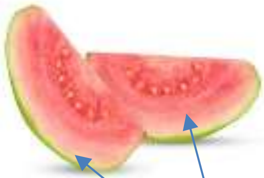
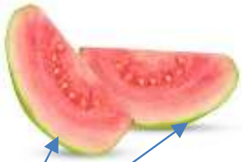
$\frac{1}{8} = \frac{1}{2\times2\times2} = 2^{-3}$

2^{-1} 2^{-2} 2^{-3}

Negative Exponent

Activity-5

 =

(Cut into 4 parts)

Value of each slice

$\frac{1}{4} = 4^{-1}$ Part

Negative Exponent

Activity-6

1 orange

10 slices

Value of each slice

$\frac{1}{10} = 10^{-1}$ Part

Negative Exponent

4. **Explain:** The teacher will divide the students into groups and give activities to each group. The teacher will say cut things into various equal parts and find the negative exponent of one part/slice. Properly write the result in your notebook.

Activity-1

Activity-2

Activity-3

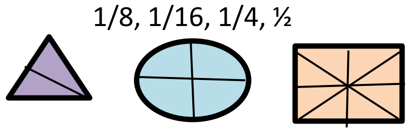
Activity-4

After completing these activities, the representative student of each group will present their activity in front of the class. The teacher will clear all doubts of students regarding this and explain the topic with the help of teaching material.

5. **Elaborate:** The teacher will teach from the textbook to explain the topic in detail and ask the question from every student. The teacher will give the flash card to the students and will say to solve the problem given in the card and explain the result in front of the class.

1. Write the numbers in negative exponents

   1/8, 1/16, 1/4, ½

2. 

   Find the negative exponent of one part of each shape.

6. **Evaluate:**

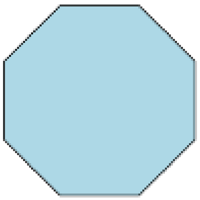
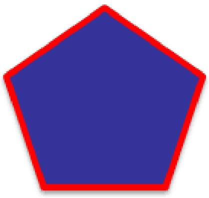
1. $3^{-3} = \frac{1}{\dots\dots\dots\dots}$
2. $2^{-4} = \frac{1}{\dots\dots\dots\dots}$
3. $\frac{\mathbf{1}}{\mathbf{6}} = \dots\dots\dots^{\mathbf{-1}}$
4. $\frac{\mathbf{1}}{\mathbf{11}} = 11$
5. Match the following

A	B
2^{-1}	$\frac{1}{3^2}$
$\frac{1}{3}$	2^{-2}
3^{-2}	$\frac{1}{2}$
$\frac{1}{4}$	3^{-1}

6. find the value of one part of Ashoka Chakra in exponential form.

7. **Extend:**
The equal parts of the following thing can be written in the form of a negative exponent.

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MODULE: 6

Subject: Mathematics **Date:** …………………

Topic: Exponent **Period**: ………………

Sub-topic: Exponential Properties of Integers

Instructional Objectives:

Knowledge

1. Students will be able to know the exponential properties of positive integers.
2. Students will be able to the exponential properties of negative integers

Understanding

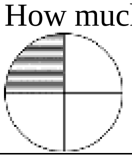
1. Students will be able to find out the value of positive integers when it becomes in exponential form
2. Students will be able to find out the value of negative integers when it becomes in exponential form

Application

1. Students will be able to give examples of positive integers and negative integers when it becomes in exponential form
2. Students will be able to give examples of this.

Material Required- Chart paper, embroidery threads, leaves, coins, 5 rupees note, chocolate, stars, bangles

1. **Elicit:**

S.no.	Teacher's Questions	Students' Response
1.	How much part is no-shaded of the circle? 	$\frac{3}{4}$ part
2.	$\frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} =$……….	$\frac{27}{64}$
3.	Write $\frac{27}{64}$ in exponential form	$(\frac{3}{4})^3$
4.	Find the value of $(-1)^3$	No response.

2. **Engage:** The teacher will give some different things to the students and will say express (-1) by using these things on the given chart.

Activity-1

Express (-1) by using the paper sheet on the provided chart paper.

Activity-2

Express (-1) by using these leaves on the provided chart paper.

Activity-3

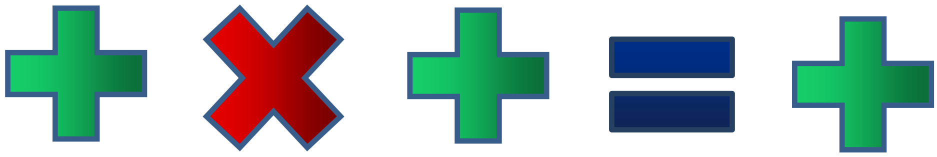
Express (-1) by using the embroidery thread on the provided chart paper.

Activity-4

Express (-1) by using the currency on the provided chart paper.

3. **Explore**: Activity will perform by the teacher.

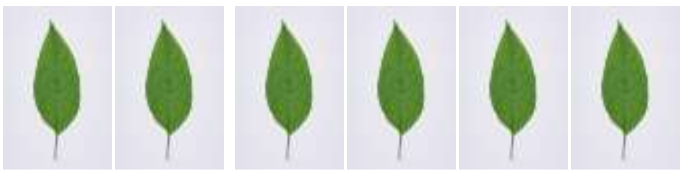
Activity-1



$(8) \qquad \times \qquad (8) \qquad = 8^2$

$= 64$ **Legs**

Activity-2



-2

$2 \quad - \quad 4 \quad = -2$

$\times$

-2

$2 \quad - \quad 4 \quad = -2$

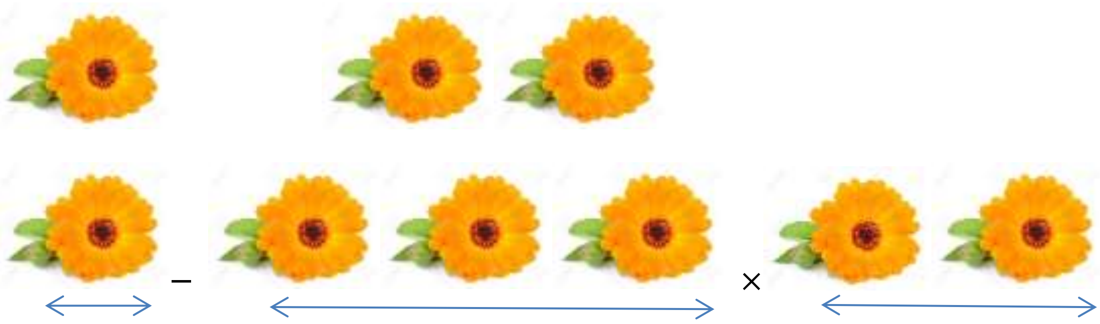
$$\boxed{(-2) \times (-2) = 4}$$

Activity-3

2 × (1 − 3)

$$\boxed{2 \times (-2) = -4}$$

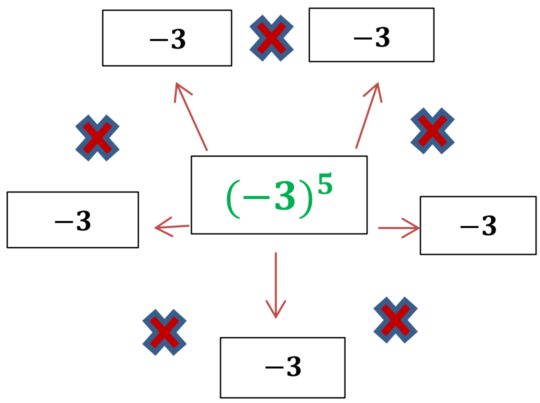
Activity-4



(2 − 5) × 2

$$\boxed{(-3) \times 2 = -6}$$

Activity-5



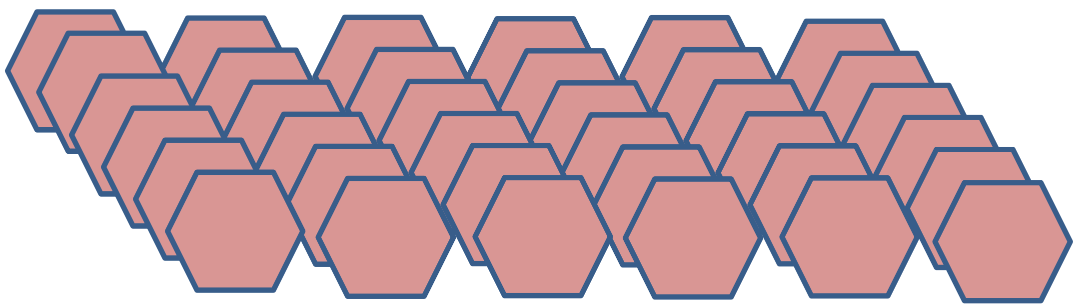
4. **Explain**

The teacher will divide the students into groups and give each group an activity to perform.

Activity-1

The teacher will say to the students that cut the paper into various small circles and express the value of (-3) & $(-3)^3$by pasting these circles on the given chart paper.

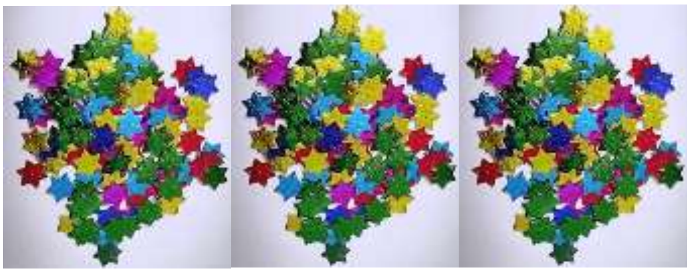
Activity-2



The teacher will say to the students express the value of (-6) & $(-2)^5$ by pasting these pentagonal on the given chart.

Activity-3

The teacher will say to the students express the value of (-7) & $(-5)^4$ by pasting these stars on the given chart.



Activity-4

The teacher will say to the students express the value of (-10) & $(-6)^3$ by making a design with the help of these bangles on the given chart.

The one representative students of the group will present the group activity in front of the whole class. After the presentation of each group teacher will correct the understood concept of the students if required and explain the topic with the help of different examples and teaching materials.

5. Elaborate

The teacher will elaborate the topic through text book properly and ask the problems of the students regarding the topic. The teacher will give the flashcards to the students. The one topic-related problem will be written on each flashcard. Students will solve the problems one by one in front of the class and in this process they can use the textbook and teaching materials.

$(-1)^4$	$(-1)^0$	$(-1)^6$	$(-1)^9$	$(-1)^5$
$(-2)^3$	$(-2)^0$	$(-3)^5$	$(-9)^2$	$(-5)^4$
$(-3)^4$	$(-2)^6$	$(-4)^4$	$(-1)^3$	$(-2)^7$
$(-1)^1$	$(-7)^3$	$(-5)^5$	$(-1)^8$	$(-3)^3$

6. Evaluate:

1. Colored the box which has the value of $(-2)^5$

-16	-18	-32	-8

2. How many boxes do you make shades to express the value of $(-3)^3$.

3. Match the following:

A	B
$(-4)^2$	-1
$(-1)^5$	1
$(6)^1$	16
$(2)^0$	6

7. Extend

$a^0 = 1$	$5^0 = 1, 7^0 = 1, 9^0 = 1, 3^0 = 1, 11^0 = 1, 15^0 = 1, 2^0 = 1,$
$a^1 = a$	$8^1 = 8, 4^1 = 4, 7^1 = 7, 6^1 = 6, 1^1 = 1, 12^1 = 12, 16^1 = 16$
$(-1)^{even} = 1$	$(-1)^2 = 1, (-1)^4 = 1, (-1)^6 = 1, (-1)^8 = 1, (-1)^{10} = 1$
$a^{even} = +$	$2^2 = 4, 2^4 = 16, 2^6 = 64, 3^2 = 9, 3^4 = 81, 3^6 = 729$
$(-1)^{odd} = -1$	$(-1)^1 = -1, (-1)^3 = -1, (-1)^5 = -1, (-1)^7 = -1$
$a^{odd} = -$	$(-3)^3 = -27, (-2)^3 = -8, (-2)^5 = -32, (-3)^7 = -2187$

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MODULE: 7

Subject: Mathematics **Date:** …………………

Topic: Exponent **Period**: ………………

Sub-topic: Product and Quotient Rule.

Instructional Objectives:

Knowledge

1. Students will be able to know the product and quotient rule of the exponent.
2. Students will be able to differentiate between the product and quotient rule of the exponent.
3. Students will be able to identify the addition and subtraction of exponents.

Understanding

1. Students will be able to add and subtract exponents.
2. Students will be able to compare between addition and subtraction of exponent.

Application

1. Students will be able to give examples of addition and subtraction of exponent.
2. Students will be able to solve the problem based on the addition and subtraction of the exponent.

Material Required- Paper blocks of 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, chart paper etc.

Teaching Process in Constructivist classroom

1. Elicit:

S.no.	Teacher's Questions	Students' Response
1.	Find out the value of $(-3) \times (-3) \times (-3) \times (-3) =$……………………	81
2.	Write 81 in the form of the exponent.	3^4
3.	Give an example that is similar to 3^4	3^7
4.	Find $3^4 \times 3^7 =$……………………	No response.

2. Engage: The teacher will give paper blocks of different numbers to the students and will say express the given exponent in a simple form by using these paper blocks and find the value of given exponent also.

Activity-1

Express the exponent 3^8 in a simple form by using the given paper blocks and pasting them on a chart and finding the value of the given exponent.

Activity-2

Express the exponent 2^{11} in a simple form by using the given paper blocks and pasting them on a chart and finding the value of the given exponent.

