# EFFECTIVENESS OF ACTIVE LEARNING STRATEGIES ON SCIENCE FOR SECONDARY SCHOOL STUDENTS IN TERM ACHIEVEMENT AND REACTION

Pre- Presentation Summary

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**SUPERVISOR**

Dr. Laxman Shinde

Associate Professor

**RESEARCHER**

Seema Lokhande

Research Scholar

**SCHOOL OF EDUCATION (IASE)**

**(ACCREDITED WITH 'A$^{+}$' GRADE BY NAAC)**

**DEVI AHILYA VISHWAVIDYALAYA**

**INDORE (M.P.)**

# SUMMARY

## 1.0.0 INTRODUCTION

The title of the present study was "Effectiveness of Active Learning Strategies on Science for Secondary School Students in term Achievement and Reaction". The main purpose of the study was to check the effectiveness of Active Learning Strategy. The treatment was based on teaching with Active Learning Strategy and lesson plan prepared from selected units of Science Subject for IX class students. To check the achievement of students in science on the basis of teaching methods and to study the effectiveness on the variables, active learning strategy and traditional method were compared in this research. During the study, Achievement in Science and Reaction scale were developed to fulfill the purpose of data collection for the dependent variables. The interaction effects of the treatment with other independent variable like Critical Thinking Skill, Scientific Temper, Scientific Attitude and Intelligence were also studied. This chapter provides a retrospect of the study which contains the statement of the problem, Objectives and Hypotheses formulated for the study, and Methodology in brief. It also includes the major findings and conclusions arrived at, educational implications of the study and suggestions for further research.

## 1.1.0 BACKGROUND OF THE STUDY

In the present scenario the most powerful tool in the hands of a teacher is the teaching-learning process and it is helpful in bringing about desirable and effective changes in the behavior of students. Mostly teachers used traditional teaching methods in their classrooms. Teachers who use the traditional lecture technique often fail to provide each student special attention. Because this method students remains passive learner and only teacher remains active. Other one the Indian classrooms are very diverse, with teachers dealing with students of varying capacities. Some people learn a subject fast, while others take longer. In most situations, however, the instructor tailors his lecture to the entire class without taking into account the diversity. As a result, the instruction may be ineffective and mode of instruction also may be ineffective. The importance and meaning of the content cannot be adequately captured to meet the needs of all types of students in the classroom.

The current era mainly focuses on developing multiple competencies in the field of education like self-awareness, social awareness, self-management, effective communication, critical, logical and creative thinking, digital age literacy and effective collaboration among learners. So that desirable changes can be brought about in their behavior. In this way, motivated and concerned learners can actively and confidently contribute to the progress of global society. To improve teaching learning the teacher should make an effort to utility different active learning practices. These approaches are one of the most-well researched teaching strategies in today's classrooms. “Active Learning Strategy” is a teaching method in which students collaborate to improve their own and others' learning. The main objective of this teaching strategy is to teach students to actively acquire skills, attitudes and knowledge along with desirable ways of living in society. Teaching involves all that a teacher does to select and execute tasks and activities for creating an instructional process in which teacher and students participate and there is a reason for including all tasks, activities, and associated processes in any description of teaching. Students tend to retain the information for longer when they are actively involved in the instructional activities.

Today's curriculum need tactics that enable students to solve problems, understand various situations, think logically, make judgments, collect data and collaborate with other students. Students that use active and experiential learning methodologies retain information for longer periods of time and develop useful skills. In fact, active learning provides an important opportunity to create meaningful learning experiences for students and make the learning process effective. Due to which increases the active participation of students in the classroom. Therefore to explore meaningful learning experience in this important area, the present study is entitled “Effectiveness of Active Learning Strategies on Science for Secondary School Students in term Achievement and Reaction” was proposed.

### 1.1.1. Concept of Active Learning Strategy

Active learning was first defined by Bonwell and Eison (1991) as “anything that involves students in doing things and thinking about the things they are doing” (emphasis added). Active learning is an important teaching approach in which students follow the

instructions given by the teacher and actively participate in the learning process. It is based on the constructivist approach in which students acquire new knowledge by incorporating their own experiences and ideas. The concept of Active Learning process is based on real experiences and cognition, which can be used to provide students with lasting knowledge.

### 1.1.2. Active Learning Strategies

Active Learning Strategies developed out of the works of an earlier group of theorists who promoted discovery learning (Meyer, 2004). Discovery learning, problem-based learning, experiential learning, and Inquiry training instruction are the most cited forms of Active Learning Strategies (Krishner, Sweller & Clarke, 2006). According to all these strategies, the learning process is learner driven, that is, it is not at all the case that the instructor can only provide guidance. He can give important tasks to the students like providing challenges, encouraging them to take risks, correcting errors and providing context because learning without a mentor is a slow and frustrating process.

Adopting Active Learning Strategies does not mean following highly structured methods or even eliminating the lecture format (Bonwell & Eison, 1991). Activities that encourage student participation, these can be included as a part of teaching in lessons. The various 'Active Learning' activities include in the classroom like; class discussions, small group discussions, debate, posing questions, think-pair-share activities, short written activities and role paly the class (Bonwell & Eison, 1991). Felder and Brent (2009) noticed Think/Pair/Share, concept tests, think aloud, problem solving as some effective Active Learning Strategies. Anything that the students do in the classroom other than merely listening to the lectures passively can be considered as active learning and any strategy that enables the learner to do so can be an active learning strategy.

### 1.1.3 Fink's Model of Active Learning

There is a very important model of Active Learning Strategy. The researcher has included this model in his study. Fink's Model is described in detail below.

Fink's Model (proposed in 1999 and revised in 2003) suggests the involvement of some kind of experience or dialogue in learning activities. The two different types of experiences include noticing and Doing, while dialogue involves Dialogue with Self and Dialogue with Others.

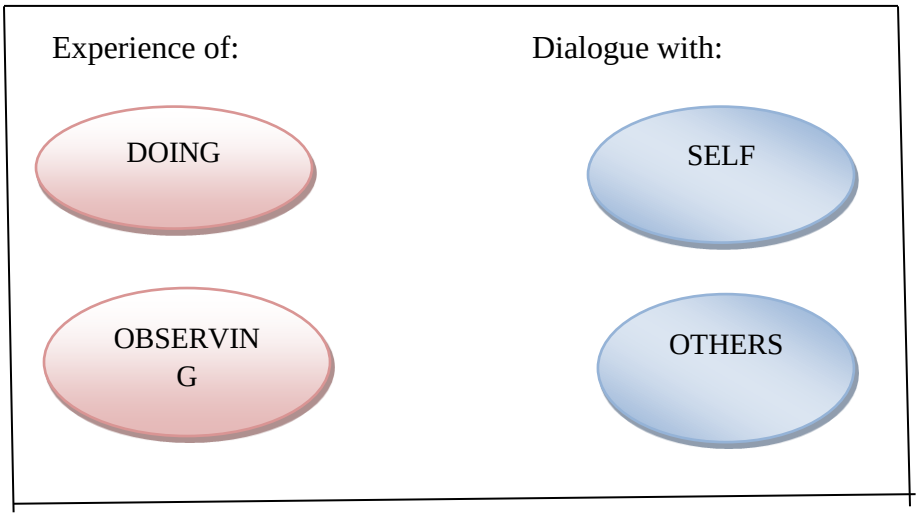


**Figure1.1:** Showing Fink's Model of Active Learning

"Experience of Observation" is when a learner listens to someone else, or learns something, or watches others do something. So that direct or indirect experience can only be the act of observation.

