A STUDY ON THE SCIENTIFIC APTITUDE OF HIGHER SECONDARY SCHOOL SCIENCE STUDENTS IN AIZAWL DISTRICT

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A STUDY ON THE SCIENTIFIC APTITUDE OF HIGHER SECONDARY SCHOOL SCIENCE STUDENTS IN AIZAWL DISTRICT

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Submitted

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CERTIFICATE

This is to certify that **Ms. Rebeck Lalrinpuii** has prepared the dissertation titled **"A Study on the Scientific Aptitude of Higher Secondary School Science Students in Aizawl District"** under my guidance and supervision for Master of Philosophy degree in Education, School of Education and Humanities, Mizoram University. In preparing the dissertation, she has complied with all the requirements as laid down in the M. Phil regulations of the University. This dissertation is the original work of the scholar and hasnot been submitted for any degree to any other University

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Dated: 28th February, 2022 Supervisor

DECLARATION

Mizoram University
February, 2022

I, Rebeck Lalrinpuii, hereby declare that the subject matter of this dissertation is the record of work done by me, that the contents of this dissertation did not form basis of the award of any previous degree to me or to do the best of my knowledge to anybody else, and that the dissertation has not been submitted by me for any research degree in any other University/Institute.

This is being submitted to the Mizoram University for the degree of Master of Philosophy in Education.

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ABBREVIATIONS

NPE	-	National Policy of Education
NCFSE	-	National Curriculum Framework for School Education
NCERT	-	National Council for Educational Research and Training
NCF	-	National Curriculum Framework
NCTE	-	National Council for Teacher Education
IT	-	Information Technology
MBSE	-	Mizoram Board of School Education
RMSA	-	Rastriya Madhyamik Shiksha Abhiyan
SSA	-	Sarva Shiksha Abhiyan
UNESCO	-	United Nations Educational, Scientific and Cultural Organization
SAT	-	Scientific Aptitude Test
B. Ed	-	Bachelor of Education
SSC	-	Secondary School Certificate
I.Q	-	Intelligence Quotient
GSAT	-	General Science Aptitude Test
ASST	-	Attitude Scale for Science and Technology
SSS2	-	Senior Secondary School 2
SAPS	-	Students' Attitude Physics Scale
TIMMS	-	Trends in International Mathematics and Science Study
SD	-	Standard Deviation
SED	-	Standard Error of Deviation
df	-	Degree of Freedom

et al.	-	And others
p.	-	Page
para.	-	Paragraph
N	-	Number

CHAPTER I

INTRODUCTION

Education is one of the most important factors for the development of a country. It is a tool to improve and change one's life which further leads to development and improvement of a country. Countries with higher literacy rates also tend to be in better economic situations. Likewise, India has always put focus on increasing the literacy rate of a country since its independence (Bhagat, 2017). The government of India carries out and operates many programs to improve different levels of education. Education is the influence of the environment on the individual with a view of producing a permanent change in his habits or behavior, or of thought and attitude (Thompson, n.d., as cited in Sodhi, 2017). Through education society passes along its accumulated knowledge, values and skills from one generation to the next. Education plays an important role in a country's economic, political, cultural, science and technological growth.

In today's world, scientific advancement leads to rapid economic development, technological and societal progress. Every citizen has to have knowledge of science for effective living. As science is intertwined with everyday life one cannot survive and lead a successful life without science. That is why an individual must be acquired with adequate knowledge of science to enjoy material happiness (Roy and Goel, 2018, p. 399).

With the help of education, the process of science and technological development leads to construction of knowledge which allows individuals to be creative, explorative and innovative in employing the naturally available resources. Education prepares an individual to have the courage to face the challenges of life and undertake risks in the field of science and technology. It develops the individual's personality in every aspect by making him wise, intelligent, and develop favourable characters which further leads to the growth and development of the society.

Scientific knowledge is superior to all other types of knowledge. The knowledge of science provides the ability to reflect aspects of validity and reliability

which ordinary knowledge cannot bring about. It is a logically related and clearly arranged knowledge of items about which any one can experiment and apply tests for validity and reliability. Science is the systematic knowledge of a particular thing. The principles of science are clear, definite, broad-based, valid, pure, real and reliable in all respects.