Activity-3

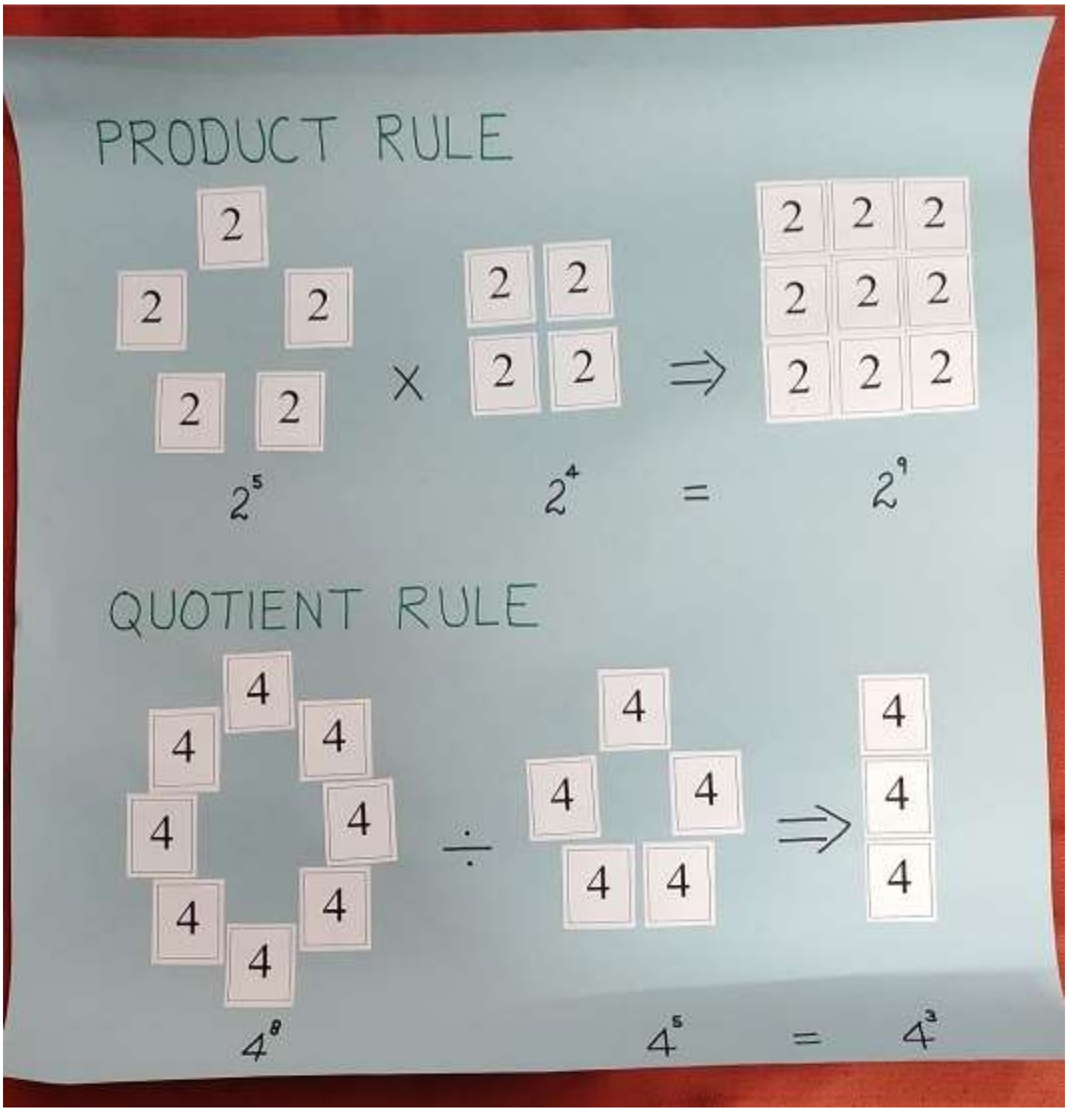
Express the exponent 9^4 in a simple form by using the given paper blocks and pasting them on a chart and finding the value of the given exponent.

Activity-4

Express the exponent 6^7 in a simple form by using the given paper blocks and pasting them on a chart and finding the value of the given exponent.

3. Explore

The teacher will perform the following activity-



4. Explain

The teacher will divide the students into groups and give each group an activity to perform.

Activity-1

Find $3^6 \times 3^2 =$ .... and express it through the given number blocks on a chart.

Activity-2

Find $5^8 \div 5^4 =$.............. and express it through the given number blocks on a chart.

Activity-3

Find $6^6 \times 6^7 =$............. and express it through the given number blocks on a chart.

Activity-4

Find $7^9 \div 7^5 =$.............. and express it through the given number blocks on a chart.

A representative student from each group will present the entire group activity to the class, and for those groups that did not perform well, the teacher will allow them to re-analyze past results. After the group presentation, the teacher will rectify the mistakes of the students group wise and explain the topic in detail using various teaching-learning materials.

5. Elaborate

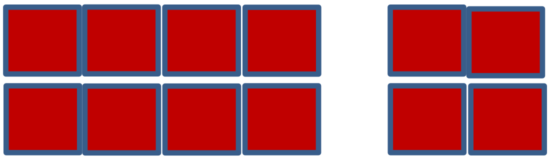
The teacher will teach through the textbook and explain the topic with various examples. The teacher will ask the question through the flashcards to every student, the student will solve the given questions infront of the students.

$2^3 \times 2^4 = \quad ^{7}$	$4^2 \times 4^5 = 4$	$5^7 \times 5^2 = 5$
$7^6 \div 7^3 = 7$	$6^5 \div 6^4 = \quad ^{1}$	$3^{11} \div 3^5 = \quad ^{6}$
$5^5 \times 5^5 =$	$8^5 \times 8^3 =$	$10^{10} \times 10^4 =$
$4^6 \div 4^1 =$	$5^7 \div 5^7 = 5$	$9^5 \div 9^0 =$

6. Evaluate

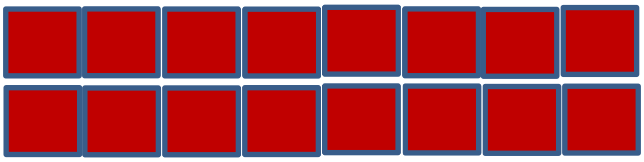
1. $(-5)^3 \times (-5)^7 = 5$
2. $3^4 \times 3^3 = \quad ^{7}$
3. $9^2 \times 9^6 =$
4. $4^4 \times 4^4 =$
5. $1^1 \div 1^0 =$
6. $6^9 \div 6^5 = \quad ^{4}$
7. $11^{10} \div 11^2 =$
8. $2^{15} \div 2^6 =$

7. Extend



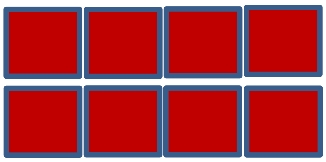
$$8 \times 4$$

$$2^{3} \times 2^{2} = 2^{3+2}$$



$$2^{4}$$

$$\div \qquad = 2^{4-3} = 2$$



$$2^{3}$$

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MODULE: 8

Subject: Mathematics **Date:** …………………

Topic: Exponent **Period**: ………………

Sub-topic: Power and Power of Two Product Rule.

Instructional Objectives:

Knowledge

1. Students will be able to know the power rule and power of the two product rules of the exponent.
2. Students will be able to differentiate between the power rule and power of two product rules of the exponent.
3. Students will be able to identify the power rule and power of two product rules of the exponent.

Understanding

1. Students will be able to multiply the exponent.
2. Students will be able to compare between power rule and the power of two product rules of the exponent.

Application

1. Students will be able to give examples of power rule and power of two product rules of the exponent.
2. Students will be able to solve the problem based on the multiplication of exponents.

Material Required- Charts, beads, pins, stars, sketch color, embroidery thread, number blocks of 3, 2, 9, 6, 4, 5, 7, etc.

1. Elicit:

S.no.	Teacher's Questions	Students' Response
1.	Write 32 in the power of 2.	2^5
2.	Write 16 in the power of 2	2^4
3.	Find $2^4 \times 2^5 =$.................	2^9
4.	Write 2^9 in a different form.	No response.

2. Engage: The teacher will give the number blocks to the students and will say make various exponents by using the given number blocks and paste them on a chart to find the value of the exponent made by you.

Activity-1

Make different exponents by using 2 number blocks, paste them on the given chart and write the value of exponent made by you.

2	2	2	2	2	2	2	2
2	2	2	2				

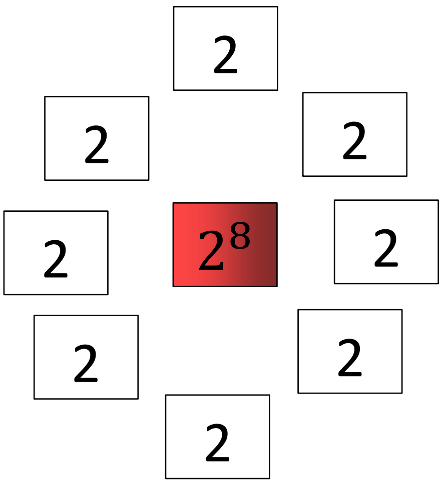
Activity-2

Make various exponents with the help of 3 number blocks.

3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3

Activity-3

Divide 2^8 into various small exponent



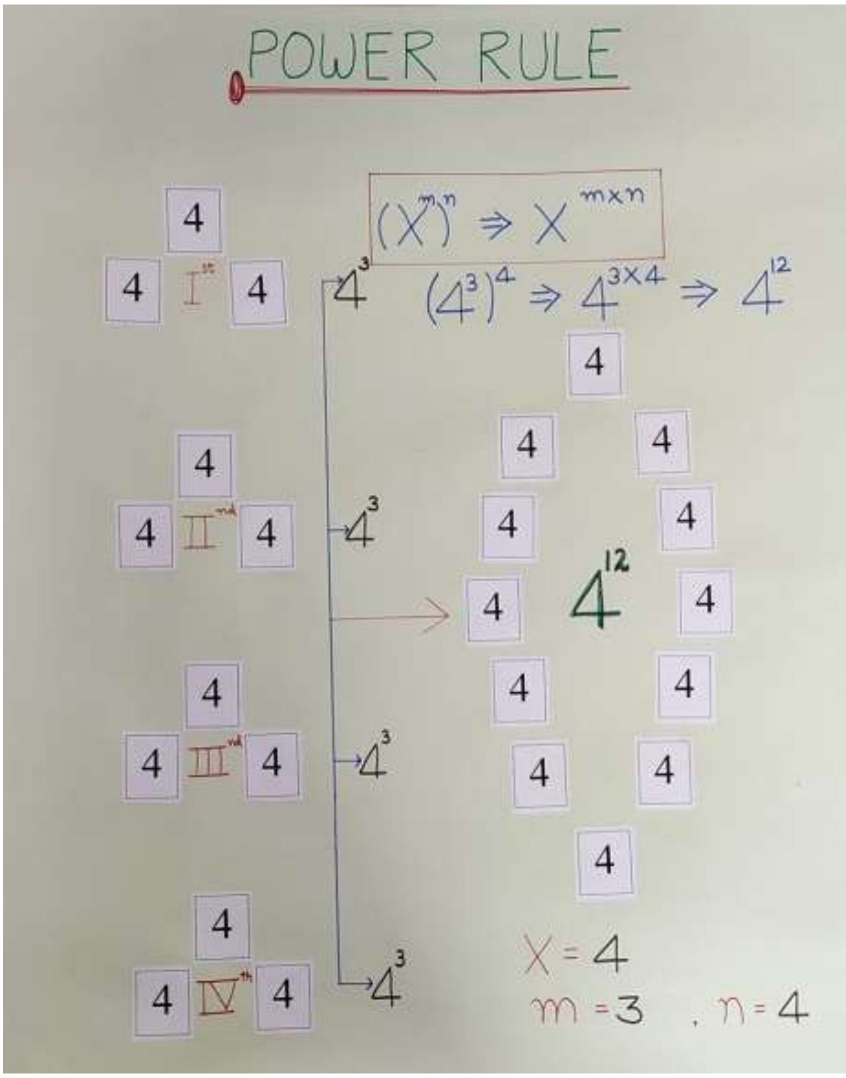
Activity-4

Make three different exponents which have the same base but different exponents by using the pins. Express your activity on the given chart.

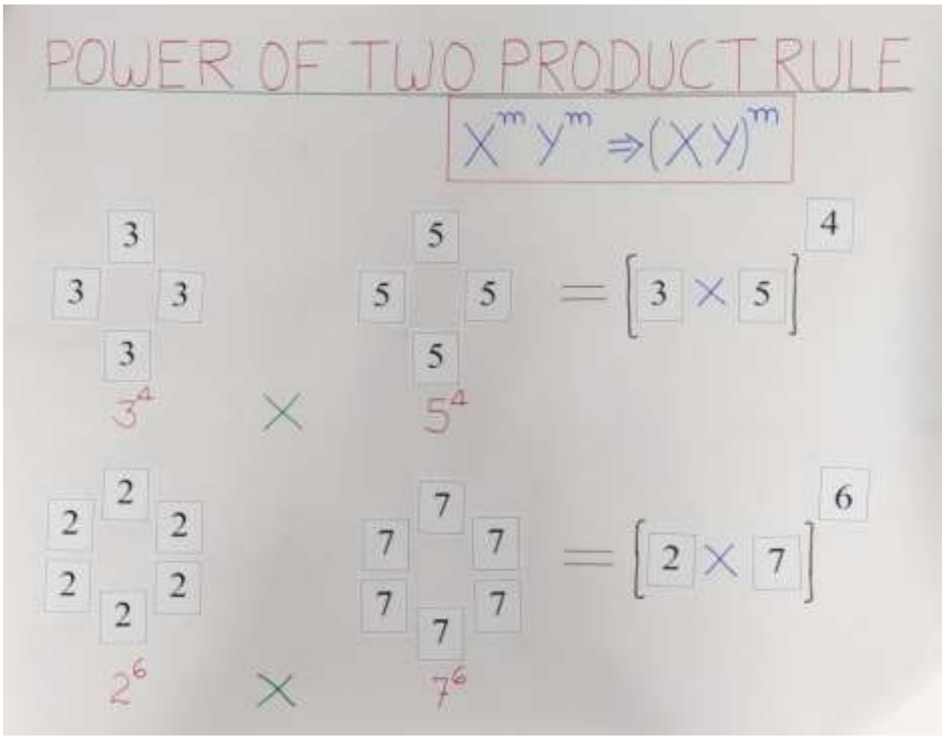
3. Explore

The teacher will perform different activities regarding the topic.