"Experience of doing" is related to the learning activity, which reflects the learning experience gained by the learner during the work done. Doing may also be direct or indirect. "Dialogue with Self" comes into the action when asking him some questions such as 'what they think, what they should think or what they feel about the topic' and so on regarding different issues. "Dialogue with Others" may appear in many different forms. In traditional education, learners listen to another person during reading a textbook or listening lecture. This can be taken as partial dialogue. An intense small group discussion on a topic created by teachers may be thought of as a more dynamic and active form of dialogue. Sometimes teachers may also introduce creative ways by involving participants in discussions with non-participant, either in class or outside the class.

According to Fink (2003), active learning activity may be guided by two principles. First, an effective learning activity comprises the following three components:

information and ideas, experience, and reflective dialogue. Second, we should search for direct types of learning activities as far as possible to enhance the quality of learners, although indirect, forms are essential in some cases. Learning activities should reflect the teacher's judgment of how effectively they address the learning goals of the class. The student's response to the learning experience having some meaning for them characterizes the improvement of learning. This can be done individually using journals, diaries, etc., or with others like discussions with teachers or in small groups. When students reflect on learning content and the way of their learning then it is valued more for them and they appreciate their learning.

### 1.1.4 Selected Active Learning Strategies

**Individual Active Learning Strategies**

- Quick write,
- Individual plus group quizzes,
- One minute paper,
- Brainstorming
- Muddiest point,
- Concept mapping,

**Group wise Active Learning Strategies**

- Whole group discussion
- Small group discussion
- Think Pair Share
- Role playing
- Four corners
- Fish bowl
- Jigsaw

## 1.1.0 RATIONALE OF THE STUDY

In the present digital era, teachers are searching for strategies that can actively engage students in classroom interaction to help nourish their pedagogical, technological skills, and thinking skills and improve their learning capacities. Active participation by the students in the class by using innovative strategies like Active Learning Strategy helps reduce academic anxiety, stress, and shyness, enhancing student learning abilities, self-confidence, motivation, capacity to think, meta-cognitive skills, critical thinking abilities, creative thinking, and encouraging personal accountability. As educators have begun to move away from the traditional teaching method as the favored teaching style, a growing number of arguments for why Active Learning Strategy is a better Strategy are emerging in the literature.

Active Learning Strategy is an interesting, innovative, and collaborative strategy that has the potential to turn pupils into independent learners. In contrast to their previous learning experiences, learners now have the chance to build their capacity to think independently via active engagement with the subject they are studying, which contrasts with their previous passive classroom experiences. During the Active Learning Strategy-based learning, students become collaborators and assist one another, hence enhancing engagement. Additionally, teachers who employ the Active Learning Strategy of instruction can communicate with each student in each class daily.

The Active Learning Strategy is based on giving time to students so that they can think and present their views. This strategy requires the active participation of pupils in the classroom. A teacher asks questions and encourages the students to share their ideas. Moreover, this Active Learning Strategy allows “all students to express their thoughts with at least one other student”, thereby developing their sense of engagement in the learning process with classmates in the classroom. Active Learning Strategy assists understudies with creating theoretical comprehension of a theme, fosters the capacity to channel data and make determinations, and fosters the capacity to think about different perspectives. Teachers should teach the students in such a way that the students are able to learn the concepts easily while acquiring process skills, positive attitude, values and critical thinking skills. Teachers use a variety of teaching strategies to teach in the classroom, alternating from teacher-centered to student-centered approaches (Efandi and Zanaton, 2007). Essentially, cooperative learning represents a shift in the educational

paradigm from teacher teacher-teacher-situated approach to more student-centered learning in small groups. For a teacher who wants to teach effectively, it is necessary to find mindfulness and active teaching methods that will enable the teacher to achieve statistically significant improvements in students' performance. The researcher's observation shows that, when students get the opportunity to work in groups, there is more encouragement for mutual interaction and group participation.

Active learning strategies are a new paradigm in teaching that reflects a social approach to teaching and learning, and promotes cooperative learning as an alternative to the traditional lecture format. In pedagogy, educators trying to learn the methodology to teach a specific subject properly so that students maximize learning. Learning appropriately occurs when students are actively involved in the construction of their knowledge (Mester & Cocking, 2002).

Numerous studies on Learning Strategies have demonstrated positive effects on learning outcomes. Learning Strategies offer many platforms to improve teaching learning process for teachers. Bhamini (2002) found that Mastery Learning Strategies and Activity Based Learning were effective on Attainment of Competencies in Mathematics at Primary Level. Kaur (2013) also found Motivational Beliefs and Learning Strategies effectively correlates of Achievement in Mathematics among College Students. Kumar (2010) observed that Blended Strategies was given positive result on Learning relation and Attitude of Secondary School Students. Sonia (2014), Eshaghali (2014), Ghatage & Mukund (2018), Dheeraj (2018), Yaduvanshi (2018) found positive impact of Learning Strategies on academic achievement on science and Arts subjects students with different Educational level like secondary level, and UG level students.

The present education system is subject-matter based in which so many subjects are presented to the students, due to which the burden of information about the subjects increases on the minds of the students. Due to which the learning process gets disrupted because due to so much load the brain is not able to process all the information properly. So students fear about subject content and doesn’t actively present in the classroom. Teachers remove this fear and create active environment in classroom can use different Active Learning Strategies like Quick write, Individual plus group quizzes, One minute paper, Brainstorming, Muddiest point, Concept mapping, Whole group discussion, Small

group discussion, Think Pair Share, Role playing, Four corners, Fish bowl, Jigsaw etc. With the help of these activities, many different mental processes can be analyzed, such as critical thinking, logical thinking, problem solving, etc.