1.1. SCIENCE AND SCIENCE EDUATION

1.1.1. MEANING OF SCIENCE

The term ‘Science’ usually refers to a way of pursuing knowledge, not just the knowledge itself. The word ‘Science’ is taken from Latin word ‘Scientia’ which means ‘Knowledge’. The Columbia Encyclopedia defines science as “An accumulated and systematized learning, in general usage restricted to natural phenomena.” According to Oxford English Dictionary, “Science is mainly about the phenomena of the material world. Science fills and replenishes our minds with curiosity and at the same time, understanding and the inclination to answer or solve various problems.”

Science is an accumulated and systemized learning in general usage restricted to natural phenomena. The progress of science is marked by the emergence of scientific method and of the scientific attitude (Sharma, 1990).

Anuraba and Krishnamurthy (2019) presented a three-fold nature of science as:

- A body of knowledge.
- A method of inquiry, a way of investigating.
- An attitude towards life, a way of thinking.

Science as one of the subjects of study in education bears its place in the process of teaching and learning accordingly with other subjects. Science is an integrated curriculum that includes Chemistry, Physics, Biology and Mathematics in the form of general principles. Since the general principles of science are linked to the everyday experiences of all the children, this integrated curriculum is compulsory for all children.

1.1.2. SCIENCE EDUCATION IN INDIA

In India, science as a school subject is a compulsory subject up to high school stage and its importance has been recognized by all educational commissions. National Policy of Education NPE (1986) emphasized the importance of science by stating that effort will be made to extend science education to the vast number who has remained outside the pale of formal education. Moreover science education will be strengthened to develop in the child well defined abilities and values such as the spirit of inquiry, creativity, objectivity, the courage to question and aesthetic sensibility. Mudaliar Commission Report (1952-1953) stressed that in order to be effective, a democratic citizen should have the ability to be truthful and must develop a scientific attitude of mind to have objective thinking and make conclusion on the basis of the tested data.

The main features of the National Curriculum Framework for School Education (NCFSE) 2000 relating to science education are as follows:

- teaching of environmental studies as a single subject of study at the primary stage instead of environmental studies (science) and environmental studies (social science);
- teaching of 'Science and Technology' instead of 'Science' at the upper primary and secondary stages, in order to familiarize the learner with various dimensions of scientific literacy and technological literacy; and
- continue the practice of teaching science at the higher secondary stage as separate disciplines such as physics, chemistry and biology.

The present century is connected with science and technology. It is necessary for every individual to have a true knowledge of this scientific age and school can be regarded as most appropriate place where the right scientific knowledge can be imparted through the right education and training. Education should be organized in such a way that every child is inspired to participate actively in the economic reconstruction of society. It should be understood that development of modern society is depending upon the development of science and technology. Education should try to develop technologically literate students so that technological ability

and high level competence is developed in them thereby enabling them to enjoy maximum advantages of science in their daily lives.

Though scientific education in India started at the beginning of 20th century, yet real advancement in this era was achieved during the second half of this century. Gradually growth of new industries began to increase during this decade. When India attained independence in 1947, national leaders thought of industrial growth side by side with the growth of agriculture and allied vocations. Demand for engineers and technicians began to grow and more and more children began to receive scientific and technical education. Opening of more institutions of these types of education was undertaken by the central as well as state governments. But soon thousands of engineers together with technicians began to swell the ranks of the unemployed (Sharma, 2014).

According to the National Policy on Education (NPE) 1986, it has been decided that scientific education must be encouraged. For this, the central government has brought into being the department of science in the National Council of Educational Research and Training (NCERT). Its primary objectives are to bring about the following improvements in the teaching of science at various levels of schools and teacher training institutions:

- To aid all the agencies engaged in the teaching of science.
- To provide training facilities to those teachers who are already in service.
- To provide improved designs for laboratories ad models of scientific devices.
- To improve the technology for teaching and teaching techniques.
- To provide ideal text-books for students and teachers by making desired changes in the curriculum.
- To enlarge the knowledge of teachers teaching science by organizing science fairs, science magazines and periodicals.
- To encourage more and more researches into the realm of science and scientific problems.
- To stimulate interests and urge of talented students studying science by awarding them scholarships and stipends.

NCERT launched various schemes through its extension services for the improvement of scientific education at all levels and in all fields of human work. Some of its working schemes are as follows:

- Schemes of teaching science.
- Promotion of science clubs.
- Organization of science fairs, seminars and symposiums.
- Selection for science education.
- Central science workshop.
- Training of science teachers.