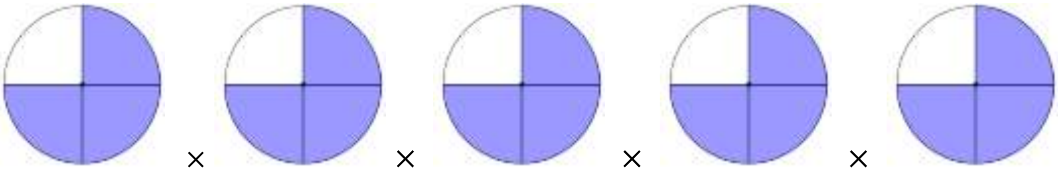
Activity-1



Activity-2



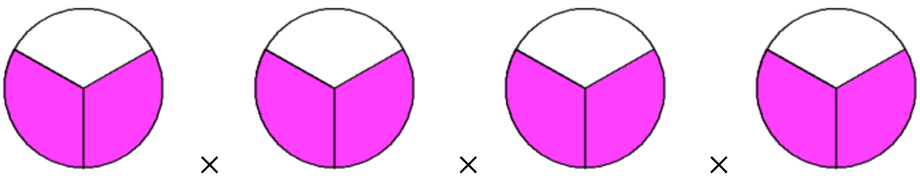
Activity-3



$\frac{3}{4}$ $\frac{3}{4}$ $\frac{3}{4}$ $\frac{3}{4}$ $\frac{3}{4}$

$$= \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} = (\frac{3}{4})^5 = \frac{3^5}{4^5}$$

Activity-4



$\frac{2}{3}$ $\frac{2}{3}$ $\frac{2}{3}$ $\frac{2}{3}$

$$= \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} = (\frac{2}{3})^4 = \frac{2^4}{3^4}$$

4. Explain

Teacher will divide the students into groups and give each group an activity to perform.

Activity-1

$4 = 2^2$ $\times$ $4 = 2^2$ $\times$ $4 = 2^2$

Here 2^2 are three times then $(2^2)^3 = 2^{2\times3} = 2^6$

Activity-2

Cut the thread into the qual value of $3^2cm \times 3^2cm \times 3^2cm$ and fill in the blanks also

$3^2cm \times 3^2cm \times 3^2cm = (\quad) =$

Activity-3

How will you express the power rule of exponent by using these beads?

Activity-4

Express the power rule of two products with the help of these number blocks.

The teacher will say to complete the given task. The representative student of every group will perform all activities of the group in front of all the class and tell how they complete their task. After the presentation, the teacher will improve the understanding of the students related to the topic, if necessary. If any group will perform a poor presentation, the teacher will be suggesting they re-analyze the prior activities. The teacher will explain the rules of exponents by using various learning materials and ask the question from every student. The students will solve the given problem on the blackboard with an explanation of it.

When base is same then powers will be added.

When powers are same then base will be multiplied.

5. Elaborate

The teacher will be elaborated the explained matter from the textbook through various examples and solve the problems of students regarding the topic. After clearing the doubts of students teacher will give flashcards to the students. Students will solve the problems through the given in the flashcards.

$$(-1)^{49} \div (-1)^{25} =$$

$$\frac{4^{10}}{9^{10}} = \left(\frac{4}{9}\right)$$

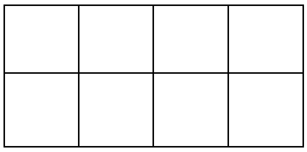
$$(4^8)^3 = 4^{8\times 3} = 4$$

$$\left(\frac{3}{2}\right)^3 \times \left(\frac{3}{2}\right)^{10} \div \left(\frac{3}{2}\right)^8 = —$$

6. Evaluate

1. $(\frac{5}{4})^6 \div (\frac{5}{4})^4 = (\frac{5}{\ })^2$
2. $4^3 \times 5^3 = \quad ^3$
3. $(-\frac{3}{7})^5 = \ldots\ldots\ldots \times \ldots\ldots\ldots \times \ldots\ldots\ldots \times \ldots\ldots\ldots \times \ldots\ldots\ldots$
4. Express the term 1221 in the form of the power of two product rules.
5. $(-8)^4 \times (-8)^3 =$
6. $10^3 \times 6^3 =$....................

7. **Extend**

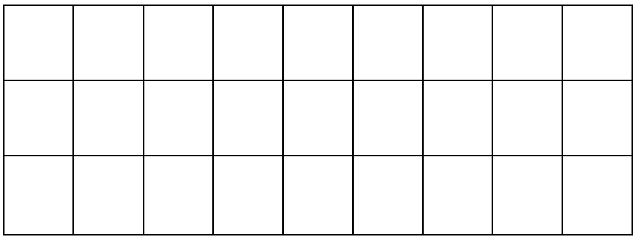


2 rows

4 columns

$(\mathbf{2 \times 4 = 8\ Boxes = 2^3})$

$\times$



3 rows

9 columns

$(\mathbf{3 \times 3 \times 3 = 27\ Boxes = 3^3})$

$\mathbf{2^3 \times 3^3 = (2 \times 3)^3 = 6^3 = 216}$

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MODULE: 9

Subject: Mathematics **Date:** …………………

Topic: Exponent **Period**: ………………

Sub-topic: Multiplicative Inverse

Instructional Objectives:

Knowledge

1. Students will be able to know the definition of the multiplicative inverse.
2. Students will be able to differentiate between the concept of multiplicative inverse and rational number.
3. Students will be able to identify the multiplicative inverse of numbers.

Understanding

1. Students will be able to find out the multiplicative inverse of the given number.
2. Students will be able to compare the multiplicative inverse of two numbers.

Application

1. Students will be able to give examples of the multiplicative inverse of any number.
2. Students will be able to solve the problem based on multiplicative inverse

Material Required: Candles, matchsticks, color-wheel, craft lace, orange, thread, chart, ice, rice, potato, flags, scale, chalk, sketch colors, plate, balloons, iron rings, double-sided tape, etc.

1. **Elicit:**

S.No.	Teacher's Questions	Students' Response
1.	What do you see? 	We see 2 candles in which one candle is reversed.
2.	What are synonyms of the word "reverse".	Opposite and inverse
3.	What is the opposite of day?	Night
4.	What is the opposite of night?	Day
5.	What is the opposite of solid?	Liquid
6.	Can you find the inverse of digits?	No response.

2. **Engage**

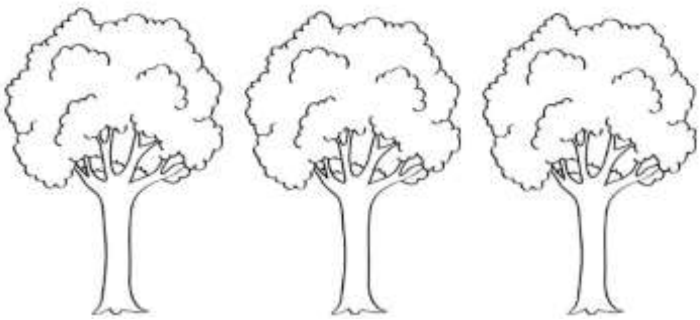
The teacher will give different activities to the students to engage them.

Activity-1

Count & write different parts and colors of the circle. Find out the value of any one part in rational form.

Activity-2

Color the group of trees. Count the number of trees and find the value of one tree with respect to the group in rational form.



Activity-3

Divide the lace into 7 equal parts to find the value of one part of lace in rational form.

Activity-4

Count the number of slices of the orange and find the value of one slice.

3. Explore

Activity will perform by the teacher regarding the topic.

Activity-1

<u>Three burning candles</u>

3 Candles (This 1 candle is $\frac{1}{3}$ part of the group of candles respectively)

Activity-2 Paper Pendulum

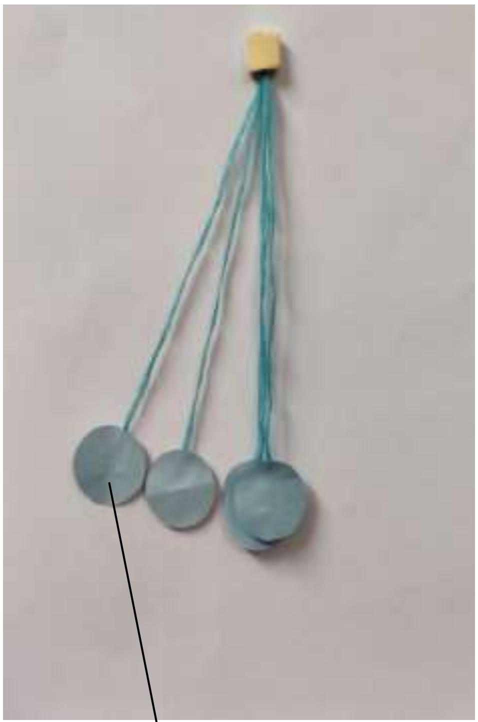
Group-A **Group-B**

$\frac{1}{2}$ of group -B

Inverse of $\frac{1}{2}$ is 2

Inverse of 2 is $\frac{1}{2}$

There are seeing the 2 Paper Pendulum in group-B of paper pendulums therefore the value of 1 pendulum will be equal to the $\frac{1}{2}$ respectively.



Group-C

Group-D

$\frac{1}{3}$ of group -C

$\frac{1}{4}$ of group -D

There are seeing the 3 Paper Pendulum in group-C of paper pendulums therefore the value of 1 pendulum will be equal to the $\frac{1}{3}$ respectively.

There are seeing the 4 Paper Pendulum in group-D of paper pendulums therefore the value of 1 pendulum will be equal to the $\frac{1}{4}$ respectively.

Multiple inverse of 4 is $\frac{1}{4}$

Multiple inverse of $\frac{1}{4}$ is 4

Multiple inverse of 3 is $\frac{1}{3}$

Multiple inverse of $\frac{1}{3}$ is 3

Group-E

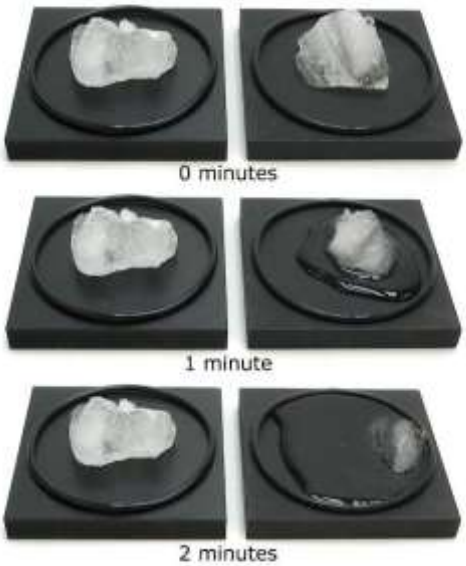
$\frac{1}{5}$ of group -E

Multiple inverse of 5 is $\frac{1}{5}$

Multiple inverse of $\frac{1}{5}$ is 5

There are seeing the 5 Paper Pendulum in group-E of paper pendulums therefore the value of 1 pendulum will be equal to the $\frac{1}{5}$ respectively.

Activity-3



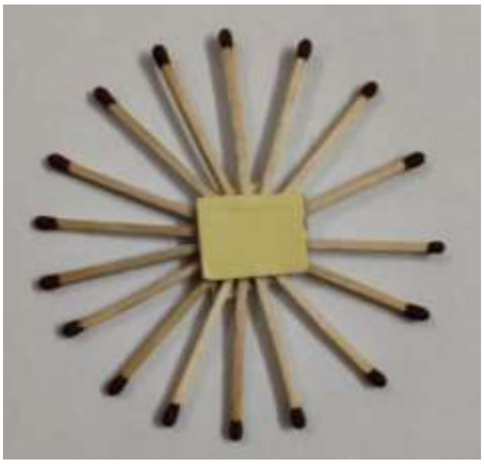
Multiple inverse of 6 is $\frac{1}{6}$

Multiple inverse of $\frac{1}{6}$ is 6

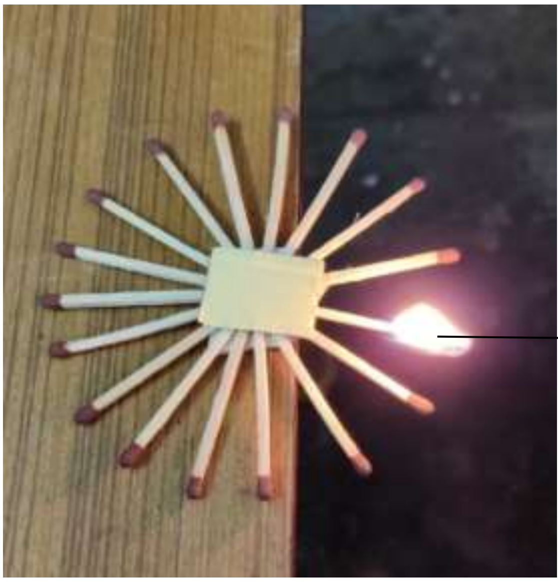
$\frac{1}{6}$ part remain

There are 6 pieces of ice

Activity-4



17 matchsticks in the wheel



burning matchstick is $^{1}/_{17}$ part of wheel

Multiple inverse of 17 is $\frac{1}{17}$

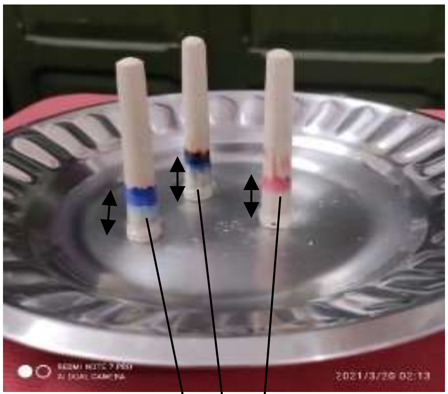
Multiple inverse of $\frac{1}{17}$ is 17

Activity-5

Raw Rice **Divided into 6 equal parts** **$\frac{1}{6}$ parts of rice remain**

Multiple inverse of each other

Activity-6



Chalk **3 Piece**

$\frac{1}{3}$ part

Multiple inverse of 3 is $\frac{1}{3}$

Multiple inverse of $\frac{1}{3}$ is 3

4. Explain

The teacher will divide students into groups and give each group activity for group performance. One representative student of each group will present the group activity in the segment of a group presentation.

Activity-1

Cut these potatoes into slices and express the multiplicative inverse of 11.

Activity-2

Express the multiplicative inverse of 3 by using these flags.

Activity-3

Express the multiplicative inverse of $\frac{1}{10}$ by using the scales.

Activity-4

Express the multiplicative inverse of 8 by using these ballons.

After the group presentation, the teacher will correct the conceptual understanding of the multiplicative inverse of students if required and ask the question. The teacher will explain the multiplicative inverse with the help of different learning materials in his/her own way.

5. Elaborate

The teacher will explain the topic to the point in detail as per the textbook with examples and clear the doubts of the students. The teacher will give the flashcards to the students. Every student will solve the problem given in the flashcards on the blackboard.

1. Multiplicative inverse of 9 is ……..
2. $\frac{1}{13}$ is multiplicative inverse of……....
3. $\frac{1}{18}$ is multiplicative inverse of……....
4. $\frac{7}{6}$ is multiplicative inverse of……....
5. 17 is multiplicative inverse of……....
6. $\frac{27}{23}$ is multiplicative inverse of……....
7. $\frac{9}{19}$ is multiplicative inverse of……....