Active Learning Strategy provides a theoretical framework dealing with individual information processing and learning. Sesin & Terhan (2011) investigated that Active-Learning implementation on high-school students found was effective. Jeffrey (2015) observed that Active Learning Strategy was very effective as compare to Lecture teaching method in large classes in Higher Education. Ghose and Swanzy (2012), Bageshwari Tripathi (2019), Prakash G.V. (2019), Hemanth Kumar B.C (2021), Mary A., Kopecki Fjetland & Matthew Steffenson (2021), Taslim D. Nu & et.al (2022) found positive impact of Active Learning Strategies on academic achievement on science, Mathematics and Biology Subjects and other area like students Attitude, and Interest of Secondary School Students. Izadora, Marcel & et.al (2121) was also found Active Learning Strategy tools improve the learning outcome with respect to Scientific Attitude and Critical Thinking in higher Education. Seeja (2015), Vinay Aparna (2018), Priyamvada (2022), Taslim D. Nu & et.al (2022) both found that positive impact through Active Learning Strategies on Critical Thinking, Higher Order Thinking, and Academic Achievement of students.

According to Killian & Bastas (2015) Active Learning Strategy is important thing for teachers to know. Killian & Bastas (2015) found that Active Learning Strategy was very effective in Sociology Classes on Students Achievement and performance. According to Vinay Aparna (2018) suggested that Role Play under the Active Learning Strategy encouraging Students Higher Order Thinking. Lili Kumari Padhy (2019) observed that case study through Active Learning Strategy in English Language given positive result in Elementary Education System in Government School. According to Andrew R. Du. Rochar (2021) self-efficacy is very important to improve student's achievement; R. Du. Rochar (2021) observed that Active Learning Strategy and self-efficacy was found to be effective on attitude towards plagiarism. David O. Obada & et.al (2023) studied that Blended Online Teaching and Learning through the significance of active learning strategy was found to be very effective for the students of the class.

The review of studies on Critical Thinking primarily indicated that Critical Thinking can be taught and learned. Many studies explored the relation between Critical Thinking and variables like achievement, intelligence, decision making, and Academic achievement focused motivation, problem solving skills, learning style etc. There were several attempts to find the correlation between Critical Thinking skills and Active Learning Strategy. Many studies were aimed at investigating the effectiveness of course with instructional paradigm in improving the Critical Thinking Skills as well as Active Learning Strategy. Critical thinking is that method of thinking that allows the thinker to think by handily examining, evaluating, and recreating the gathered information. Gurubasappa (2011), Rui and et.al (2011), Celina & et.al (2016), Tirunehand & et.al (2017), Bandari and Lilit (2017), M.L. Styers & et.al (2018), Ulger (2019), and Alsarayreh S.R. (2021) were found that Critical Thinking makes positives impact on Achievement in Science, Mathematics and Biology Subjects and improve students Scientific Literacy using some Active Learning Strategy of secondary school students. Mahmood (2017) investigates the effectiveness of an intervention designed to develop critical thinking skills in an Initial Teacher Education (ITE) institution and found that critical thinking looked effective of CT skills interventions as not being detached from the environment of the application.

According to Miliya Susan Joseph (2018) Strategy based on Andes Intelligent Tutoring system is more effective than Activity Oriented Method in enhancing Critical Thinking of Students at Higher Secondary Level. Malkit Singh (2019) observed that Cooperative and Individualized Learning Strategies found to be positive impact on Critical Thinking. Amin, A.M. & et.al (2020) studied that correlation between Metacognition Skill and Critical Thinking Skill in Animal Physiology Lectures and found to be positive improvement by Critical Thinking on Animal Physiology Lectures.

National Society for the Study of Education (NSSE) said that, open mindedness, desire for accurate knowledge, belief in the processes of acquiring knowledge, problem solving, and vertical application of knowledge is known as Scientific Attitude. Scientific Attitude is defined in the literature of science education as a set of emotionally refined ideas related directly or indirectly to science, scientific methods, and courses of action. The term scientific Attitude to such qualities of mind as intellectual curiosity, passion for

truth, respects for evidence, and appreciation of the need for free communication in science (Singh, 1988).

According to Ikmanda Nagrahal (2020) Scientific Attitude and Learning Style found to be effective impact on analysis of the relationship between students Scientific Attitude and Learning Style in junior school. Evi Suryawati & Kamisah Osman (2018) observed that Innovative approach towards the development of students Scientific Attitude and Natural Science performance and found to be positive result. Moura Trgnovita (2021) found that with the help of Scientific Attitude in learning physics using problem based learning Model with Experimental and Project Method makes positive impact on students learning. Ravi Kant and Murlidhar Singh (2015) found effective relationship between Learning style and Scientific Attitude. Ahmad (2007) observed that Scientific Attitude and Scientific Aptitude improve student's achievement in positive way. Gayatri (2017) developed scientific Attitude improvement Programme and found to be effective results on adolescents. Kour (2022), K. Bhagavathy (2015), A. Ranganath (2012) were found that Scientific Attitude makes positives impact on Achievement in Science, Mathematics and Biology Subjects and improve students Scientific creativity using problem solving skill and locus of control of secondary school students.

Scientific temperament refers to the attitude of logical and critical thinking in a person. If a person adopts scientific method of decision making in everyday life then he is considered to be scientifically minded. The term was first coined by the first Prime Minister of India, Jawaharlal Nehru, in his book 'The Discovery of India'. Nehru believed that scientific thinking would play an important role in the socio-economic development of the country. Joshua Elizabeth (2015) studied effectiveness of Scientific Temper on certain Cognitive and Affective variables of students and found to be effective result on students achievement at secondary level. Rishu Deep Bhatnagar (2020) investigated effective relation into Scientific Temper and Scientific Creativity of science students. Eswari, P.J. (2019) Positive results were found in relation to students' scientific interest, scientific temper and home environment on their achievement in Physics.

The above review shows that most of the studies have been conducted in abroad, and very little research has been conducted in India. Researchers doing research in India are Seeja (2015), and Vinay Aparna (2018), Bageshwari Tripathi (2019), G.V. Prakash

(2019), and Priyamvada (2022). Using principles from educational psychology, they have drawn positive findings regarding student achievement based on active learning strategies.

It is clear from the above review that most of these studies were conducted with samples of schools, colleges and teacher trainees. In which some studies were based on surveys and some studies were based on experimental research. This research work was done by researchers on some demographic variables. All the above research studies have concluded that teaching through active learning strategy is a very effective tool to achieve educational objectives as it enhances student achievement, retention and student performance. This makes teaching more interesting, which reduces rote learning and increases the ability of learners to understand. This is a warm up activity for learning in classroom. This develops memory and effective learning style in science students.

But there are very few researches on active learning strategies in India. Very few researches have been done on Scientific Temperament and Achievement with Scientific Attitude, Critical Thinking and Active Learning Strategies. Therefore, the researcher did not find any studies based on these variables. This means that studies on all the variables are yet to be done. Therefore, filling this gap, the researcher decided to study this important variable, and the researcher selected the present title for his research.

## 1.3.0 STATEMENT OF THE PROBLEM

**Effectiveness of Active Learning Strategies on Science for Secondary School Students in term Achievement and Reaction**

## 1.4.0 OPERATIONAL DEFINITION

**Active Learning Strategies**: Active Learning Strategies are defined as instructional strategies that motivate learners to take an active role in the learning process in the classroom. The Active Learning Strategies utilized in the present study were Student participation, Discussion, Brainstorming, Interest, Peer instruction, Role Play, Think-Pare-Share, One Minute Paper and Concept Map.