1.1.3. AIMS OF SCIENCE EDUCATION

Position Paper of National Focus Group on Teaching of Science, 2006 and National Curriculum Framework NCF-2005 have proposed 6 criteria for validity of the science curriculum which are cognitive validity, content validity, process validity, historical validity, environmental validity and ethical validity. On this basis, following general aims of science education have been conceptualized:

Science education should enable the learner to:

- know the facts and principles of science and its applications, consistent with the stage of cognitive development,
- acquire the skills and understand the methods and processes that lead to generation and validation of scientific knowledge,
- develop a historical and developmental perspective of science and to enable her to view science as a social enterprise,
- relate to the environment (natural environment, artifacts and people), local as well as global, and appreciate the issues at the interface of science, technology and society,
- acquire the requisite theoretical knowledge and practical technological skills to enter the world of work,
- nurture the natural curiosity, aesthetic sense and creativity in science and Science Teaching-Learning technology,

- imbibe the values of honesty, integrity, cooperation, concern for life and preservation of environment,
- cultivate ‘scientific temper’ such as objectivity, critical thinking and freedom from fear and prejudice.

1.1.4. IMPORTANCE OF SCIENCE EDUCATION

Science is an important subject in the curriculum which lays an important part of foundation for education for all children (Das et al., 2014, p. 15). Science should continue to be encouraged and supported in schools and not marginalized by trendy topics that encompass the curriculum. Scientific concepts typically proceed with an idea followed by an experiment to prove that idea through scientific methods and analysis. It exhibits a logical way of approaching unfamiliar topic by making certain that students can learn how to perform practical and theoretical work. In this ways it proves that science enhances critical thinking and helps in cultivation of a passion for learning. It nourishes the children with natural curiosity and encourages them to venture in the fields of science and technology.

Science elevates many disciplines. For one to understand science, a reasonable understanding of other disciplines and area of study is required. For instance, the knowledge of mathematical concepts is a fundamental prerequisite which can be of use for qualitative and quantitative analysis. Moreover, science holds the key to future and opens numerous career opportunities for the youth. Ultimately one of the main reasons why students go to school is to enrich themselves with knowledge and prepare themselves in finding a good job. Through the enhancement of logic and mathematics based skill, students with science background are able to explore enormous opportunities ahead of them. These account for professions both within and outside of scientific fields, extending to related fields such as engineering, information technology (IT), business and healthcare.

Children and adolescents receive science education at school and participate in science related activities such as various workshops, projects, camps, fairs and exhibitions. Along with these, students can gain better chance to develop cognitive skills and problem solving with better understanding the construction of knowledge and the scientific processes. These skills help them to manage themselves better in

the present society. Science education can also generate an interest in university studies and increase their positive attitude towards science in society (Timonen, 2020, para. 4).

The advantages of science education can be summarized by the following points:

- Thinking and memory develops.
- Principles are formulated
- Self-confidence and self-reliance develop.
- Love for truth enhances.
- Confidence regarding unity in diversity increases.
- Devotion towards nature increases.
- Avenues open for recent and more new vocation.
- Science has become the basis of our cultural heritage and social progress.
- Like other disciplines, education is placed in the Faculty of Science. Education is not only an art but also Science.
- Most of the principles of modern education are scientific. Almost all the strategies, tactics and techniques of teaching are scientific in nature.

The knowledge of science is essential in supporting the daily lives of every human being. The ways and means of life on earth have been changing rapidly with the progress in science. An individual without scientific aptitude finds it hard to adjust himself to this unstable situation. But, an individual with scientific aptitude can easily make use of his knowledge in science for solving different problems in his daily life and make his life happier and comfortable. Hence science must be taught from young age and the traditional responsibility for strengthening the young to develop scientific aptitude lies with the education system so that the new generation leads better and comfortable ways of living in the world of science.

1.1.5. SCHOOL EDUCATION IN MIZORAM AND THE DEVELOPMENT OF SCIENCE EDUCATION

In Mizoram formal education was introduced with the arrival of Christian missionaries in 1893. The missionaries, James Herbert Lorrain and Frederick William Savidge, formulated the new alphabet for the Mizos and started opening schools in few villages in 1894 and from then on primary education began to expand. In 1909, middle schools were opened in Aizawl and Serkawn respectively. In 1944, the first high school was established in Aizawl. The opening of high school marked a new era of event in the educational progress in Mizoram.