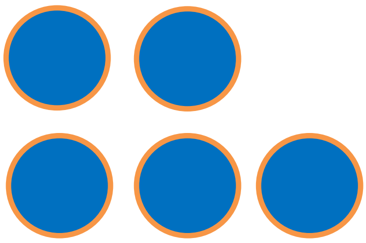
6. Evaluate

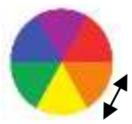
1. The multiplicative inverse of $\frac{3}{7}$ is ……………….
2. The multiplicative inverse of 4 is ……………….
3. The multiplicative inverse of $\frac{5}{6}$ is ……………….
4. The multiplicative inverse of 12 is ……………….
5. Find the multiplicative inverse of 25.
6. Find the multiplicative inverse of 9

7. Match the following:

A	B
$\frac{3}{10}$	$\frac{5}{2}$
$\frac{2}{5}$	$\frac{1}{11}$
7	$\frac{10}{3}$
11	$\frac{1}{7}$

7. Extend

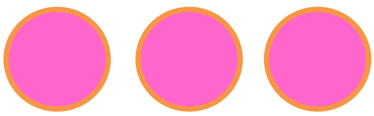




$\frac{1}{5}$ circle

5 circles

5 and $\frac{1}{5}$ Multiplicative Inverse of each other



$\frac{1}{3}$ Circle

3 Circle

3 and $\frac{1}{3}$ Multiplicative Inverse of each other

****

MODULE: 10

Subject: Mathematics **Date:** …………………

Topic: Exponent **Period**: ………………

Sub-topic: Standard/Scientific Notation

Instructional Objectives:

Knowledge

1. Students will be able to know the definition of standard/scientific notation.
2. Students will be able to identify standard/scientific notation of numbers.

Understanding

1. Students will be able to find out the standard/scientific notation of given numbers.
2. Students will be able to compare between standard/scientific notation of two numbers.

Application

1. Students will be able to give examples of standard/scientific notation.
2. Students will be able to solve the problems based on standard/scientific notation.

Material Required- Chip's packet, thread, bottle, glass, beaker, etc.

1. **Elicit:**

S.no.	**Teacher's Questions**	**Students' Response**
1.	What is this? 	Lays chips packet.
2.	What is its price?	It can be 5, 10, 20.
3.	If one lays chips packet you purchase of rupee 10 then how many rupee you will be paid for purchase 10 packets?	100
4.	Write 100 in exponent form.	10^2
5.	How will write you 100 in the form of scientific notation?	No response.

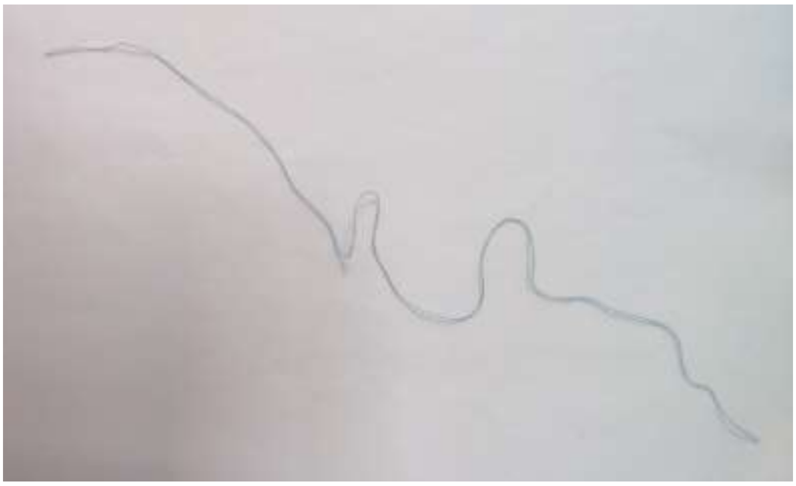
2. **Engage**
   The teacher will give different activities to the students to engage them.

Activity-1

Measure the line and write the value in powers of 10.

A ____ **B**

Activity-2
Measure the thread and write the value in powers of 10.



Activity-3
Measure the height of the bottle and write the value in powers of 10.

Activity-4
Measure the height of the glass and write the value in powers of 10.

3. Explore

The teacher will perform different activities to explore the scientific notation.

Empty beaker

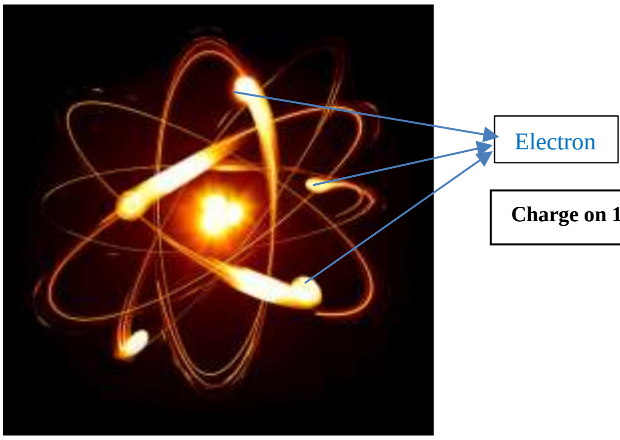
water level: 10 ml = 0.1×10^2

water level: 15 ml = 0.15×10^2

water level: 20 ml = 0.2×10^2

water level: 25 ml = 0.25×10^2

water level: 30 ml = 0.3×10^2



Charge on 1 electron is 0.00000000000000000016

Electrons' movement

The mass of earth is

5976,000,000,000,000,000,000,000,000 kg. = 5.976×10^{27}

Earth

4. Explain

The teacher will divide students into groups and will give activities to each group in the form of a problem.

Activity-1

Every student of the group will measure his/her weight by the weighting machine to find the sum of the weight of all students of the group and write the value in the form of scientific notation.

Activity-2

The amount of the rupees in the form of standard/scientific notation.

Activity-3

Find the quantity of juice in the bottle. Write the value in the form of standard/scientific notation.

Activity-4

Mass of the moon is 735,000,000,000,000,000,000,00 kg. write it in the form of standard/scientific notation.

After the performance of each group, the teacher will write the result of each activity on the blackboard and explain the scientific/standard notation by using various learning materials.

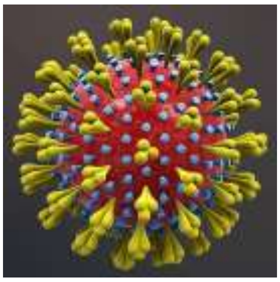
5. Elaborate

The teacher will teach the concept in detail according to the textbook of class seventh with examples and will ask the questions based on the topic. The teacher will give a mathematical problem to every student which he/she will solve on the blackboard with its complete explanation. If any student will not able to solve the given problem in the right way, then the teacher will facilitate and guide them.

6. Evaluate

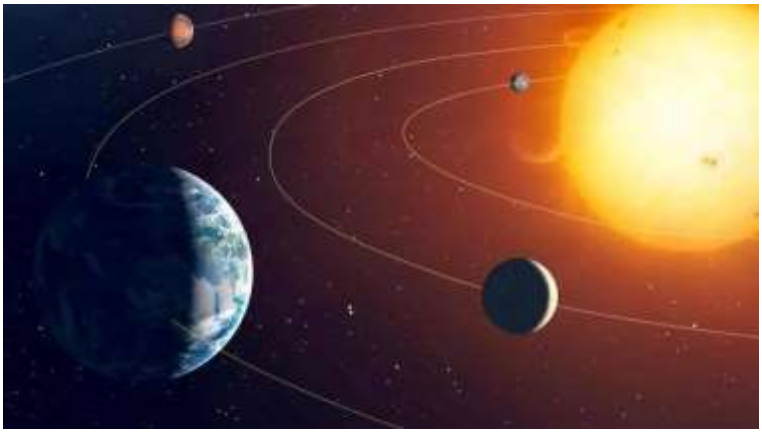
1. Write 3124 in the form of scientific/standard notation.
2. Find the value whose scientific notation is 6.41×10^{-4}.
3. The diameter of the Sun is 1400000000 meters. write the value in the form of scientific/standard notation.
4. The diameter of the earth is 1.2756×10^{7}meter. write the value in a simple mathematical way.
5. Write 73,00,00,000 in the form of scientific/standard notation.

7. Extend



The perimeter of a virus is-

0.00000005= 5.0×10^{-8}meter



Distance of earth from the Sun is-

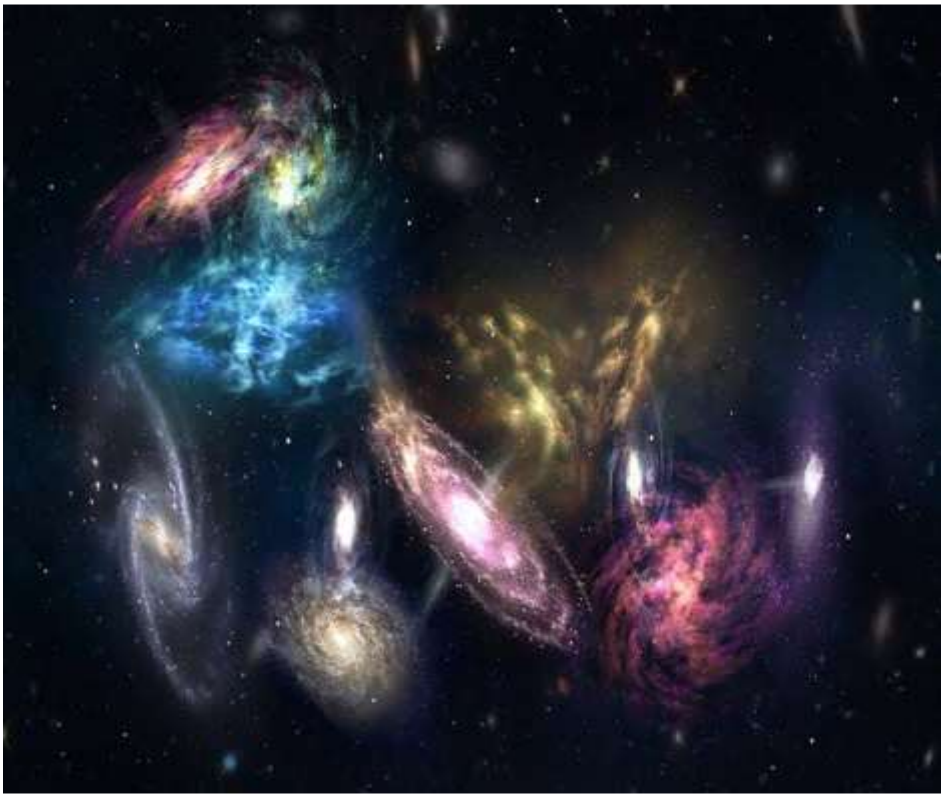
1,49,60,00,00,000 meter= 1.49×10^{11}meter

Water on earth is-

1,35,30,00,000 km^3 = 1.353×10^9 km^3

Distance of moon from the earth is-

38,44,67,000 meter= $\mathbf{3.84467 \times 10^{8}}$**meter**



Average number of stars in a galaxy is-

1,00,00,00,00,000 meter = $\mathbf{1.0 \times 10^{11}}$**stars**

****

APPENDIX – II

Concept Attainment Test (C.A.T.)

(Final Draft)

APPENDIX- II

गोपनीय (केवल अनुसंधान हेतु)

संकल्पना अधिग्रहण परीक्षण

CONCEPT ATTAINMENT TEST

(C.A.T.)

कक्षा 7 के विद्यार्थियों के लिए

शोध पर्यवेक्षक

डॉ. संगीता चौहान

असिस्टेंट प्रोफेसर

(शिक्षाशास्त्र विभाग)

बाबासाहब भीमराव अंबेडकर विश्वविद्यालय लखनऊ

शोध छात्रा

नीलम सुमन

पी.एच.डी. रिसर्च स्कॉलर

(शिक्षाशास्त्र विभाग)

बाबासाहब भीमराव अंबेडकर विश्वविद्यालय लखनऊ

uke**:**………………………………….......... vk;q**:**…………………………….

d{kk**:**…………………………............................ fyax**:**…………………………….

fo|ky;**:**…………………………………………………………………………

vkoklh; irk**:** …………………………………………………………………

<u>आवश्यक निर्देश</u>:

यह परीक्षण मनोवैज्ञानिक अध्ययन का एक भाग है, इसका उद्देश्य कक्षा 7 के विद्यार्थियों का गणितीय संकल्पना अधिग्रहण ज्ञात करना है। इस परीक्षण में कुल 4 भाग है प्रत्येक भाग से संबंधित प्रश्न करने से पहले उस भाग में दिए गए निर्देशों को ध्यान से पढ़ें उसके पश्चात उसका उत्तर दें। इस परीक्षण पुस्तिका के माध्यम से आपके द्वारा दी गई जानकारी पूर्णता गोपनीय रखी जाएगी एवं इसका प्रयोग सिर्फ अनुसंधान हेतु किया जाएगा।

C.A.T.	Hkkx 1	Hkkx 2	Hkkx 3	Hkkx 4	MATHEMATICAL CONCEPT ATTAINMENT LEVEL
SCORE					
TOTAL SCORES					

Hkkx% 1

कॉलम A में दिए गए कुछ उदाहरण एक विशेष गणितीय संकल्पना से जुड़े हुए हैं जबकि कॉलम B में संकल्पनाए लिखी हैं। ध्यानपूर्वक कॉलम A के विकल्प पढ़कर दूसरी ओर लिखे हुए कॉलम B के विकल्पों को देखकर सही संकल्पना के सामने सही का नि ाान लगायें–

उदाहरण–

dkye $\boldsymbol{A}$	dkye $\boldsymbol{B}$	
3	प्राकृतिक संख्याए	☐
7	विषम संख्याए	☑
1	गुणा	☐
5	सम संख्याए	☐

कॉलम A में दी गई संख्याए, विषम संख्याए हैं। अतः इसका उत्तर विषम संख्याए है। dkye $\boldsymbol{B}$ से विषम संख्याए के सामने के बॉक्स में सही का नि ाान लगाया गया है।

1.

	dkye $\boldsymbol{A}$	dkye $\boldsymbol{B}$	
1.	3^3	जोड़ना	☐
2.	5^3	वर्ग	☐
3.	7^3	द ामलव	☐
4.	12^3	घन	☐

2.