**Secondary School Students**: The secondary stage of education involves 2-3 years of academic study, which includes studies from class 8th to 10th. Present study researcher took IX class for treatment as secondary school students.

**Achievement:** Achievement in science refers to the relative achievement or proficiency of the learner's performance in the knowledge or skill imparted after studying a science subject. Which can be measured by Achievement Test in science some selected topics. Achievement measured outcome of science subject students of secondary level.

**Reaction:** The responses represent students' reactions of active learning strategies related statements in the experimental group.

## 1.5.0 VARIABLES OF THE STUDY

The following variables in the present study namely, independent variable, dependent variables, and covariates.

### 1.5.1 Independent Variables

The independent variable is manipulated to study its effects on the dependent variable. Here, in the present experimental study, the Methods of Teaching is the independent variable that has been manipulated to study the kind of effect it produces on the dependent variables. The two methods of teaching in the study were the Active Learning Strategies and the Traditional method. The present study attempts to establish the effectiveness of active learning strategy as compared to the traditional (lecture) method of teaching on science subject. Therefore, the independent variable is a treatment having two levels namely – the experimental group, which was based on active learning strategy and the control group, which was based on lecture method. Other secondary independent variables were Critical thinking, Scientific Temper, Scientific Attitude and Intelligence.

### 1.5.2 Dependent Variables

The dependent variable is measured or observed in the study. In the present study, the experiment was carried out to test the comparative effectiveness of Methods of teaching on the dependent variables, i.e., Achievement in Science.

### 1.5.3 Covariates

The covariates are variables which moderates the impact of the independent variable on the dependent variable. The researcher needs to control for the variables, which have the potential to co-vary with the dependent variable. It is also known as confounding factor or concomitant variable. In the present study, the pre-test scores for the dependent variables, Achievement in Science, were considered as covariates. The reason behind their selection was that they may affect the post-test scores on the dependent variables so in order to control them they were included in the study.

## 1.6.0 OBJECTIVES

Objectives of the study are:

1. To compare the adjusted mean scores on Achievement of students of Experimental group and Control group by taking pre- Achievement in Science as Covariate.
2. To study the effect of Treatment, Critical Thinking and their Interaction on Achievement of students by taking pre- Achievement in Science as Covariate.
3. To study the effect of Treatment, Scientific Temper and their Interaction on Achievement of students by taking pre- Achievement in Science as Covariate.
4. To study the effect of Treatment, Scientific Attitude and their Interaction on Achievement of students by taking pre- Achievement in Science as Covariate.
5. To study the effect of Treatment, Intelligence and their Interaction on Achievement of students by taking pre- Achievement in Science as Covariate.
6. To study the effect of Treatment, Gender and their Interaction on Achievement of students by taking pre- Achievement in Science as Covariate.
7. To study the effect of Treatment, School Type and their Interaction on Achievement of students by taking pre- Achievement in Science as Covariate.
8. To study the Effectiveness of the Active Learning Strategy in terms of Reaction of students of the Experimental group.

## 1.7.0 HYPOTHESES

The following null hypotheses of the study are:

1. There is no significant difference in the adjusted mean scores on Achievement of students of Experimental group and Control group by taking pre- Achievement in Science as Covariate.
2. There is no significant effect of Treatment, Critical Thinking and their Interaction on Achievement of students by taking pre- Achievement in Science as Covariate.
3. There is no significant effect of Treatment, Scientific Temper and their Interaction on Achievement of students by taking pre- Achievement in Science as Covariate.
4. There is no significant effect of Treatment, Scientific Attitude and their Interaction on Achievement of students by taking pre- Achievement in Science as Covariate.
5. There is no significant effect of Treatment, Intelligence and their Interaction on Achievement of students by taking pre- Achievement in Science as Covariate.
6. There is no significant effect of Treatment, Gender and their Interaction on Achievement of students by taking pre- Achievement in Science as Covariate.
7. There is no significant effect of Treatment, School Type and their Interaction on Achievement of students by taking pre- Achievement in Science as Covariate.

## 1.8.0 DELIMITATIONS OF THE STUDY

The delimitations of the study were as follows:

- The present study was confined only to M.P. Board syllabus in Government and Private School of Jabalpur City.
- The study was limited to only Hindi medium schools in urban areas.
- The Active Learning Strategy has designed the selected topics in Science of class IX.

## 1.9.0 SAMPLE

The nature of the present study was based on experimental research and it was conducted into government and private schools of Jabalpur city. The researcher selected purposive sampling technique for the selection of the school. Researcher went to the selected schools and met the principals and took the permission to conduct the research for control and experiment group. After getting permission, the researcher established rapport with the students of the selected schools and created positive environment to

collect data. The researcher selected 4 schools for data collection namely Satpula Higher Secondary Kanya Shala G.C.F. state Jabalpur, Nirmala English/Hindi Medium School Jabalpur, Shishu Vidyapith Bengali Girls Higher secondary School, Jabalpur, Naveen Cant High School, Sadar, Jabalpur affiliated to M.P. Board. The population comprised of Secondary School Student of School situated in Madhya Pradesh and following the state board of Secondary Education system. The Sample comprised of 132 students of Secondary School Student, which further divided in two equal Groups by random sampling. Two schools divided into experiment group and another two divided into the control group. Out of four schools Satpula Higher Secondary Kanya Shala G.C.F. state Jabalpur, Nirmala English/Hindi Medium School Jabalpur, the two schools was selected as an experiment group and was given treatment through Active Learning Strategies. Another two schools Shishu Vidyapith Bengali Girls Higher secondary School Jabalpur, Naveen Cant High School Sadar, Jabalpur was selected as a control group and was given treatment through Traditional method.

**Treatment Wise and School wise distribution of sample is given in the table 1.1:**

| S.No. | School | Group | Treatment | Male | Female | Total | Total E/C |
|---|---|---|---|---|---|---|---|
| 1. | Satpula Higher Secondary Kanya Shala G.C.F. state Jabalpur, (Gov. School) | Experiment Group | Active Learning Strategy | 18 | 16 | 34 | 67 |
| 2. | Nirmala English/Hindi Medium School Jabalpur (Priv. School) | Experiment Group | Active Learning Strategy | 21 | 12 | 33 | |
| 3. | Shishu Vidyapith Bengali Girls Higher Secondary School Jabalpur, (Priv. School) | Control Group | Traditional Method | 09 | 30 | 39 | 65 |
| 4. | Naveen Cant High | Control Group | Traditional | 12 | 14 | 26 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | School Sadar, Jabalpur (Gov. School) | | Method | | | | |
| Total | | | | 60 | 72 | 132 | 132 |

Table 1.1 shows that the number of students in the experimental group was 67. Out of total 67, 39 were male students and 28 were female students. On the other hand, the number of students in the control group was 65. Out of total 65, 21 were male students and 44 were female students. The age of the boys and girls was between 15-17 years. The students belong to different communities and socio-economic status. Students can read, write and understand English and Hindi language properly. The medium of teaching the students through active learning method and traditional method was Hindi because all Hindi medium schools were selected to collect the research data.