Mizoram marched forward after India got independence and achieved immense progress and development in the field of education. With the appointment of the first Deputy Inspector of Schools for Mizoram, the Government took over administration, control and supervision of education in Mizoram from the hands of the missionaries with effect from 1st May, 1952 (Sangkima, 2005, p. 106). Since then opening of new school increased from year to year in different districts of Mizoram which consequently led to the development of science education. Although there was no diversification of courses at this stage in those times, this was the stage where science education was given its proper form along with all the divisions in Physical and Life Sciences (Zohmingliani, 2011, p. 22).

In 1966, with the introduction of 10+2 education according to the recommendation of Kothari Commission (1964-66), the Pre-University class (equivalent to Classes XI to XII) was shifted from college to school where the higher secondary schools came into existence. This stage lasted for two academic years and was called the Intermediate stage or Pre-University stage. Mizoram state began administering secondary education from 1996 by converting 26 high schools to higher secondary schools. Out of the schools converted to higher secondary schools only 9 schools were chosen to offer science education. From then on, schools that offer science subjects had increased year by year. As of today, there are 614 high schools and 138 higher secondary schools within Mizoram state (Directorate of School Education, 2021).

Since Mizoram had all along been very backward in Science and Mathematics from the beginning of introduction of education, therefore, effective steps have been taken for the improvement of science education. As a part of the special drive in this direction, the Government makes annual cash awards to deserving students for proficiency in Science and Mathematics. The Science Promotion Wing of the Directorate and also the Mizoram Board of School Education (MBSE) organize seminars and short course training for the Science and Mathematics teachers from time to time (Sangkima, 2005, p. 109).

Presently Mizoram is striving to provide free and compulsory quality education at the elementary level following with a focus on improving the standard of secondary and higher secondary education to increase the literacy rate of adult generation. In order to extend educational support to the masses, various educational schemes have been put forward by the state through the central government with the view to make education accessible to all. These schemes revolve around the four programmes such as Rastriya Madhyamik Shiksha Abhiyan (RMSA), Sarva Shiksha Abhiyan (SSA), Mid-Day Meal and Right to Education Act, 2009.

1.2. APTITUDE, APTITUDE TEST AND ITS TYPES

1.2.1. APTITUDE

Aptitude means the innate or acquired capacity, capability, ability to do something, in other words, talent. It can be understood as a person's readiness or quickness in learning. It also refers to the state of being apt or in other words special fitness in doing things. So aptitude can be referred to those qualities showing one's way of behavior which serve to specify how good he is in encountering and solving different kinds of problems.

The word aptitude is derived from Latin word 'Aptitudo' which means 'Fitness'. Aptitude may be understood as a specific ability or capacity which has separate meaning from the general intellectual ability that helps a person to acquire the degree of proficiency in a specific field. Aptitude is both inherited and acquired where certain aspects are inborn. Thus aptitude can be said to be influenced by both cultural and biological factors of an individual.

For having a clearer understanding of the term aptitude the following definitions given by different scholars may be considered:

Bingham (1937; as cited in Mangal, 1988, p. 243) stated that "Aptitude includes those qualities characterizing a person's way of behaviour which serve to indicate how well he can learn to meet and solve certain specific kinds of problems."

Traxler (1957; as cited in Moshahid, 2016, p. 300) defined aptitude as "A condition, a quality or a set of qualities in an individual which is indicative of the probable extent to which he will be able to acquire under suitable training, some knowledge, skill or composite of knowledge, understanding and skill, such as ability to contribute to art or music, mechanical ability, mathematical ability or ability to read and speak a foreign language."

According to Freeman (1971; as cited in Yaseer, 2015, para. 2), "An aptitude is a combination of characteristics indicative of an individual's capacity to acquire (with training) some specific knowledge, skill, or set of organized responses, for instance the ability to speak a language, to become a musician, to do mechanical work."

All these definitions reveal the predictive nature of aptitude. For example, if a person has an aptitude for teaching, it means that that person has the capacity or ability to acquire proficiency in teaching under appropriate condition. Similarly if an individual has an aptitude for science, his present condition or ability reveals that if he were to take up science subject he would excel in the subject which leads to better achievement in his studies. In this way the knowledge of aptitude helps in prediction of future success of an individual, in a particular area of activity, under suitable training or experiences.

1.2.2. APTITUDE TEST

An aptitude test is a test that is used to measure a person's potential in a given area of specialization. Aptitude test reveals the ability to occupy certain behavior or skill when given an opportunity. The goal of aptitude testing is to predict what can be learned in future (Goswami, 2011, p. 149). Aptitude tests are also used to estimate the extent to which an individual would benefit from a specific course or training.