	dkye $\boldsymbol{A}$	dkye $\boldsymbol{B}$	
1.	$5^{-3} = \frac{1}{5^3}$	$a^{-m} = \frac{1}{a^m}$	☐
2.	$3^{-2} = \frac{1}{3^2}$	घातांक	☐
3.	$2^{-5} = \frac{1}{2^5}$	$a^m \div a^n = a^{m-n}$	☐
4.	$7^{-4} = \frac{1}{7^4}$	$a \times a = a^2$	☐

3.

	dkye $\boldsymbol{A}$	dkye $\boldsymbol{B}$	
1.	$3^3 \times 6^3 = (18)^3$	$a^m \div a^n = a^{m-n}$	☐
2.	$4^2 \times 3^2 = (12)^2$	वर्ग	☐
3.	$2^5 \times 3^5 = (6)^5$	$a^m \times b^m = (a \times b)^m$	☐
4.	$8^7 \times 2^7 = (16)^7$	अपरिमेय संख्याए	☐

4.

	dkWye A	dkWye B	
1.	$2^2 \times 2^3 = 2^5$	$a \times a = a^2$	☐
2.	$7^4 \times 7^2 = 7^6$	$a^m \times a^n = a^{m+n}$	☐
3.	$3^5 \times 3^8 = 3^{13}$	$a \times a \times a = a^3$	☐
4.	$4^6 \times 4^5 = 4^{11}$	$a \times b = ab$	☐

5.

	dkWye A	dkWye B	
1.	$\frac{2^7}{2^5} = 2^2$	$a^m \times a^n = a^{m+n}$	☐
2.	$\frac{4^8}{4^3} = 4^5$	$a \times a \times a \times a = a^4$	☐
3.	$\frac{3^4}{3^1} = 3^3$	$a^0 = 1$	☐
4.	$\frac{7^{11}}{7^8} = 7^3$	$a^m \div a^n = a^{m-n}$	☐

6.

	dkWye A	dkWye B	
1.	$(\frac{4}{5})^7 \div (\frac{4}{5})^{13} = \frac{1}{(\frac{4}{5})^{13-7}}$	$a^m \div a^n = a^{m-n}$	☐
2.	$(\frac{1}{2})^{11} \div (\frac{1}{2})^{18} = \frac{1}{(\frac{1}{2})^{18-11}}$	$a^0 = 1$	☐
3.	$(\frac{2}{7})^5 \div (\frac{2}{7})^{12} = \frac{1}{(\frac{2}{7})^{12-5}}$	$a^m \div a^n = \frac{1}{a^{n-m}}$	☐
4.	$(\frac{8}{9})^4 \div (\frac{8}{9})^{13} = \frac{1}{(\frac{8}{9})^{13-4}}$	$a \times a \times a = a^3$	☐

7.

	dkWye A	dkWye B	
1.	$2^0 = 1$	$a \times b = ab$	☐
2.	$5^0 = 1$	$a^0 = 1$	☐
3.	$18^0 = 1$	घन	☐
4.	$25^0 = 1$	$a^m \div a^n = a^{m-n}$	☐

****

P.T.O…………

Hkkx½ 2

प्रस्तुत भाग में कुछ प्र न दिए जा रहे हैं। जिनमें से प्रत्येक के पांच विकल्प दिए गए हैं। इसमें से चार किसी एक संकल्पना से संबंधित है, जबकि इनमें से कोई एक है जो उस संकल्पना से संबंधित नहीं है, उसे पहचानकर उसके सामने सही का नि ान लगायें–

उदाहरण–

i. 4^{15} ☐

ii. 3^{12} ☐

iii. 6^{4} ☐

iv. 729 ☑

v. 2^{6} ☐

प्रस्तुत उदाहरण में दिए गये विकल्प i, ii, iii, तथा v घातांक की संकल्पना को प्रद ित करतें हैं जबकि विकल्प iv घन की संकल्पना को व्यक्त कर रहा है। अतः विकल्प चार सभी विकल्पों में से सबसे अलग होने के कारण इसके सामने सही का नि ान लगाया गया है।

1. i. $[\{2\}^3]^4 = (2)^{3\times4}$ ☐

   ii. $[\{7\}^{11}\}^8 = (7)^{11\times8}$ ☐

   iii. $[\{5\}^6\}^3 = (5)^{6\times3}$ ☐

   iv. $[\{3\}^8\}^6 = (7)^{8\times6}$ ☐

   v. $\{6\}^7 \times \{6\}^2 = (6)^{7+2}$ ☐

2. i. $11^4 \times 6^4 = (11 \times 6)^4$ ☐

   ii. $7^9 \times 8^9 = (7 \times 8)^9$ ☐

   iii. $4^3 \times 8^3 = (4 \times 8)^3$ ☐

   iv. $3^5 \times 7^5 = (3 \times 7)^5$ ☐

   v. $6^8 \times 6^4 = 6^{12}$ ☐

3. i. $\frac{2^6}{7^6} = \{\frac{2}{7}\}^6$ ☐

   ii. $\frac{8^2}{3^2} = \{\frac{8}{3}\}^2$ ☐

   iii. $\frac{7^2}{3^2} = \{\frac{3}{7}\}^{-2}$ ☐

   iv. $\frac{2^6}{7^6} = \{\frac{2}{7}\}^6$ ☐

   v. $\frac{11^6}{41^6} = \{\frac{11}{41}\}^6$ ☐

4. i. $8^2 \times 8^{-1} = (8)^{2-1}$ ☐
ii. $4^{15} \times 4^{-4} = (4)^{15-4}$ ☐
iii. $5^2 \times 7^2 = (5 \times 7)^2$ ☐
iv. $7^3 \times 7^{-2} = (7)^{3-2}$ ☐
v. $3^5 \times 3^{-3} = (3)^{5-3}$ ☐

5. i. $36 = 6^2$ ☐
ii. $4 = 2^2$ ☐
iii. $16 = 4^2$ ☐
iv. $27 = 3^3$ ☐
v. $49 = 7^2$ ☐

6. i. $5^6 \div 5^{-2} = 5^6 \times 5^2$ ☐
ii. $3^{-3} \div 3^2 = 3^{-3} \times 3^{-2}$ ☐
iii. $11^4 \div 11^{-3} = 11^4 \times 11^3$ ☐
iv. $14^4 \div 14^{-2} = 14^4 \times 14^2$ ☐
v. $9^{11} \div 9^{-3} = 9^{11} \times 9^3$ ☐

7. i. $4^{-3} \times 7^{-3} = (4 \times 7)^{-3}$ ☐
ii. $5^{-17} \times 9^{-17} = (5 \times 9)^{-17}$ ☐
iii. $2^{-7} \times 5^{-7} = (2 \times 5)^{-7}$ ☐
iv. $9^{-13} \times 10^{-13} = (9 \times 10)^{-13}$ ☐
v. $2^3 \times 3^3 = (2 \times 3)^3$ ☐

8. i. $3124 = 31.24 \times 100$ ☐
ii. $0.12 = 1.2 \times 10^{-1}$ ☐
iii. $0.072 = 7.2 \times 10^{-2}$ ☐
iv. $0.0011 = 1.1 \times 10^{-3}$ ☐
v. $0.00034 = 3.4 \times 10^{-4}$ ☐

9. i. $65 = 2^3 + 1^2$ ☐
ii. $10 = 3^2 + 1^2$ ☐
iii. $82 = 9^2 + 1^2$ ☐
iv. $1729 = 10^3 + 1^3$ ☐
v. $20 = 4^2 + 1^2$ ☐

10. i. 1000 ☐
ii. 729 ☐
iii. 49 ☐
iv. 216 ☐
v. 125 ☐

****

P.T.O…………

Hkkx % 3

नीचे संकल्पना की परिभाषा दी गई है, उसे ध्यानपूर्वक पढ़ें और समझने का प्रयास करे। अभिव्यक्त की गई संकल्पना से संबंधित चार विकल्प दिये गए हैं, इसमें से सही विकल्प चुनकर उसके सामने का सही नि ाान लगाए।

उदाहरण–

यदि a एक परिमेय संख्या तथा m और n कोई दो धन पूर्णांक हो तो $(a^m)^n = a^{(m \times n)}$

i. $(6^2)^4 = 6^8$ ☑   ii. $2 \times 3 \times 4 = 24$ ☐

iii. $7 \times 2 = 14$ ☐   iv. $5^2 = 5 \times 5$ ☐

उपरोकत उदाहरण में चार विकल्प हैं, परन्तु प्रस्तुत की गयी संकल्पना से संबंधित विकल्प i है, अतः उसके सामने के बॉक्स में सही का नि ाान लगाया गया है।

1. ?kkrkd **(Exponent)** – किसी संख्या को उसी संख्या से जितनी बार गुणा करतें हैं वह उसका घातांक होता है।

   a^n=a x a x ....n

   i. $3 \times 3 \times 3 \times 3 = 3^4$ ☐   ii. $2 \times 3 = 6$ ☐

   iii. $5 \times 2 \times 2 = 20$ ☐   iv. $4 \times 7 = 28$ ☐

2. ?ku **(Cube)** – किसी भी संख्या को जब तीन बार गुणा करते हैं तो प्राप्त मान उस संख्या का घन कहलाता है।

   a^3=a x a x a, 2^3= 2 x 2 x 2= 8

   i. $8 \times 8 = 64$ ☐   ii. $3 \times 3 \times 2 = 18$ ☐

   iii. $6 \times 6 \times 6 = 216$ ☐   iv. $2 \times 2 \times 2 \times 2 = 16$ ☐

3. oxZ **(Square)**– किसी भी संख्या को परस्पर जब दो बार गुणा करते हैं, तब प्राप्त मान उस संख्या का वर्ग कहलाता है।

   a^2= a x a

   i. $7 \times 8 = 56$ ☐   ii. $11 \times 11 = 121$ ☐

   iii. $4 \times 9 = 36$ ☐   iv. $2 \times 2 \times 2 = 8$ ☐

4. यदि $(-a) \times b = -(ab)$

i. $3 \times 4 = 12$ ☐　　ii. $4 \times 4 = 16$ ☐

iii. $(-6) \times 9 = -54$ ☐　　iv. $(-7) \times (-7) = 49$ ☐

5. n के सम प्राकृतिक संख्या होने पर $[-1]^n = 1$, जहां n = 2, 4, 6, 8,…

i. $(-1)^4 = 1$ ☐　　ii. $(-1)^3 = 1$ ☐

iii. $(-1)^7 = 1$ ☐　　iv. $(-1)^7 = 1$ ☐

6. x.kkRed i;frykke& किसी शून्यत्तर परिमेय संख्या के लिये $a^{-m} = \frac{1}{a^m}$ जहां m एक धनात्मक परिमेय संख्या है। इस प्रकार a^{-m}, a^m का गुणात्मक प्रतिलोम है।

i. $3^{-2} \times 2^{-2} = (3 \times 2)^{-2}$ ☐　　ii. $9 \times (-4) = 36$ ☐

iii. $7^2 = 7 \times 7$ ☐　　iv. $6^4 = \frac{1}{6^4}$ ☐

7. किसी शून्येत्तर परिमेय संख्या की (−1) घात उस संख्या के गुणात्मक प्रतिलोम (व्युत्क्रम) के बराबर होता है। दूसरे शब्दों में, यदि $\frac{a}{b}$ कोई शून्येत्तर परिमेय संख्या हो तो उसका व्युत्क्रम $\frac{b}{a}$ होता है, अर्थात $\frac{b}{a} = (\frac{a}{b})^{-1}$

i. $\frac{5}{9} = (\frac{9}{5})^{-1}$ ☐　　ii. $\frac{4}{9} = (\frac{2}{3})^2$ ☐

iii. $8 = \frac{1}{8}$ ☐　　iv. $\frac{8}{216} = \{\frac{2}{6}\}^3$ ☐

8. मानक रूप में या वैज्ञानिक संकेतन में संख्याए $K \times 10^n$ के रूप में लिखी जातीं हैं, जहां $1 \le K < 10$ दशमलव की कोई संख्या है एवं n कोई पूर्णांक हैं।

i. $10^3 = 1000$ ☐　　ii. $729 = 9^3$ ☐

iii. $7300 = 7.3 \times 10^3$ ☐　　iv. $4200 = 42 \times 100$ ☐

9. यदि एक शून्यत्तर धनात्मक परिमेय संख्या तथा m और n कोई दो धनात्मक पूर्णांक हो जहां m>n तो $a^m \div a^n = a^{m-n}$

i. $3^4 \div 3^{15} = \frac{1}{3^{15-4}}$ ☐　　ii. $3^{20} \div 3^{13} = 3^7$ ☐

iii. $10000 = 1 \times 10^4$ ☐　　iv. $\frac{3}{8} = (\frac{8}{3})^{-1}$ ☐

****

P.T.O…………..

Hkkx % 4

संकल्पना से संबंधित विभिन्न आव यक तत्व नीचे दिए गये है। जिनके आधार पर आपको संकल्पना को पहचानकर उसके सामने सही का नि ाान लगाना है।

mnkgj.k&

ऐसी संख्याएं जिन्हें 2 से भाग करने पर शेषफल 0 आए उन्हें ....संख्या कहते हैं।

f l) kUr

i. अप्राकृतिक संख्याएं ☐
ii. सम संख्याएं ☑
iii. विषम संख्याएं ☐

उदाहरण में संकल्पना संबंधी कथन दिया गया है जिसके तीन विकल्प के रूप में अलग–अलग सिद्धान्त दिए गए है। जिसमें संकल्पना से संबंधित विकल्प ii है जिसके सामने सही का नि ाान लगाया गया है।

1. किसी भी संख्या को दो बार उसी संख्या से गुणा करने पर प्राप्त मान .... होता है।

f l) kUr

i. वर्ग ☐
ii. घन ☐
iii. परिमेय संख्याएं ☐

2. किसी भी संख्या को यदि n बार उसी संख्या से गुणा करते हैं तो n उस संख्या का .. ..होता है।

f l) kUr

i. घन ☐
ii. जोड़ ☐
iii. घातांक ☐

3. किसी भी संख्या को तीन बार उसी संख्या से गुणा करने पर प्राप्त मान .... होता है।

f l) kUr

i. वर्ग ☐
ii. अपरिमेय संख्याए ☐
iii. घन ☐

4. यदि कोई प्राकृतिक संख्या है और $[1]^n$, जहां $n = 1, 2, 3, 4, \ldots \ldots$ तो प्राप्त मान... .... होगा।

fl)kUr

i. ऋण पूर्णांक
ii. भिन्न
iii. धन पूर्णांक

5. 1. यदि a एक शून्येत्तर धनात्मक परिमेय संख्या है तथा m और n कोई दो धनात्मक पूर्णांक हो, जहां $m > n$
2. $a^m \div a^n =$..................

fl)kUr

i. $(a)^{m+n}$
ii. $(a)^{m-n}$
iii. $(a)^{m\times n}$

6. जब किसी संख्या को 10 की घात के गुणनफल के रूप में व्यक्त किया जाता है, तो वह उस संख्या का ....होता है।

fl)kUr

i. मानक रूप/वैज्ञानिक संकेतन
ii. अपरिमेय संख्या
iii. घातांक

7. किसी शून्येत्तर परिमेय संख्या a के लिए, $a^{-m} = \frac{1}{a^m}$ जहां पर m एक धनात्मक परिमेय संख्या है। इसमें a^m तथा a^{-m} परस्पर एक दूसरे के होंगे।

fl)kUr

i. प्रतिरूप
ii. गुणात्मक प्रतिलोम
iii. विपरीत

8. यदि a और b कोई दो शून्येत्तर संख्याए हो जिसमें m एक धनपूर्णांक हो तो $a^m \div b^m =$ ....होगा।

fl)kUr

i. $(a+b)^m$
ii. $(\frac{a}{b})^m$
iii. $(\frac{b}{a})^{-1}$

9. .... कहते हैं कि दो संख्याओं के घनों के अन्तर को दो संख्याओं के योग के रूप में भी व्यक्त किया जा सकता है।

fl)kUr

i. यूनानी गणितज्ञ डायफॅण्टस ☐

ii. रामानुजन ☐

iii. डा0 एच0 हार्डी ☐

10. 1. $1729 = 12^3 + 1^3$

2. $1729 = 10^3 + 9^3$

fl)kUr

i. रामानुजन संख्या ☐

ii. डा0 एच0 हार्डी संख्या ☐

iii. प्राकृतिक संख्याएं ☐

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APPENDIX – III

CONSTRUCTED AND STANDARDIZED

Mathematical Anxiety Scale (M.A.S.)