### 1.10.0 EXPERIMENTAL DESIGN

The present study used experimental research in nature; the study was designed by Campbell and Stanley 1963. This design was designed along the lines of non-equivalent control group design according to Campbell and Stanley 1963. the layout of the design as given under-

O X O

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O O

Whereas,

**O**- Represents pre-test and post-test of both Groups (Measurement of the depended variable)

**X**- Represents Treatment given to Experimental Group

----- Non-equivalent groups (Control and Experiment groups are not equivalent)

In the present study, there were two groups; one group is designed as the experimental group and the other group is designed as the control group. Students from both groups were included in the experimental study. For this study the Sample was purposively selected and assigned purposively. The Treatment was given on Experimental group with Active Learning Strategy and the control group was continuing

with Traditional Activities. Both groups were administrative appropriate tools to assess on Active Learning Strategies, Critical Thinking, Scientific Temper, Scientific Attitude, Intelligence and Achievement in Science. Treatment was given continuing for 56 of working days (including tools testing), at the rate of four periods per day. At the end of treatment, both groups were post-tested using the same tool that was used for pre-testing. The response to active learning strategies after treatment was also evaluated. The response scale was given only to the experimental group.

**Schematic Representation of the Experiment**

**Table 1.2**

| Activities | Experimental Group | Control Group | Time |
|---|---|---|---|
| Group Formation | Section was selected randomly | | 40 min |
| Pre-Testing of Dependent Variable | Administration of Achievement test on Science Subject | | 40 min |
| Treatment | Implementation and conduct activities based on Active Learning Strategies on Science Subject | Routine Activities and Traditional Method | 56 working Days, control group were taught through the traditional teaching method for 56 working days @ 40 minutes per period and experimental group were taught for the same period through the active teaching strategy. |
| Testing secondary | Administration of Intelligence test, | | 40 min |

| | | | |
|---|---|---|---|
| Independent Variable (during Experiment) | Critical Thinking,<br>Scientific Temper,<br>Scientific Attitude | | 30 min<br>30 min<br>30 min |
| Post Testing of Dependent Variable | Administration of Achievement test on Science Subject | | 40 min |
| Reaction Scale | Response scale after treatment was administered only to the experiment group | ---------- | 30 min |

### 1.11.0 TOOLS

The following variables are to be assessed in this study were Critical Thinking, Scientific Temper, Scientific Attitude, Intelligence and Achievement of Science. For assessing Critical Thinking, Scientific Temper, Scientific Attitude, and Intelligence the standardized tools were used by the researcher. Achievement of Science and reaction was assessed with the help of test developed by the investigator. All the tools were of Hindi Language. The brief description of the tools is presented in Table 1.3.

**Table 1.3** Details of the Tools used in the study

| Name of the Test | Tool Developed by | Age | Reliability | Validity |
|---|---|---|---|---|
| Critical Thinking Scale | Prof. Hemantlata Sharma & Priyamvada | 14+ years | 0.987 | Face validity & construct validity |
| Scientific Temper Scale | Dr. K. K. Dubey | 14 to 19 | 0.62 | 0.59<br>Content validity |
| Scientific Attitude Scale | Dr. Shailaja Bhagwat | 14 +years | 0.94 | 0.86<br>Content validity |
| Verbal Intelligence Test | Dr. R. K. Ojha & Dr. K. Ray Choudhury | 13 to 20 years | 0.87 | ----- |
| Achievement of | Developed by researcher | | | |

| | | | | |
|---|---|---|---|---|
| Science | | | | |
| Reaction Scale | Developed by researcher | | | |

### 1.11.1 Critical Thinking Scale

Critical Thinking Ability Scale has developed by Prof. Hemant Lata Sharma and Priyamvada (2022). The basis for constructing this scale is based on the ability to draw conclusions about situations given reasons (the process of thinking) and given conclusions (the product of thoughts). This depends on the critical thinking ability and its element to analyze the situation in different ways. It was based on an important model such as assessing the critical thinking level of adolescents in the classroom. This scale was measures the Critical Thinking of students studying at senior secondary and higher level. This scale is based on cognitive and affective disposition. Cognitive disposition has Analysis, Inference, Evaluation, and Self-Regulation. Affective disposition has Ethics and values, Self-Confidence, Inquisitiveness and Open mindedness. This scale was constructed to measure the Critical Thinking of students ranging in age group 14-18 year olds. This scale has 85 items to measure Critical Thinking. The Reliability of Critical Thinking scale was basis of test re-test is 0.987 and split-half is 0.915. Validity of the scale was subjected to face validity and Construct validity. 20 subject experts from Psychology and Educational Psychology validated the items, scoring pattern, Process and Product categories. The reliability measures were calculated on a sample of 250 students with age range of 14 up to 18. Reliability was calculated using Pearson coefficients correlation ‘r’ 0.380.

### 1.11.2 Verbal Intelligence Test

This Verbal Intelligence Test was constructed by R. K. Ojha and Ray Choudhary in 1958. This verbal intelligence test was constructed in 1958 by R.K. Ojha and Ray Choudhary. This is a verbal intelligence test. This test is helpful in measuring the intelligence of students aged 9-16 years. This intelligence test is an objective type of intelligence test. It is used to test the general intelligence ability or intelligence of the students. It has eight parts and each part has different number of questions. The different

parts of this test are (i) Classification; (ii) Similes; (iii) synonyms; (iv) Number test; (v) completion test; (vi) Paragraph test; (vii) Best reasons; and (viii) simple reasons. For standardization, this verbal intelligence test was conducted on 1200 students in the age group of 13-20 years from classes 9 to 12. Reliability Coefficient of reliability was determined by (i) split half method (ii) Richardson formula. The validity of different parts of this test was measured by analyzing the results on a sample of more than 2000 students use for standardization.

### 1.11.3 Scientific Temper Scale

This Scientific Temper Scale was constructed and validated by Dr. K. K. Dubey. The main objective to construct this scale was to develop a tendency of verifying the facts, beliefs etc. open-mindedly. The Scientific Temper Scale comprises six dimensions namely: (i) Rationality (ii) Curiosity (iii) Open mindedness (iv) Aversion to superstition (v) Objectivity intellectual honesty (vi) Suspended judgment . In the STS the statements of all the components were included. There are 48 statements and it contains 24 favorable and 24 unfavorable statements related to Scientific Temper. Every statement has three alternatives 'Agree' Indefinite' and 'Disagree'. The scale was standardized on 960 students and 190 teachers. The age range of the students was 14 to 19 years and the teacher was 25 to 45 years. The Reliability coefficients by test-retest method after the gap of one month were 0.62 and the content validity coefficient was 0.59.