For example, a scientific aptitude test would be able to indicate whether a student would do well as a science student after appropriate training and with the right motivation.

According to Encyclopedia Britannica, “An aptitude test is the examination that attempts to determine and measure a person’s ability to acquire through future training, some specific set of skills (intellectual, motor etc.). Aptitude test assumes that people differ in their special abilities and that these differences can be useful in future achievements.”

According to Merriam Webster, “Aptitude test is a standardized test designed to predict an individual’s ability to learn certain skills.”

According to Hull, “An aptitude test is a test designed to discover what potentiality a given person has for learning some particular vocation or acquiring some particular skill.”

1.2.3. TYPES OF APTITUDE TEST

Aptitude tests are typically divided into two broad approaches according to the test constructors. The two types of test usually employed in psychological testing are:

1. Multiple Aptitude Batteries or General Aptitude Tests
2. Specialized Aptitude tests

The first approach, i.e. Multiple Test Batteries or General Aptitude Tests is used to develop integrated batteries that measure a number of relatively broad abilities. They are intended for the independent measurement of each of several kinds of mental operation and that provide a separate score for each. The objective of this type of aptitude test is to determine a number of separate scores in order to differentiate among several abilities within each individual.

General Aptitude Tests usually consist of the following subsets which are as follows:

- Verbal reasoning test
- Numerical ability test

- Abstract reasoning test
- Space relation tests
- Mechanical reasoning test
- Clerical speed and accuracy test
- Language usage test

The other approach, i.e. Specialized Aptitude Test is to develop individual tests for specific ability. In this type of testing, the test constructors concentrate on a particular ability rather than broadly measuring the range of individual's ability (Goswami, 2011).

There are different tests available under the Specialized Aptitude Tests which can be mentioned as follows:

1. Mechanical Aptitude Test: This type of testing measures individual's aptitude test for mechanical work. Some examples are:

    - Minnesota Mechanical Assembly Test
    - Stenquinst Mechanical Aptitude Test
    - A Battery of Mechanical Aptitude Tests by Mano-Vigyanshala, Allahabad.

2. Clerical Aptitude Test: These types of tests are employed for measuring aptitude for clerical work. Examples are as follows:

    - Minnesota Clerical Test
    - General Clerical Test
    - Clerical Aptitude Test

3. Test for Artistic Aptitude: These types of tests attempt to find out talent for graphic art of an individual. The Meier Art Judgment Test is one common example of test for artistic aptitude.

4. Professional Aptitude Test: These tests measure aptitude for different professions. Some examples include:

    - Shah's Teaching Aptitude Test

- Stanford Scientific Aptitude Test by D. L. Zyve
- Ferguson and Stoddard's Law Aptitude Examination

5. Scholastic Aptitude Test: This type of aptitude test measures the scholastic aptitudes. Some scholastic tests include the measurement of relevant specific courses. Examples are as follows:

    - Moss Scholastic Aptitude Test for Medical Students
    - Modern Language Aptitude Test

1.3. SCIENTIFIC APTITUDE AND SCIENTIFIC APTITUDE TEST

1.3.1. SCIENTIFIC APTITUDE

According to Rao (1996; as cited in Naresh & Upadhyaya, 2017, p. 79), scientific aptitude means ability in science according to some hereditary and environmental determinants. Therefore a person's future accomplishment in science can be predicted through these abilities. The determinants of scientific aptitude can be of different types including motivation, factors like socioeconomic and cultural background as well as persistence in learning science.

Dressel (1963; as cited in Lakshmi and Rao, 2000), p. 11) defines that "Scientific aptitude is a potentiality for future accomplishment in science without regard to past training and achievement."

Miles (1954; as cited in Rao, 2003, p. 42) stated that "Scientific aptitude is another example of talent present in the gifted group so far greater extent than its probable realization in adult achievement."

The term scientific aptitude encompasses a wide variety of factors including physical development, social maturity, emotional maturity, moral character, attitudes, interests and skills. Scientific aptitude comprises of curiosity, observation, identification, description, experimental study and theoretical description of phenomena. The characteristics that individuals with aptitude for science possess include creative abilities, critical thinking ability, ability to see relationships, ability to reason, and open-mindedness.