(Final Draft: English and Hindi Version)

APPENDIX - III

Confidential *(For Only Research)*

MATHEMATICAL ANXIETY SCALE (M.A.S.)

FOR GRADE VII STUDENTS

Research Supervisor

Dr. Sangeeta Chauhan

Assistant Professor

(Department of Education)

Babsaheb Bhimrao Ambedkar University, Lucknow

(A Central University)

Researcher

Neelam Suman

Ph.D. Research Scholar

(Department of Education)

Babsaheb Bhimrao Ambedkar University, Lucknow

(A Central University)

NAME:……………………………………………………………AGE:………………………………………

CLASS:……………………………………………………………GENDER:……………………..................

SCHOOL:……………………………………………………………………………………………………….

DATE………………………………………………………CONTACT NO.:……………………..................

ADDRESS……………………………………………………………………………………………………….

Instructions-

This scale is a part of psychological study. Its aim is to measure the mathematical anxiety of Class Seventh Students. Through the Mathematical Anxiety Scale (M.A.S.) you can express your views about mathematics subjects. There are some options in front of the questions. The scale consists 49 statements with the options of **'Strongly Agree', 'Agree', 'Uncertain', 'Disagree', 'Strongly Disagree'** Tick (√) on the option that you think is the best according to you by keeping the various options in your mind. The topic of my research work is entitled **"Effect of Constructivist Pedagogy on Concept Attainment and Anxiety in Mathematics Among Seventh Class Students".** The information provided by you will be kept completely confidential and will only be used for research work. The researcher will always be grateful for your cooperation.

(For Instructor Only)

M.A.S.	STRONGLY AGREE	AGREE	UNCERTAIN	DISAGREE	STRONGLY DISAGREE	Mathematical Anxiety Category
SCORES						
TOTAL						

MATHEMATICAL ANXIETY SCALE (M.A.S.)

S. No.	STATEMENTS	STRONGLY AGREE	AGREE	UNCERTAIN	DISAGREE	STRONGLY DISAGREE
1.	Mathematics is an easy subject.					
2.	I feel that mathematics is the most difficult subject.					
3.	I get nervous before going to mathematics class.					
4.	Mathematics is a interesting subject.					
5.	Mathematics is one of the subjects which I wish to study.					
6.	I get nervous about it a few days before the mathematics exam.					
7.	I solve mathematics questions easily.					
8.	I feel fear at the time of the mathematics exam.					
9.	I feel more difficulty in doing mathematics homework than any other subject.					
10.	I feel happier in maths class than other subjects.					
11.	I will choose maths subject for my bright future.					
12.	I am always worried about maths subject.					
13.	I have always imagined that maths subject is easier than other subjects.					
14.	When a question is asked by the teacher in the math class, I am unable to tell it even though I know the answer.					
15.	I am unable to ask questions in math class even if I want to.					
16.	I like the academic atmosphere of the mathematics class.					
17.	I feel no mental distress at all in the math class.					
18.	I experience a psychological burden while studying mathematics in class.					
19.	I do not want to solve math questions at all.					
20.	I feel that I understand mathematical concepts much later than other students in the class.					

21.	I solve the question by using mathematical operations, but I have some doubts about the obtained answer always.					
22.	There is no need to study Mathematics.					
23.	I don't feel inferior at all when I ask my classmates a solution to mathematical questions.					
24.	Observing other students understand mathematics, I feel astonishment and inferiority.					
25.	I can understand mathematical concepts.					
26.	After understanding a mathematical concept in the classroom with a teacher, I wish that the questions based on it would be given to me to solve.					
27.	I wish that mathematics lessons should be taught slowly in the classroom.					
28.	I believe that I can solve any question based on the mathematical concept which I had understood in past time.					
29.	Understanding mathematics requires more attention than any other subject.					
30.	Mathematics does not have to be crammed.					
31.	I take time to understand mathematical signs.					
32.	There is a fear of punishment by the teacher if I make any mistake in the mathematical homework.					
33.	I am afraid to ask any question to the teacher.					
34.	Mathematics is a boring subject.					
35.	In mathematics, there is a fear of getting the whole answer will be wrong on just one mistake.					
36.	I study mathematics more than any other subject at home.					
37.	I wake up early in the morning on the day of the math exam and I study about the subject.					
38.	The answers to these questions which I have solved in the exam, I					

	am worried about getting them wrong.					
39.	The environment of the exam hall has an impact on the exam result in a math exam.					
40.	I don't have any problem in understanding maths subject.					
41.	Mathematics is the best subject.					
42.	Nothing is possible without mathematics.					
43.	I practice solving questions before entering the exam.					
44.	I feel more nervous in exams related to maths subjects as compared to exams of other subjects.					
45.	Even after knowing how to solve questions in maths exams, I feel that I know very little about the subject.					
46.	There is a lot of worry before the exam of maths.					
47.	Anxiety gets worse after the maths exam.					
48.	Mathematics should not be taught in school.					
49.	There is a lot of benefit to studying mathematics.					

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APPENDIX- III

गोपनीय (केवल अनुसंधान हेतु)

गणितीय चिंता मापनी

MATHEMATICAL ANXIETY SCALE

(M.A.S.)

कक्षा 7 के विद्यार्थियों के लिए

शोध पर्यवेक्षक

डॉ. संगीता चौहान

असिस्टेंट प्रोफेसर

शिक्षाशास्त्र विभाग

बाबासाहब भीमराव अंबेडकर विश्वविद्यालय लखनऊ

(केंद्रीय विश्वविद्यालय)

शोध छात्रा

नीलम सुमन

पी.एच.डी. रिसर्च स्कॉलर

शिक्षाशास्त्र विभाग

बाबासाहब भीमराव अंबेडकर विश्वविद्यालय लखनऊ

(केंद्रीय विश्वविद्यालय)

uke:………………………………………….......... vk;q:…………………………….

d{kk:………………………............................. fyax:…………………………….

fo|ky;:……………………………………………………………………….

vkoklh; irk: ………………………………………………………………………

आवश्यक निर्देश:

यह परीक्षण मनोवैज्ञानिक अध्ययन का एक भाग है, इसका उद्देश्य कक्षा 7 के विद्यार्थियों का गणितीय चिंता का मापन करना है। इस स्केल के माध्यम से विद्यार्थियों को गणित विषय के संबंध में अपने दृष्टिकोण प्रस्तुत करने का अवसर प्राप्त होता है। इस स्केल में कुल 49 तथ्य है। इसमें अत्यधिक सहमत (Strongly Agree), सहमत (Agree), अनिश्चित (Uncertain), असहमत (Disagree), और अत्यधिक सहमत (Strongly Disagree) नामक विकल्प उपस्थित है, जिसमें से किसी एक पर सही का निशान लगाकर अपनी प्रतिक्रिया व्यक्त करना है। सभी कथनों पर अपनी प्रतिक्रिया व्यक्त करना अनिवार्य है। इस परीक्षण पुस्तिका के माध्यम से आपके द्वारा दी गई जानकारी पूर्णता गोपनीय रखी जाएगी एवं इसका प्रयोग केवल सिर्फ अनुसंधान हेतु किया जाएगा।

(For Instructor Only)

M.A.S.	STRONGLY AGREE	AGREE	UNCERTAIN	DISAGREE	STRONGLY DISAGREE	Mathematical Anxiety Category
SCORES						
TOTAL						

MATHEMATICAL ANXIETY SCALE (M.A.S.)

क्रम संख्या	कथन	अत्यधिक सहमत	सहमत	अनिश्चित	असहमत	अत्यधिक असहमत
1.	गणित एक सरल विषय है।					
2.	मुझे गणित सबसे कठिन विषय लगता है।					
3.	गणित की कक्षा में जाने से पूर्व मुझे घबराहट होने लगती है।					
4.	गणित एक रुचिकर विषय है।					
5.	मैं जिन विषयों का अध्ययन करने की इच्छा रखता/रखती हूं, गणित उनमें से एक है।					
6.	गणित विषय की परीक्षा के कुछ दिनों पहले से ही मुझे इसकी घबराहट होने लगती है।					
7.	मैं आसानी से गणित विषय के प्रश्न हल कर लेता/लेती हूं।					
8.	मैं गणित विषय की परीक्षा देते समय में डर का अनुभव करता/करती हूं।					
9.	अन्य विषय की अपेक्षा गणित का विषय का ग्रह कार्य करने में मुझे अधिक कठिनाई होती है।					
10.	मैं गणित विषय की कक्षा में अन्य विषयों की कक्षा की अपेक्षा अधिक खुश रहता/रहती हूं।					
11.	मैं भविष्य के वैकल्पिक विषय के चयन में गणित का चुनाव करूंगा/करूंगी।					
12.	मैं गणित विषय से बहुत परेशान हूं।					
13.	गणित मुझे अन्य विषय की अपेक्षा सरल लगती है।					

14.	गणित विषय की कक्षा में पूछे जाने पर उत्तर ज्ञात होते हुए भी मैं उसे बता नहीं पाता/पाती।					
15.	गणित की कक्षा में चाह कर भी प्रश्न नहीं पूछ पाता/पाती।					
16.	गणित विषय की कक्षा का शैक्षिक वातावरण मुझे अच्छा लगता है।					
17.	गणित विषय की कक्षा में मुझे मानसिक कष्ट बिल्कुल भी नहीं होता है।					
18.	कक्षा में गणित विषय पढ़ते समय मैं मनोवैज्ञानिक बोझ अनुभव करता/करती हूं।					
19.	मेरा गणित विषय के प्रश्नों को हल करने का बिल्कुल भी मन नहीं करता है।					
20.	मुझे ऐसा लगता है कि कक्षा में अन्य विद्यार्थियों की अपेक्षा मैं गणितीय विषय संकल्पनाएं देर से समझता/समझती हूं।					
21.	मैं गणितीय संक्रियाएं द्वारा प्रश्न को हल कर लेता हूं परंतु प्राप्त उत्तर पर मुझे कुछ संदेह रहता है।					
22.	गणित विषय का अध्ययन करने की कोई आवश्यकता नहीं है।					
23.	मुझे अपने सहपाठियों से गणित के प्रश्न का हल पूछने में हीनता का अनुभव नहीं होता है।					
24.	अन्य विद्यार्थियों को गणित विषय समझता हुआ देख मुझे आश्चर्य एवं हीनता का अनुभव होता है।					
25.	मैं गणितीय संकल्पनाए समझ सकता/सकती हूं।					

26.	कक्षा में किसी गणितीय संकल्पना को अध्यापक से समझने के बाद मेरी इच्छा होती है कि उस पर आधारित प्रश्न मुझे हल करने को दिए जाएं।					
27.	मैं इच्छा करता/करती हूं कि कक्षा में गणित विषय का पाठ धीरे-धीरे पढ़ाया जाए।					
28.	मुझे विश्वास है कि मेरे द्वारा समझ ली गई किसी गणितीय संकल्पना पर आधारित कोई भी प्रश्न मैं हल कर सकता/सकती हूं।					
29.	गणित विषय समझने में अन्य विषय की अपेक्षा अधिक ध्यान लगाना पड़ता है।					
30.	गणित विषय को रटना नहीं पड़ता है।					
31.	मुझे गणितीय संकेतों को समझने में देर लगती है।					
32.	गणित संबंधी गृह कार्य में गलती होने पर अध्यापक द्वारा डांट-फटकार का भय रहता है।					
33.	गणित विषय की कक्षा में मुझे अध्यापक से प्रश्न पूछने में डर लगता है।					
34.	गणित एक नीरस विषय है।					
35.	गणित विषय में एक गलती पर संपूर्ण उत्तर गलत होने का भय रहता है।					
36.	मैं घर पर अन्य सभी विषय छोड़ गणित पढ़ता/पढ़ती हूं।					
37.	मैं गणित विषय की परीक्षा के दिन सुबह जल्दी उठकर पढ़ता/पढ़ती हूं।					
38.	गणित विषय की परीक्षा में मेरे द्वारा हल किए गए प्रश्नों					

	के उत्तर गलत हो जाने की चिंता रहती है।					
39.	गणित विषय की परीक्षा में परीक्षा-कक्ष के वातावरण का परीक्षा परिणाम पर प्रभाव पड़ता है।					
40.	गणित समझने में मुझे कोई समस्या नहीं होती है।					
41.	गणित सबसे अच्छा विषय है।					
42.	गणित विषय के बिना कुछ भी संभव नहीं है।					
43.	मैं गणित विषय की परीक्षा के पूर्व इस के प्रश्नों को हल करने का अभ्यास अधिक करता/करती हूं।					
44.	गणित विषय की परीक्षा में अन्य विषय की परीक्षा की अपेक्षा अधिक घबराहट होती है।					
45.	गणित विषय की परीक्षा में प्रश्न हल करने की विधि जानने पर भी मुझे यह आभास होता है कि मुझे कुछ भी नहीं आता है।					
46.	गणित विषय की परीक्षा से पहले चिंता अधिक होती है।					
47.	गणित विषय की परीक्षा के बाद चिंता अधिक होती है।					
48.	विद्यालय में गणित विषय की शिक्षा नहीं देना चाहिए।					
49.	गणित विषय पढ़ने से बहुत लाभ है।					

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APPENDIX – IV

Constructivist Pedagogy Effectiveness Students' Opinionnaire

(Final Draft: In both English and Hindi)

APPENDIX – IV

Confidential *(For Only Research)*

CONSTRUCTIVIST PEDAGOGY EFFECTIVENESS STUDENTS' OPINIONNAIRE

FOR GRADE VII STUDENTS

Research Supervisor

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Babsaheb Bhimrao Ambedkar University, Lucknow

(A Central University)

Name……………………………………………………………………………………………

Class…………………. School:……………………………………………….......................