### 1.11.4 Science Attitude Scale

Scientific Attitude Scale was constructed by Dr. Shailaja Bhagwat. The main purpose of this scale to find out the analytical and critical approach helps to solve any problems and arrive at a logically valid conclusion. The Science Attitude Scale comprises six dimensions namely: Objectivity, Verification, Rational Outlook, Superstitions, Flexible, and Critical Approach. The test is applicable for the students of age group 17-55 years. Total sample including males and females consists of 340 subjects. The comprised of 24 items out of which 12 items were of favorable and 12 unfavorable. In this questionnaire, there are 24 statements expressing the opinions on Scientific Attitude Every statement has five alternatives 'Strongly Agree', 'Agree', Indefinite' and 'Strongly

Disagree' and 'Disagree'. Reliability coefficients by test-retest method are 0.94 and split half method is 0.87. The content validity coefficient was 0.86.

### 1.11.5 Achievement in Science

Achievement of science subject of class IX was developed by the researcher.Achievement test in Physics topics for secondary school (Class IX) was generally designed to measure knowledge, comprehension, application and skill. Keeping in view the importance of analysis of the subject in the construction of achievement tests in physics topics, the investigator first reviewed the textbooks of science (physics topics) for class of IX prescribed by NCERT board. The investigator decides to construct multiple choice objective type questions. The test consists of 56 questions developed by the researcher on 3 units selected for treatment. Student achievement was assessed with the help of objective type tests. Multiple choice questions were prepared based on the selected 3 units, which had four options, out of which only one was the correct answer. Questions like multiple choice questions, matching columns, filling in the blanks and giving answers in one word were included in the test. One mark was given for a correct answer and no mark was given for a wrong answer. There was no negative marking. The maximum marks for the test were 50 and 40 minutes were given to complete the test. The achievement test is given in Appendix I.

### 1.11.6 Reaction Scale

The reaction scale was developed by the researcher for assessing the Reaction of the students of the experimental group towards the Active Learning Strategies. The statements were related to various aspects of the Active Learning Strategies and its sessions. In this scale, 21 statements (both positive and negative) were included. Each statement had five options as it was based on Likert five-point scale. The options given were 'SA for strongly agree', 'A for Agree', 'UD for Undecided', 'D for Disagree' and 'SD for strongly disagree.' The students have to read and choose one appropriate alternative carefully for each statement out of the given five. Both positive as well as negative statements were included in the reaction scale. 5,4,3,2,1 shows weightage for positive statements and 1,2,3,4,5 shows weightage for negative statements. The response scale of active learning strategy is given in Appendix-II. There was no restricted time for

responding to the reaction scale, but it hardly took 20-25 minutes to enter their responses in the reaction scale. Based on the responses, their attitudes towards the Active Learning Strategies and sessions were obtained.

## 1.12.0 PROCEDURE OF DATA COLLECTION

In the present study, the researcher was followed the procedure of the study in two phases which are the Developmental Phase and Experimental Phase. Both phases were represented the procedure of the study.

### 1.12.1 Developmental Phase

The study was carried out systemically in two stages. The first phase was Development phase. This phase included the preparation of lesson plan on Active Learning Strategies to teach selected topics in the science of class IX and selected tools and the achievement test used in the study. The lesson plans and achievement test were prepared by the investigator and validated by experts and teachers in the field of science to find out the Achievement in Science. To prepare the Active Learning Strategy based activity and lesson plan, the investigator was analyzed these units in science to identify the major points, expected learning outcomes, materials, and resources required, learning activities to be implemented, modes of assessment, etc. Concept map for each unit was prepared strategies and activities appropriate for each topic were decided.

### 1.12.2 Experimental phase

The present study was conducted on the students of IX class in science subject of State Board. Four schools were selected purposively for collecting data, two schools were randomly assigned to experiment and two were selected to traditional teaching. Both two schools that received the treatment through Active Learning Strategies was treated as experimental group, while the other two schools taught through Traditional method was treated as control group.

Before collecting the data, the following steps were taken;

- Taking permission from Head/Principal of the Sample School,
- Taking and arranging the lecturer time with the subject Teacher,

- Making a rapport with the class students and delivering an orientation about the way of teaching before taking the pre-test.
- After taking pre-test taught through Active Learning Strategy of Experimental group and taught through Traditional method of control group.
- The Experiment was carried out in three stages: 1. Administration of pre-test, 2. Implementation of the Treatment, 3. Administration of post-tests.

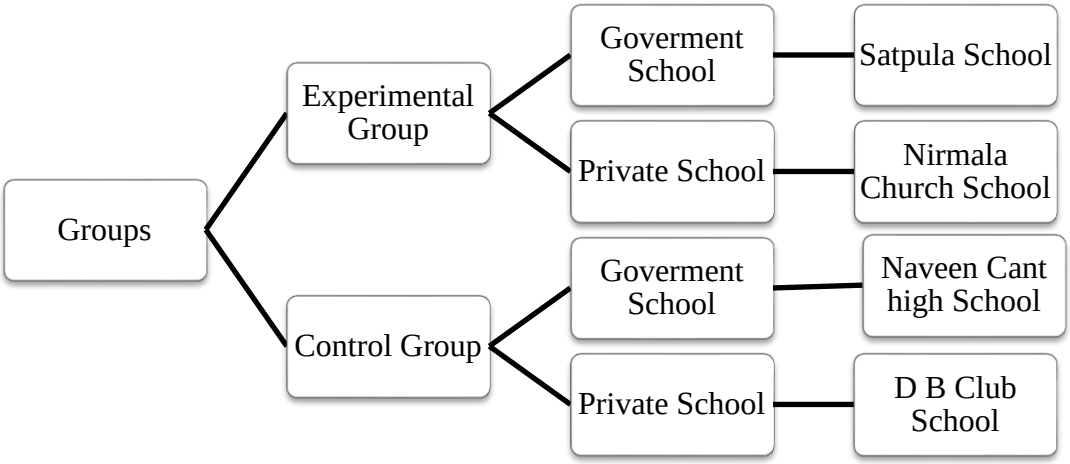


**Table 1.4**

**Schematic presentation of the activities of the Experiment**

| Session | Experimental group | Control Group | Approx. Time |
|---|---|---|---|
| Pre test | Achievement Test of Science | Achievement Test of Science | 60 min |
| Test of Secondary Independent Variables | Administration of Scientific Temperament Scale,<br>Critical Thinking Scale,<br>Scientific Attitude,<br>Intelligence test | Administration of Scientific Temperament Scale,<br>Critical Thinking Scale,<br>Scientific Attitude,<br>Intelligence test | 30 min<br>40 min<br>40 min<br>40 min |
| Treatment | Active Learning Strategies | Traditional Method | 46 days |
| Post Test | Achievement Test of | Achievement Test of Science | 60 min |

| | | | |
|---|---|---|---|
| | Science | | |
| Reaction Scale | Test of Reaction Scale only experiment group | | 30 min |