One who has scientific aptitude not only grasps the knowledge correctly but also applies it in understanding dynamic situations. The ability to apply the knowledge of science in solving problems is another trait of an individual having scientific aptitude. One who is scientific minded and has aptitude for science is curious to solve problems, curious to know things and raise significant questions with reference to observed phenomenon.

Developing scientific aptitude amongst young people should be the major aim of science teaching and education. The knowledge of science and deeper understanding of science can completely change the mind-set and attitude of child. Effective teaching in science in order to develop scientific aptitude in children can bring about the desirable changes in the child. School is the only institution where children can be trained to develop this aptitude. Science teaching is not just a simple presentation of facts, in certain; it helps in development of new ways of thinking. This development reveals in itself increased skills, improvement in characters and desirable aptitudes.

1.3.2. SCIENTIFIC APTITUDE TEST

Scientific aptitude test, which is the main focus for the present study, is an example of specialized aptitude tests and it is designed to test the individual's potential and capacity in the area of science. This kind of aptitude test is administered to determine if an individual possess the skills to excel in science subject or how skilled and knowledgeable the person is at science. It reveals whether or not a person has the potential to encounter the problems of science. Thus scientific aptitude test can be understood as a tool to determine the probability of success in science and science related subjects. It also helps in measuring the students' abilities in science. These are of great importance for the students studying in school or those who want to choose their career.

Scientific aptitude tests are important for having better knowledge of strengths and weaknesses of the learners. Knowledge of one's strengths and weaknesses in the subjects is very important step in learning. Without it, students cannot know if they are leading the right path or not. Scientific aptitude test is one reliable tool for children and parents as well as the teachers to have a better

understanding of the students' strengths and weaknesses in science. Accordingly, the results of the tests will provide parents and teachers with better understanding of the students' abilities and condition in science. In this ways necessary actions can be taken by the parents and teachers in developing and improving the scientific aptitude of the students. Moreover the scientific aptitude tests are also useful for professional development of students and also help in highlighting the hidden talents of children.

Scientific aptitude tests help the students in choosing a career. Many times, students make mistakes in choosing their career depending on their interests. But having an interest in a particular subject does not mean that the individual has the potential to perform well in the same. The result of the aptitude test will declare about the person's abilities so that he will get to know which subject he is good at and will choose a career accordingly.

Test of aptitude in science also helps in academic improvement of the students. The result of the scientific aptitude test directly reveals the level of strengths and weakness of the students. The students will therefore work on their weak points in order to have improvements. Thus it becomes easier for the students to boost the chances of success in the future.

1.4. RATIONALE OF THE STUDY

Science education has been playing one of the major roles in the school curriculum as one of the school subjects for the preparation of the learner. As stated by the UNESCO, science has a specific role, as well as a variety of functions for the benefit of the society: creating new knowledge, improving education, and increasing the quality of every life. Therefore science contributes significantly for the development of nation and prepares the learner to lead a quality life as an intellectual citizen. Teaching of science imparts training in the scientific method and develops scientific aptitude which is very important in helping the children to have higher achievement in science. An individual with high aptitude in science will have the capability to perform better in science and this will help in choosing the right path and selecting a career. A student who is scientific minded and has aptitude for science is curious to solve problems, curious to know things and raise significant questions with reference to observed phenomenon. Therefore it is quite obvious that

the scientific aptitude predicts the achievement in science and interest in science education.

Science as a subject of study is often assumed to be much tougher and vaster as compared to the other streams of study, especially in Mizoram. With the growing number of students opting for science subject at the higher secondary level, it has become crucial to create awareness on the importance and significance of scientific aptitude and the impact that it could have on the future endeavors of every individual. This study attempts to reveal the scientific aptitude of science students which is highly expected to derive findings that would be useful for students, parents and teachers and create awareness in future students to give importance to aptitude before choosing their streams of study. The study is also considered to be a potential generation of information that could be used for further studies where the determinants as well as impact of scientific aptitude could be taken up.

The researcher is interested to conduct this study since it will reveal the true potential of science students in Aizawl district. This is important to tackle the practice of forcing learners who excel in their matriculation to simply opt for science stream without proper knowledge about their potential, interest or of their aptitude in total. The researcher also feels that the findings of this study will enable the parents and the caretakers as well as the teachers to provide guidance and would enable the students to be aware of their own potential and have an impact on the career choices in the future. The findings of this study will also provide an answer to several underlying questions and misconceptions about the subject of science. With the help of this study, the teachers can also plan their interventions appropriately to suit the need of all students with different levels of scientific aptitude.