Gender:	**Male:**	☐	**Female:**	☐
Area:	**Urban:**	☐	**Rural:**	☐
Type of School:	**Private:**	☐	**Govt.:**	☐

Instructions:

This opinionnaire is a part of psychological study. The aim of the scale is to know the effect of constructivist pedagogy on concept attainment and anxiety in mathematics among 7th class students. In the students' opinionnaire student found an opportunity to express their views about constructivist pedagogy. There are some options in front of each question. The scale consists 57 statements with the options of **'Agree', 'Uncertain', 'Disagree'.** Tick (√) on the option that you think is the best according to you by keeping the various options in your mind. The information provided by you will be kept completely confidential and will only be used for research work. The researcher will always be grateful for your cooperation.

CONSTRUCTIVIST PEDAGOGY EFFECTIVENESS STUDENTS' OPINIONNAIRE

S.No.	Statements and Dimensions			
A.	**Constructivist Pedagogy**	**Agree**	**Uncertain**	**Disagree**
1.	पढ़ाई गई विषय वस्तु आपके पूर्व ज्ञान से संबंधित थी। The material was taught by relating your prior knowledge.			
2.	रचनावादी कक्षा में आपने स्वयं सीखने का प्रयास किया। You tried to learn on your own in a constructivist class.			
3.	रचनावादी विधि से शिक्षण करने से आपके अधिगम में वृद्धि हुई। Teaching by the constructivist method increased your learning.			
4.	रचनावादी कक्षा में आप सीखने हेतु उत्साहित थे। You were excited to learn in the constructivist class.			
5.	रचनावादी विधि से आपको सीखने में कठिनाई हुई। The constructivist method made it difficult to learn.			
6.	रचनावादी विधि से सीखने हेतु क्रियाशीलता की आवश्यकता नहीं है। Activity is not required to learn with constructivist method.			
7.	रचनावादी कक्षा में अज्ञात प्रश्नों के उत्तर खोजने का प्रयास करना पड़ा। Tried to find answers to unknown questions in the constructivist class.			
8.	रचनावादी कक्षा में आप पारंपरिक कक्षा की अपेक्षा कम ध्यान देकर कार्य कर रहे थे। In constructivist class, you were working with less attention in the comparison to traditional class.			
9.	रचनावादी कक्षा का वातावरण अधिगम हेतु उचित था। The constructivist classroom environment was appropriate for learning.			
10.	रचनावादी पद्धति से सीखने के लिए अधिक लगन की आवश्यकता होती है। Learning with the constructivist method requires more diligence.			

11.	रचनावादी विधि से आप कम समय में अधिक अधिगम कर सकते हैं। By using constructivist method, you can learn more in less time.			
12.	आप रचनावादी विधि का प्रयोग जाने अनजाने में सीखने में करते रहते हैं। You keep using the constructivist method to learn unknowingly			
13.	आप उतना ही अधिगम करते हैं जितना रचनावाद के अनुरूप हमें कहीं ना कहीं किसी भी तरह से सीखने को मिलता है। You learn as much as we get to learn in some way or the other according to constructivism.			
14.	रचनावादी विधि विद्यालय की शिक्षा में अनिवार्य हो जाए तो निर्धारित समय में पाठ्यक्रम को पूर्ण कराने के लिए पाठ्यक्रम को कम करना पड़ेगा। If constructivist law becomes mandatory in school education, then the syllabus will have to be reduced to complete the syllabus in the stipulated time.			
B.	**Constructivist Pedagogy and Mathematics**			
1.	रचनावादी कक्षा शिक्षण आपको दैनिक जीवन में गणित के उपयोग के लिए प्रेरित करता है। Constructivist classroom teaching motivates you to use mathematics in daily life.			
2.	रचनावादी शिक्षण विधि गणित विषय हेतु पारंपरिक शिक्षण विधि से कम लाभकारी है। Constructivist teaching method is less beneficial than the traditional teaching method for mathematics subject.			
3.	रचनावादी शिक्षण विधि से आप गणित में स्थाई अधिगम प्राप्त कर सकते हैं। With constructivist pedagogy, you can achieve permanent learning in mathematics.			
4.	रचनावादी विधि की सहायता से गणित एक रुचिकर विषय बन जाता है। Mathematics becomes an interesting subject with the help of constructivist method.			
5.	रचनावादी विधि गणित के अध्ययन हेतु उचित नहीं है।			

	The constructivist method is not suitable for a mathematics study.			
6.	रचनावादी शिक्षण विधि से आप गणितीय संकल्पना आसानी से समझ जाते हैं। Constructivist teaching method makes you understand mathematical concepts easily.			
7.	रचनावादी शिक्षण विधि से प्रश्न अनुसार उचित गणितीय संक्रियाओं का प्रयोग कर सही उत्तर प्राप्त किया जा सकता है। In constructivist teaching method, correct answer can be obtained by using appropriate mathematical operations according to the question.			
8.	रचनावादी विधि के प्रयोग से गणित को अन्य विषय के समान ही सामान्य बनाया जा सकता है जिससे गणित व अन्य विषयों में कठिनाई स्तर पर अधिक अंतर न अनुभव हो। Using the constructivist method, mathematics can be made as general as any other subject, so that there is not much difference in difficulty level between mathematics and other subjects.			
9.	कक्षा-7 के गणित शिक्षण में रचनावादी विधि का प्रयोग करना आवश्यक नहीं है। It is not necessary to use constructivist method in teaching mathematics of class-7.			
10.	गणित शिक्षण में रचनावादी विधि और परंपरागत विधि में कोई विशेष अंतर नहीं है। There is no significant difference between the constructivist method and the traditional method in teaching mathematics.			
11.	कंस्ट्रक्टिविज्म कक्षा गणित सीखने योग्य नहीं थी। The constructivist classroom was not learnable to mathematics.			
12.	परंपरागत विधि की अपेक्षा रचनावादी विधि से सीखने के लिए शिक्षा के प्रति विशेष समर्पण आवश्यक है। Special dedication to education is necessary for learning through constructivist method as compared to traditional method.			
13.	रचनावादी गणितीय कक्षा का वातावरण अधिगम योग्य था।			

	The environment of the constructivist mathematical classroom was learnable.			
14.	रचनावादी विधि से गणित सीखने पर आपको परंपरागत विधि की अपेक्षा अधिक कठिनाई तथा मेहनत का सामना करना पड़ा। You had to face more difficulty and effort when you learned mathematics from the constructivist method than the traditional method.			
15.	गणित शिक्षण में परंपरागत विधि की अपेक्षा रचनावादी विधि से सीखने पर आप अधिक स्थाई अधिगम प्राप्त करते हैं। In teaching mathematics, you get more sustainable learning when you learn from the constructivist method than the traditional method.			
16.	अन्य विषयों की अपेक्षा गणित शिक्षण में रचनावादी विधि अधिक उपयोगी लगती है। The constructivist method seems to be more useful in teaching mathematics than other subjects.			
17.	रचनावादी शिक्षण विधि गणित सीखने के लिए उचित शैक्षिक वातावरण देती है। Constructivist teaching method gives proper educational environment for learning mathematics.			
18.	रचनावादी शिक्षण विधि कक्षा में लागू कर नियमित रूप से अध्ययन करना एक चुनौतीपूर्ण कार्य हो सकता है। Applying constructivist pedagogy in the classroom and studying regularly can be a daunting task.			
19.	रचनावादी शिक्षण विधि गणित सीखने में प्रभावहीन है। Constructivist teaching method is ineffective in learning mathematics.			
C.	**Constructivist Pedagogy and Mathematical Anxiety**			
1.	रचनावादी विधि की सहायता से गणित सीखने पर विद्यार्थी की गणित के प्रति घबराहट कम हो सकती है। Students can reduce nervousness towards mathematics, with the help of the constructivist method.			

2.	रचनावादी विधि से सीखने पर गणित की परीक्षा के भय को समाप्त किया जा सकता है। The fear of examination of mathematics can be eliminated by learning through constructivist method.			
3.	रचनावादी विधि द्वारा गणित पढ़ने पर उसके कठिन होने की संकल्पना सच नहीं लगती है। The concept that mathematics is difficult to study by constructivist method does not seem to be true.			
4.	रचनावादी विधि के माध्यम से गणित समझने में कठिनाई होती है। It is difficult to understand mathematics through the constructivist method.			
5.	रचनावादी विधि के माध्यम से पढ़ने पर गणित विषय में थकान बिल्कुल भी नहीं लगती है। There is no fatigue in mathematics studying through the constructivist method.			
6.	रचनावादी विधि से पढ़ने पर गणितीय संकल्पनाए समझने में परंपरागत विधि की अपेक्षा अधिक मानसिक कष्ट होता है। Studying through constructivist method does not feel tired at all in the subject of mathematics.			
7.	रचनावादी विधि के माध्यम से पढ़ने पर गणित के प्रति मेरा मानसिक बोझ कम हुआ। My mental burden towards mathematics was reduced by studying through constructivist method.			
8.	रचनावादी विधि से सीखने में गणित के आशातीत अधिगम तक पहुंचने में कक्षा के वातावरण की भूमिका नगण्य होती है। In constructivist learning, the role of the classroom environment is negligible in reaching the expected learning of mathematics.			
9.	रचनावादी विधि से गणित सीखने पर इसकी परीक्षा देते समय मुझे पहले की तरह अपने गणित ज्ञान के प्रति आभासी शून्यता अनुभव नहीं होती है। When I take the test of learning mathematics through the constructivist method, I do not feel a			

	virtual void in my mathematics knowledge as before.			
10.	रचनावादी विधि की सहायता से गणितीय प्रश्नों का भरपूर अभ्यास किया जा सकता है। Mathematical questions can be practiced well with the help of constructivist method.			
11.	रचनावादी विधि का प्रयोग करके मैं गणित में सर्वोत्तम संकल्पना अधिग्रहण कर सकता हूं। With the help of constructivist method, mathematical questions can be practiced a lot.			
D.	**Constructivist Pedagogy and Concept Attainment in Mathematics**			
1.	गणित विषय में रचनावादी विधि प्रभावहीन लगती है। The constructivist method seems ineffective in the subject of mathematics.			
2.	रचनावादी विधि की सहायता से गणितीय संकल्पना संबंधी विभिन्न उदाहरणों का सटीक अनुमान लगाया जा सकता है। With the help of constructivist method, various examples of mathematical concepts can be accurately estimated.			
3.	परंपरागत शिक्षण विधि की अपेक्षा रचनावादी विधि के माध्यम से गणितीय संकल्पनाए आसानी से ग्रहण की जा सकती हैं। Mathematical concepts can be easily grasped through constructivist method as compared to traditional teaching method.			
4.	रचनावादी विधि के माध्यम से ग्रहण की गई गणितीय संकल्पना अपेक्षाकृत अधिक स्थाई होती है। The mathematical concept adopted through the constructivist method is relatively more stable.			
5.	रचनावादी विधि के माध्यम से पढ़ाई गई गणितीय संकल्पना का मस्तिष्क में अधिक स्पष्ट मानचित्रण होता है। The mathematical concept taught through the constructivist			

	method has a clearer mapping in the mind.			
6.	रचनावादी विधि से सीखी गई गणितीय संकल्पना का आसानी से दैनिक जीवन में अनुप्रयोग किया जा सकता है । The mathematical concepts learned from the constructivist method can be easily applied in daily life.			
7.	रचनावादी शिक्षण विधि गणितीय संकल्पना को समझने में उपयोगी नहीं है। Constructivist teaching method is not useful in understanding mathematical concepts.			
8.	रचनावादी विधि के प्रयोग से किसी भी गणितीय संकल्पना को आसानी से नहीं समझा जा सकता है। No mathematical concept can be easily understood using the constructivist method.			
9.	रचनावादी विधि के माध्यम से कक्षा-7 के गणित पाठ्यक्रम संबंधी सभी संकल्पनाएं आसानी से नहीं समझी जा सकती हैं। Not all concepts related to Class seventh Mathematics curriculum are easily understood through constructivist method.			
10.	रचनावादी विधि के माध्यम से मुझे गणितीय संकल्पना अधिग्रहण अपेक्षाकृत सरल होता है। Through the constructivist method, I find mathematical concept acquisition relatively easy.			
11.	गणितीय संकल्पना अधिग्रहण हेतु रचनावादी शिक्षण विधि से उत्तम अन्य कोई विधि नहीं है। There is no better method for acquisition of mathematical concepts than constructivist teaching method.			
12.	रचनावादी विधि से गणितीय शिक्षण में पढ़ाई गई संकल्पना सरल लगती हैं जिससे आगामी प्रत्यय को सीखने के लिए उत्सुकता बढ़ती है। Concepts taught in mathematical teaching in the constructivist			

	method seem simple, which increases the eagerness to learn the next concept.			
13.	रचनावादी विधि सरल गणितीय संकल्पना के लिए तो सटीक है पर कठिन गणितीय संकल्पना हेतु नहीं। The constructivist method is accurate for simple mathematical concepts but not for difficult mathematical concepts.			

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APPENDIX – V

Constructivist Pedagogy Effectiveness Teachers' Opinionnaire

(Final Draft: In both English and Hindi)

APPENDIX – V

Confidential *(For Only Research)*

CONSTRUCTIVIST PEDAGOGY EFFECTIVENESS TEACHERS' OPINIONNAIRE

FOR GRADE VII STUDENTS

Research Supervisor

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NAME:……………………………………………………………AGE:………………………………………

DESIGNATION:…………………………………………………GENDER:…………………….................

COLLEGE/SCHOOL:………………………………………………………………………………………….