### 1.13.0 STATISTICAL TECHNIQUES FOR ANALYSIS OF DATA

The objective wise data Analysis was given as below:

1. For comparing the Adjusted mean score of Achievement of students of Experiment group and Control group by taking pre- Achievement in Science as Covariate, the data were analyzed with the help of One-way ANCOVA. (The assumptions of ANCOVA were not fulfilled, so the researcher proceeded towards Picked Point Analysis (PPA). Also supported with one-way ANCOVA.)
2. For studying the effect of Treatment, Critical Thinking and their Interaction on Achievement of students by Taking pre- Achievement in Science as Covariate, the data was analyzed with the help of two-way ANCOVA. (The assumptions of ANCOVA were not fulfilled, so the researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).
3. For studying the effect of Treatment, Scientific Temper and their Interaction on Achievement of students by Taking pre- Achievement in Science as Covariate, two-way ANCOVA were used. (The assumptions of ANCOVA were not fulfilled, so the researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).
4. For studying the effect of Treatment, Scientific Attitude and their Interaction on Achievement of students by Taking pre- Achievement in Science as Covariate, two-way ANCOVA were used. (The assumptions of ANCOVA were not fulfilled, so the researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).
5. For studying the effect of Treatment, Intelligence and their Interaction on Achievement of student by taking pre- Achievement in Science as Covariate two-way ANCOVA were used. (The assumptions of ANCOVA were not fulfilled, so the

researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).

6. For studying the effect of Treatment, Gender and their Interaction on Achievement of students by taking pre- Achievement in Science as Covariate two-way ANCOVA were used. (The assumptions of ANCOVA were not fulfilled, so the researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).
7. For studying the effect of Treatment, School Types and their Interaction on Achievement of students by taking pre- Achievement in Science as Covariate two-way ANCOVA were used. (The assumptions of ANCOVA were not fulfilled, so the researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).
8. For studying the Effectiveness of the Active Learning Strategy in terms of Reaction of students of the Experimental group. The percentagewise analysis for each statement of the reaction scale was also calculated.

## 1.14.0 FINDINGS

The findings of the study are presented objective wise. The following findings have emerged from the present study:

**1.0 Finding of the First Objective:**

1.1 In comparison to the Traditional method, teaching with the Active Learning Strategy was found to be significantly effective for students achievement in science subject when pre-Achievement in science was taken as covariate at two levels (mid and low).

1.2 In comparison to the Traditional method, teaching with the Active Learning Strategy was not found to be significantly effective for student's achievement in science subject when pre-Achievement in science was taken as covariate at high levels.

**2.0 Finding of the Second Objective:**

2.1 The treatment given through Active Learning Strategy was found to be significantly more effective than Traditional teaching methods in terms of Critical Thinking, when pre- Achievement in science was taken as a covariate.

2.2 The development of Active Learning Strategy for students was found to be independent of Critical Thinking, when pre-Achievement in science was taken as a covariate. The students with high, Critical Thinking were found to have higher levels of achievement in science, when pre-Achievement in science was taken as a covariate. However, the students with average and low Critical Thinking were found to possess the same level of achievements in science when pre-Achievement in science was taken as a covariate.

2.3 The development of Active Learning Strategy for students was found to be independent of the resultant of interaction between Treatment and Critical Thinking, when pre-achievement of science was taken as covariate.

**3.0 Finding of the Third Objective:**

3.1 The treatment given through Active Learning Strategy was found to be significantly more effective than Traditional teaching methods in terms of Scientific Temper, when pre- Achievement in science was taken as a covariate.

3.2 The development of Active Learning Strategy for students was found to be independent of Scientific Temper, when pre-Achievement in science was taken as a covariate. The students with average and low Scientific Temper were found to possess the same level of achievements in science when pre-Achievement in science was taken as a covariate. But the students with high, Scientific Temper were found to have low level of achievement in science, when pre-Achievement in science was taken as a covariate.

3.3 The development of Active Learning Strategy for students was found to be independent of the resultant of interaction between Treatment and Scientific Temper when pre-achievement of science was taken as covariate.

**4.0 Finding of the forth objective:**

4.1 The treatment given through Active Learning Strategy was found to be significantly more effective than Traditional teaching methods in terms of Scientific Attitude, when pre- Achievement in science was taken as a covariate.

4.2 The development of Active Learning Strategy for students was found to be independent of Scientific Attitude, when pre-Achievement in science was taken as a

covariate. The students with high, Scientific Attitude were found to have low level of achievement in science, when pre-Achievement in science was taken as a covariate. However, the students with average and low Scientific Attitude were found to possess the same level of achievements in science when pre-Achievement in science was taken as a covariate.

4.3 The development of Active Learning Strategy for students was found to be independent of the resultant of interaction between Treatment and Scientific Attitude when pre-achievement of science was taken as covariate.

**5.0 Finding of the Fifth Objective:**

5.1 The treatment given through Active Learning Strategy was found to be significantly more effective than Traditional teaching methods in terms of Intelligence, when pre-Achievement in science was taken as a covariate.

5.2 The development of Active Learning Strategy for students was found to be independent of Intelligence when pre-achievement of science was taken as covariate. The students with high, average, and low Intelligence were found to possess the same level of achievement in science when pre achievement in science as covariate.

5.3 The development of Active Learning Strategy for students was found to be independent of the resultant of interaction between Treatment and Intelligence when pre-achievement of science was taken as covariate.

**6.0 Finding of the Sixth Objective:**

6.1 The treatment given through Active Learning Strategy was found to be significantly more effective than Traditional teaching methods in terms of Gender, when pre-Achievement in science was taken as a covariate.

6.2 The development of an Active Learning Strategy for students was found to be independent of Gender, when pre-achievement in science was taken as a covariate. The students with female Gender were found to have high levels of achievement in science, when pre-achievement in science was taken as a covariate. However, the students of the male gender were found to have low levels of achievements in science when pre-achievement in science was taken as a covariate.

6.3 The development of an Active Learning Strategy for students was found to be independent of the resultant interaction between Treatment and Gender when pre-achievement of science was taken as a covariate.

**7.0 Finding of the Seventh Objective:**

7.1 The treatment given through the Active Learning Strategy was found to be significantly more effective than Traditional teaching methods in terms of School Type when pre- Achievement in science was taken as a covariate.

7.2 The development of an Active Learning Strategy for students was found to be independent of School Type, when pre-achievement in science was taken as a covariate. The students of Private school were found to have high levels of achievement in science, when pre-achievement in science was taken as a covariate. However, the students of the Government school were found to have low levels of achievements in science when pre-achievement in science was taken as a covariate.