Moreover, scientific aptitude in the field of education is an area of study that has not been widely studied, especially among the science students of Aizawl. So, the researcher is eager to conduct this study that can enrich the field of research. Therefore the multifaceted possibilities of creating awareness, generating new knowledge and providing information that would be useful for further studies etc. has compelled the researcher to take up this study. A reliable finding generated from this study can prove useful not only on planning the current learning experiences for the students based on their ability and aptitude, but it will also help the teachers and

parents to provide accurate and meaningful guidance for further studies and future career. This study will, therefore, pave the way for a more meaningful and directive academic endeavor for the science students of Aizawl district. Thus, the researcher, with a view to improve science education by creating awareness about scientific aptitude that can have a huge impact on the academic life of students has decided to conduct an in-depth study on the scientific aptitude of higher secondary science students in Aizawl district.

1.5. STATEMENT OF THE PROBLEM

The present study is entitled, **"A Study on the Scientific Aptitude of Higher Secondary School Science Students in Aizawl District."**

1.6. OPERATIONAL DEFINITIONS OF THE KEY TERMS

Aptitude: Aptitude is a specific ability or a specific capacity that helps and individual in acquiring the degree of proficiency or achievement in a particular field.

Science: Science is the study of the nature and behavior of natural things and the knowledge that we obtain about them. Science refers to one of the streams offered in higher secondary level of education.

Scientific Aptitude: Scientific aptitude refers to ability in science comprising of curiosity, observation, identification, description, experimental study and theoretical description of phenomena. Thus for the present study, Scientific Aptitude refers to the scores obtained by the students after performing the test given to them.

Higher Secondary School: Higher secondary school refers to the educational institution imparting formal education which offers Science stream for class XI and XII.

Science Students: Science students are learners who are studying in class XI and class XII of Science stream in the higher secondary school.

Aizawl district: Aizawl district is one of the districts in Mizoram state where the present study is conducted.

1.7. RESEARCH QUESTIONS

The following research questions are framed for the present study.

1. What is the level of scientific aptitude of higher secondary school science students in Aizawl district?
2. Is there any significant difference between the scientific aptitude of higher secondary school science students of Aizawl district with respect to gender?
3. Is there any significant difference between the scientific aptitude of higher secondary school science students of Aizawl district with respect to type of school management?
4. Is there any significant difference between the scientific aptitude of higher secondary school science students of Aizawl district with respect to locale?

1.8. OBJECTIVES OF THE STUDY

The present study has the following objectives as follows:

1. To find out the level of scientific aptitude of higher secondary school science students in Aizawl district.
2. To compare the scientific aptitude of higher secondary school science students of Aizawl district with respect to gender.
3. To compare the scientific aptitude of higher secondary school science students of Aizawl district with respect to type of school management.
4. To compare the scientific aptitude of higher secondary school science students of Aizawl district with respect to locale.

1.9. HYPOTHESES OF THE STUDY

The hypotheses of the present study are formulated as follows:

1. There is no significant difference between boys and girls with respect to their scientific aptitude.
2. There is no significant difference between government and private higher secondary school science students of Aizawl district with respect to their scientific aptitude.

3. There is no significant difference between private and deficit higher secondary school science students of Aizawl district with respect to their scientific aptitude.
4. There is no significant difference between government and deficit higher secondary school science students of Aizawl district with respect to their scientific aptitude.
5. There is no significant difference between urban and rural higher secondary school science students with respect to their scientific aptitude.

CHAPTER II

REVIEW OF RELATED LITERATURE

Review of literature means summarizing and over viewing of previous researches on a specific topic. It is an important step in the process of any research work. The process of literature review involves surveying and examining of previously related research works from book, journals, articles and other sources relevant to a particular area of research. Review of literature helps the investigator gain better perspective of the problem and recognizing of the research methodology which refers to the procedure of how the research has to be taken up. It also helps the researcher to know about the tools and techniques to be utilized based on the problem of the study.

An in-depth survey of related literatures was conducted based on the objectives of the study. The related reviews have been divided into two main categories according to the area of studies conducted which are presented as follows:

- Studies done in India
- Studies done Abroad

2.1. STUDIES DONE IN INDIA

Ghosh (1986) investigated on "Study of scientific attitude and aptitude of the students." The main purpose of the study was to ascertain the aptitude of the students in science with the help of a specially developed scientific aptitude test. The result of the study indicated that rural students scored better in the scientific aptitude test than urban students and girls possessed better scientific aptitude than boys. The results also revealed a positive relationship between scientific aptitude and scientific attitude, scientific aptitude and academic motivation and scientific attitude and academic motivation.