DATE………………………………………………………CONTACT NO.:…………………….................

TEACHING EXPERIENCE: ……………..……………………………………………………………………

ADDRESS:…………………………………………………………………………………………………….

E-mail:………………………………………………………………………………………………………

Instructions:

This opinionnaire is a part of psychological study. The aim of the scale is to know the effect of constructivist pedagogy on concept attainment and anxiety in mathematics among 7^{th} class students. In the students', opinionnaire student found an opportunity to express their views about constructivist pedagogy. There are some options in front of each question. The opininonnaire consists 54 statements with the options of **'Agree', 'Uncertain', 'Disagree'.** Tick (√) on the option that you think is the best according to you by keeping the various options in your mind. The information provided by you will be kept completely confidential and will only be used for research work. The researcher will always be grateful for your cooperation.

CONSTRUCTIVIST PEDAGOGY EFFECTIVENESS TEACHERS' OPINIONNAIRE

S.No.	Statements and Dimensions			
A.	**Constructivist Pedagogy**	**Agree**	**Uncertain**	**Disagree**
1.	रचनावादी विधि से विद्यार्थियों के अधिगम में वृद्धि हुई। Constructivist method increased the learning of the students.			
2.	रचनावादी विधि से विद्यार्थी सरलता से सीख नहीं सकते हैं। Students cannot learn easily by constructivist method.			
3.	रचनावादी विधि से सीखने में विद्यार्थी हेतु कम क्रियाशील हो सकते हैं। Students may be less active to learn through the constructivist method.			
4.	रचनावादी कक्षा में विद्यार्थी स्वयं अज्ञात प्रश्नों के उत्तर खोजने का प्रयास कर सकते हैं। In the Constructivist class, the students can try to find answers to unknown questions himself.			
5.	रचनावादी विधि से शिक्षण करने का अनुभव शिक्षक के लिए आवश्यक नहीं है। The experience of teaching through constructivist method is not necessary for the teacher.			
6.	रचनावादी विधि को कक्षा में लागू करना पारंपरिक शिक्षण विधि को लागू करने की अपेक्षा कठिन है। Applying the constructivist method in the classroom is more difficult than applying the traditional method of teaching.			
7.	रचनावादी विधि में शिक्षक एवं विद्यार्थी दोनों को अधिक लगन की आवश्यकता हो सकती है । Constructivist method may require more dedication from both the teacher and the student.			
8.	रचनावादी विधि को प्राथमिक, पूर्व-माध्यमिक, माध्यमिक तथा उच्चतर-माध्यमिक शिक्षा में, भावी समय में वर्तमान समय की अपेक्षा अधिक प्रयोग में लाया जाना चाहिए। Constructivist method should be used more in primary, pre-secondary, secondary and higher-secondary education in future time than in present time.			

9.	रचनावादी विधि से विद्यार्थी कम समय में अधिक अधिगम कर सकते हैं। With the constructivist method, students can learn more in less time.			
10.	विद्यार्थी रचनावादी विधि का प्रयोग जाने-अनजाने में सीखने में करते रहते हैं। Students keep using the constructivist method in learning knowingly or unknowingly.			
11.	विद्यार्थी उतना ही अधिगम करते हैं जितना रचनावादी उपागम के अनुरूप उन्हें कहीं ना कहीं किसी भी तरह से सीखने को मिलता है। Students learn only as much as they get to learn in some way or the other according to the constructivist approach.			
12.	रचनावादी विधि को राज्य सरकार विद्यालय शिक्षा में अनिवार्य कर दे तो पाठ्यक्रम को निर्धारित समय में पूर्ण कराने की बाध्यता को देखते हुए कम करना पड़ सकता है। If the state government makes the constructivist method mandatory in school education, it may have to be reduced in view of the obligation to complete the syllabus in the stipulated time.			
13.	रचनावादी शिक्षण विधि का विद्यार्थी अधिगम पर अधिक प्रभाव नहीं पड़ता है। Constructivist teaching method does not have much impact on student learning.			
14.	रचनावादी शिक्षण विधि कक्षा में लागू कर नियमित रूप से शिक्षण कर पाना शिक्षक हेतु चुनौतीपूर्ण कार्य हो सकता है। Implementing constructivist teaching method in the classroom and doing regular teaching can be a challenging task for the teacher.			
B.	**Constructivist Pedagogy and Mathematics**			
1.	रचनावादी कक्षा शिक्षण विद्यार्थी को दैनिक जीवन में गणित के उपयोग के लिए प्रेरित करता है। Constructivist classroom teaching motivates the student to use mathematics in daily life.			
2.	रचनावादी शिक्षण विधि गणित विषय हेतु पारंपरिक शिक्षण विधि से कम लाभकारी है। Constructivist teaching method is less beneficial than traditional teaching method for mathematics subject.			

3.	रचनावादी विधि से अधिकतम विद्यार्थी गणित में स्थाई अधिगम प्राप्त करते हैं। Most of the students get permanent learning in Mathematics by constructivist method.			
4.	रचनावादी विधि की सहायता से गणित को एक रुचिकर विषय बनाया जा सकता है। Mathematics can be made an interesting subject with the help of constructivist method.			
5.	रचनावादी विधि गणित शिक्षण हेतु अनुपयुक्त है। Constructivist method is unsuitable for teaching mathematics.			
6.	रचनावादी शिक्षण विधि से विद्यार्थी को गणितीय संकल्पनाए आसानी से समझाई जा सकती हैं। Mathematical concepts can be easily explained to the student through constructivist teaching method.			
7.	रचनावादी विधि के प्रयोग से गणित को अन्य विषय के समान ही सामान्य बनाया जा सकता है जिससे विद्यार्थी गणित व अन्य विषयों में कठिनाई स्तर पर अधिक अंतर न अनुभव करें। Using the constructivist method, mathematics can be made as general as any other subject so that students do not experience much difference in difficulty level between mathematics and other subjects.			
8.	कक्षा 7 के गणित पाठ्यक्रम में रचनावादी विधि का प्रयोग नहीं होना चाहिए। Constructivist method should not be used in class seventh maths syllabus.			
9.	गणित शिक्षण में रचनावादी विधि का प्रयोग देख कर आपको लगा कि इससे शिक्षण-अधिगम परंपरागत विधि की अपेक्षा अधिक होगा। Seeing the use of constructivist method in teaching mathematics, you felt that this teaching-learning would be more than the traditional method.			
10.	रचनावादी शिक्षण विधि तथा परंपरागत शिक्षण विधि में कोई विशेष अंतर नहीं है। There is no special difference between constructivist teaching method and traditional method of teaching.			

11.	परंपरागत विधि की अपेक्षा रचनावादी विधि से शिक्षण-अधिगम में शिक्षक एवं छात्र दोनों का शिक्षा के प्रति विशेष समर्पण आवश्यक है। In comparison to the traditional method, teaching-learning by constructivist method requires special dedication of both the teacher and the student towards education.			
12.	अन्य विषयों की अपेक्षा गणित शिक्षण में प्रश्न वादी विधि अधिक उपयोगी लगती है। Questionnaire method seems to be more useful in teaching mathematics than other subjects.			
13.	रचनावादी शिक्षण विधि विद्यार्थियों को गणित अधिगम हेतु उचित शैक्षिक वातावरण देती है। Constructivist teaching method gives proper educational environment to the students for learning mathematics.			
14.	रचनावादी विधि से गणित विषय में शिक्षण कार्य करने में शिक्षक को पारंपरिक विधि की अपेक्षा अधिक कठिनाई होगी। The teacher will have more difficulty in doing the teaching work in the subject of mathematics with the constructivist method than the traditional method.			
C.	**Constructivist Pedagogy and Mathematical Anxiety**			
1.	रचनावादी विधि की सहायता से विद्यार्थी की गणित के प्रति घबराहट को कम किया जा सकता है। With the help of constructivist method, student's nervousness towards mathematics can be reduced.			
2.	रचनावादी विधि से विद्यार्थियों में गणित की परीक्षा संबंधी भय को समाप्त किया जा सकता है। Constructivist method can eliminate the fear of examination of mathematics in the students.			
3.	रचनावादी विधि द्वारा विद्यार्थियों की गणित विषय के कठिन होने की संकल्पना को बदला नहीं जा सकता है। Constructivist method cannot change the students' concept of Mathematics as being difficult.			
4.	रचनावादी विधि गणित-शिक्षण हेतु उपयुक्त नहीं है। Constructivist method is not suitable for teaching mathematics.			

5.	गणितीय घबराहट को रचनावादी विधि के प्रयोग से कम किया जा सकता है। Mathematical nervousness can be reduced by using the constructivist method.			
6.	रचनावादी विधि शिक्षण में प्रयोग करने पर गणित की संकल्पनाए समझने में विद्यार्थियों को परंपरागत विधि की अपेक्षा अधिक मानसिक कष्ट होता है। When the constructivist method is used in teaching, students have more mental trouble in understanding the concepts of mathematics than the traditional method.			
7.	रचनावादी विधि के प्रयोग से विद्यार्थी के गणित के प्रति मानसिक बोझ को कम किया जा सकता है। The mental burden of the student towards mathematics can be reduced by the use of constructivist method.			
8.	रचनावादी विधि से शिक्षण में गणित के आशातीत अधिगम में कक्षा के वातावरण की भूमिका नगण्य होती है। In teaching through constructivist method, the role of classroom environment is negligible in the expected learning of mathematics.			
9.	रचनावादी विधि गणित परीक्षा के समय विद्यार्थी में गणित परीक्षा के प्रति उत्पन्न आभासीय शून्यता को समाप्त करती है। The constructivist method eliminates the virtual emptiness created in the student towards the mathematics examination at the time of mathematics examination.			
10.	रचनावादी विधि की सहायता से विद्यार्थी गणितीय प्रश्नों के हल का भरपूर अभ्यास कर सकते हैं। With the help of constructivist method, students can practice solving mathematical problems a lot.			
11.	रचनावादी विधि के माध्यम से प्राप्त अपेक्षाकृत अधिक स्थाई अधिगम विद्यार्थी की गणित के प्रति घबराहट को बढ़ा देता है। The relatively more stable learning achieved through the constructivist method increases the student's anxiety about mathematics.			
D.	**Constructivist Pedagogy and Concept Attainment in Mathematics**			
1.	रचनावादी विधि के प्रयोग से विद्यार्थी गणित में श्रेष्ठ संकल्पना अधिग्रहण प्राप्त करते हैं।			

	By using the constructivist method, students achieve the best concept acquisition in mathematics.			
2.	गणित विषय समझने में रचनावादी विधि प्रभावहीन है। The constructivist method is ineffective in understanding the subject of mathematics.			
3.	रचनावादी विधि की सहायता से विद्यार्थी गणितीय संकल्पना संबंधी विभिन्न उदाहरणों का सटीक अनुमान लगा सकते हैं। With the help of constructivist method, students can make accurate predictions of various examples of mathematical concepts.			
4.	परंपरागत शिक्षण विधि की अपेक्षा रचनावादी विधि के माध्यम से विद्यार्थी गणितीय संकल्पना आसानी से ग्रहण कर लेते हैं। The students grasp mathematical concepts easily through constructivist method as compared to traditional teaching method.			
5.	रचनावादी विधि के माध्यम से ग्रहण की गई गणितीय संकल्पनाए अपेक्षाकृत अधिक स्थाई होती हैं। The mathematical concepts adopted through the constructivist method are relatively more stable.			
6.	रचनावादी विधि के माध्यम से पढ़ाई गई गणितीय संकल्पना का मस्तिष्क में अधिक स्पष्ट मानचित्रण होता है। The mathematical concept taught through the constructivist method has a more clear mapping in the mind.			
7.	रचनावादी विधि के माध्यम से ग्रहण की गई गणितीय संकल्पना का विद्यार्थी के दैनिक जीवन में कोई उपयोग नहीं है। The mathematical concept acquired through constructivist method is of no use in the daily life of the student.			
8.	कक्षा 7 के विद्यार्थी हेतु रचनावादी शिक्षण विधि गणितीय प्रत्यय को समझने में अनुपयोगी है। Constructivist teaching method for class seventh student is useless in understanding mathematical concepts.			
9.	रचनावादी विधि के प्रयोग से किसी भी गणितीय प्रत्यय को आसानी से नहीं समझा जा सकता है। No mathematical concept can be easily understood using the constructivist method.			

10.	रचनावादी विधि के माध्यम से कक्षा 7 के विद्यार्थी को उनके गणित-पाठ्यक्रम संबंधी सभी प्रत्यय आसानी से नहीं समझाया जा सकते हैं। Through the constructivist method, all the concepts related to their maths-curriculum cannot be easily explained to the student of class seventh.			
11.	रचनावादी विधि के माध्यम से गणितीय संकल्पना अधिग्रहण अपेक्षाकृत सरल होता है। The acquisition of mathematical concepts through the constructivist method is relatively simple.			
12.	गणितीय संकल्पना अधिग्रहण हेतु रचनावादी शिक्षण विधि से उत्तम अन्य कोई विधि नहीं है। There is no better method for acquisition of mathematical concepts than constructivist teaching method.			
13.	रचनावादी विधि से शिक्षण करने में गणितीय संकल्पना अधिग्रहण होने से विद्यार्थी की गणितीय चिंता कम हो जाती है। The mathematical concern of the student is reduced by the acquisition of mathematical concepts in teaching in the constructivist method.			
14.	रचनावादी विधि से गणितीय शिक्षण में पढ़ाए गए गणितीय प्रत्यय विद्यार्थी को सरल लगते हैं जिससे वह आगामी प्रत्यय को सीखने के लिए तत्पर रहता है। Mathematical concepts taught in mathematical teaching through constructivist method seem simple to the students, so that he is ready to learn the next concept.			
15.	रचनावादी विधि सरल गणितीय प्रत्यय के लिए तो सटीक है पर कठिन गणितीय प्रत्यय हेतु नहीं। The constructivist method is accurate for simple mathematical concepts but not for difficult mathematical concepts.			

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APPENDIX – VI

Group Test of General Mental Ability

(Hindi Modified 72)

by

Dr. Shyamswaroop Jalota

APPENDIX - VII

Socio-Economic Status Scale (SESS)

by

Dr. Sunil Kumar

APPENDIX– VIII

Concept Attainment Test (C.A.T)

by

Dr. Anuradha Joshi and Dr. Ratnamala Arya

APPENDIX – IX

Mathematical Anxiety Scale- India

(MAS-I)

by

Dr. Ayatollah Karimi and Prof. S. Venkatesan