7.3 The development of Active Learning Strategy for students was found to be independent of the resultant of interaction between Treatment and School Type when pre-achievement of science was taken as covariate.

**8.0 Finding of the Eighth Objective:**

The reaction of students of the Experimental group towards the Active Learning Strategy was found to be favorable.

## 1.15.0 EDUCATIONAL IMPLICATIONS

The significance of the findings of this study has implications for the following areas.

### 1.15.1 Implication for Students

The study revealed that Active Learning Strategies can influence in improving the Critical Thinking, Scientific temperament, Scientific Attitude and achievement of the students. Active learning strategies are very beneficial for students. According to the findings of the present study, the teaching material based on active learning strategy was found to be effective on the achievement and thinking of the students. That benefits

students with diverse nature in the classroom. This activity developed the thinking ability of the student's. It's promoted to the learner centered education. They can revise concepts using active learning strategies to enhance their memory. The findings of the present study also state that there is no significant effect of intelligence on achievement in science subjects in ninth grade students. Therefore students can use active learning strategies without worrying about their intelligence. They can use different Active Learning Strategies and Activity technique for understanding the complex concept in an easy way and apply its day to day life for communication. Male and female students can also use an Active Learning Strategies without any bothering about their gender. The finding of the present study also states there is no significant effect of Gender on Achievement in Science subject in class IX students. With the help of this activity students improve their thinking and attitude.

### 1.15.2 Implication for Teachers

A teacher plays a crucial role in the teaching-learning process. Teachers need to develop the understanding and necessary skills for successful implementation of these strategies in the classroom. The present study suggests that instead of Traditional approaches in the classroom, the Active Learning Strategies, which belongs to the Constructivists paradigm, will surely help the teacher to develop necessary skills among the students, which is the need for the current society and the globe. The study emphasizes the need to make deliberate efforts to boost students' thinking abilities. Therefore teachers should be oriented in promoting the thinking skills of students. And they should be informed about different ways of implementing them according to their context and purpose. The study revealed that students enjoyed the classroom experiences and that the strategies enabled them to become responsible in the learning process. Therefore teachers can successfully use such strategies in the classroom to promote a healthy learning environment and enjoyable learning experiences for learners. Teachers can develop effective Learning Strategies according to the need and interest of their learners and deliver through any kind of platform like Think-Pair Share, Role play, one minutes, fish bowl etc. according to their availability. They can use Active Learning Strategies making their teaching and learning process more effective and efficient.

Research findings have proven effectiveness of Active Learning Strategies in teaching-learning process.

### 1.15.3 Implication for Teacher Educator

Effective steps should be taken for enriching the teacher education programmes by giving adequate priorities for the innovative instructional strategies in the theoretical and practical aspects of teacher education curriculum. The findings of the study show that active learning strategies were found to be effective in enhancing students' achievement, critical thinking, scientific temperament, hence there is need for effective training of teacher trainers, so that they can create their own materials using innovation. Teachers can use active learning strategies as an effective tool in the teaching-learning process. The syllabus of Teacher education should be designed in such a way that the Active Learning Strategies should be practiced at the training level of the teachers. The TPS Strategy and different strategies can be taught to teachers in refresher courses so that they can acquire the benefits of these methods. Teachers must be given training and retraining programmes “to improve the quality of education. The teachers need to be well proficient with the subject material and content “in order to solve the problems of the students” in the class activities.

### 1.15.4 Implication for Curriculum Developer

The Curriculum Developers should include Active Learning Strategies in the curriculum of secondary education as well higher Secondary education system. Along with books and other study materials, curriculum developers can develop active learning Strategies and may keep it in the curriculum of both. The finding shows that it was found effective in enhancing the achievement of students. Therefore, when it is added to the curriculum, student achievement will definitely improve. Curriculum developers must gain a more sophisticated understanding of the conditions and circumstances that exist, as well as the means and mechanisms by which learning strategies such as ALS Strategy can be closely linked to young pupil teachers and their teaching effectiveness.

### 1.15.5 Implication for Textbook Writer

The textbook writer should use strategies given in Active Learning Strategies for writing the textbooks. Active Learning activities and sessions should be included in the textbook, which will help in enhancing the students' Achievement. Textbook writers can do this by designing subject-wise Active Learning sessions and introducing them in the respective subject textbook. The Textbook writers make sure the designing of the Active Learning activities and sessions for different classes according to their age, curriculum, and psychological phase should be done. They can write different Active Learning Strategies for different subject content. It will help the teachers and students.

### 1.15.6 Implication for School Administrators

School authorities should provide sufficient support systems including availability of infrastructure, resource materials, and flexibility in scheduling the classes so that teachers can employ these strategies easily and effectively. Principals or Administrators should also conduct workshops to enhance the ALS of Teachers through Active Learning Strategies, which also helps to develop a democratic environment in the School or the Institute. The school administration system appoints trained teachers to implement these strategies in their school and classroom.

School management systems and higher education establishments have to utilize the immense potential of our students by including these types of innovative learning strategies in the curriculum.

### 1.15.7 Implication for Experts and Researchers

Experts and researchers in the field of education should work to develop diverse pedagogical practices suitable to our classrooms and propagate them productively among the practitioners. Critical thinking in the research area plays an essential role because it helps to develop understanding through raising related questions of why? what? how? The results of this study will contribute towards new learning strategies and will be helpful for all those who are concerned with the field of Science.

## 1.16.0 SUGGESTION FOR THE FUTURE RESEARCH

The study has investigated the combined effect of the select strategies in influencing the dependent variables. There are some suggestions for further research:

1. The Effectiveness of the Strategy based on Active Learning Strategy can be compared with other innovative teaching and learning strategies.
2. Similar studies can be conducted to find out the effectiveness of the Active Learning Strategy in other school subjects.
3. A similar study can be conducted by including other dependent variables like Scientific Creativity, Scientific Interest, Scientific Thinking, Science self-efficacy, Science Anxiety, etc.
4. The attitude of educational practitioners, curriculum framers, administrators, teachers, and students towards the use of this strategy in teaching Science subjects at the Higher Secondary Level can be studied.
5. It is possible to investigate the effectiveness of Active Learning Strategy concerning gender, and locality.
6. Similar studies can be conducted to study the influence of these strategies on other categories of digital technological support.
7. The study can be extended to explore the effectiveness of Active Learning Strategies on other higher-order thinking skills.
8. The study can be replicated in other populations including students at elementary or higher education using more sophisticated experimental designs.
9. The effectiveness of the Active Learning Strategy can be studied on a sample of secondary schools of CBSE and ICSE Board.
10. In the present study streams, i.e., Science, Commerce, and Arts, were not considered as a variable in the study. However future researchers can study the effect of the Active Learning Strategy on different streams.

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