Rao (2003) projected a research "Scientific attitude vis-à-vis scientific aptitude," where 600 students were taken as sample. From the result, students were found to possess medium level of scientific attitude and scientific aptitude. There was a significant positive interrelationship between scientific attitude and scientific aptitude.

Patel (2010), in his research, "A study of scientific aptitude of students of secondary schools," did a study on the secondary school students from Gujarat and examined their scientific aptitude based on different variables. The study revealed that boys had higher scientific aptitude compared to girls. The students of urban area were superior to students of semi urban area. The students of class 9 were superior to class 8 and the students of class 10were superior to the students of class 9 in their scientific aptitude.

Jayalekshmi and Raja (2011) conducted a research entitled "Does creativity impact scientific aptitude of school children?" among a sample of 251 students of standard 8^{th}. The tools used were creativity tool by Baquer Medhi (1985) and a self-constructed tool for scientific aptitude. Data collected were analyzed using statistical techniques such as t-test, analysis of variance and Pearson's product moment correlation. It was found that there is no significant relation between creativity and scientific aptitude with respect to background variables. The study concluded that students who are highly creative may not have scientific aptitude up to the mark. Students who are interested in science and thereby developing their skills and abilities may not always be creative in nature.

Kaur (2013) did a research on "Scientific aptitude and intelligence as correlates of performance of students in Pre Medical Entrance Test" among 180 medical students who have recently passed the PMET. The result of the study revealedthat the scientific aptitude of boys and girls was average and there exist no significant difference between the two groups in their scientific aptitude.

Yeli and Sadiqa (2013) performed a study on "Learning achievement in science among secondary school students in relation to their scientific aptitude," which was conducted among a sample of 800 9^{th} grade students of secondary schools in Karnataka. The result indicated that the learning achievement in science and scientific aptitude scores of the students was dependent on each other. Urban students were found to have higher scientific aptitude than rural students. Another finding is that students of unaided secondary schools possessed higher scientific aptitude than students of aided and government secondary schools.

Barwal (2014) conducted a study on "Scientific aptitude of college students of Himachal Pradesh." Collection of data was done from a sample of 150 college

students from two districts of Himachal Pradesh. The result showed that there was significant difference between students of science and arts as well as students of science and commerce in their scientific aptitude. The findings also revealed that rural and urban students did not differ significantly on their scientific aptitude.

Manichander and Brindhamani (2014) investigated on "Academic achievement and scientific aptitude in science among the students of standard X." The findings of the study showed that students of aided schools had higher scientific aptitude than students of government schools. The urban school students were having higher scientific aptitude as compared to the rural school students. Moreover girls were superior compared to boys in their scientific aptitude.

Manjula (2015) conducted a research on "A study of scientific aptitude of Class X school students in relation to their achievement in mathematics." The major findings revealed that there is significant relationship between achievement in mathematics and scientific aptitude. It was also found that with regards to sub samples like gender and locality, students showed significant difference while for the type of family they did not show significant difference with respect to achievement in mathematics. Moreover it was also found that there is no significant difference between the sub samples with respect to scientific aptitude.

Sudha et al. (2015) performed a research on "Measurement of scientific aptitude among class 9 students in Erode district, Tamil Nadu" among a sample of 388 students. Scientific Aptitude Test (SAT) developed by C. R. Rao and Nagappa P. Shahapur (2006) was employed to measure the scientific aptitude of students based on gender, locality, medium of instruction and types of school. The study revealed that the scientific aptitude of students was high and there was significant difference in the scientific aptitude of students in relation to gender, locality, medium of instruction and types of school (Government, Private and Aided schools).

Banerjee (2016) had undertaken a study entitled "Project on achievement in life science: relationship with aptitude in life science and scientific attitude- An investigation" among the secondary students in North 24 Parganas of West Bengal. The result showed that there is strong correlation between students' achievement in life science and aptitude in life science. There was a strong association of scientific attitude with achievement in life science. The study concluded that the result of

strong aptitude and attitude implies that there is a possibility of a learner to acquire skills and competency in learning life science.

A study on "Scientific aptitude among English & Urdu medium secondary level students," by **Moshahid (2016)** revealed that English medium secondary level students have better scientific aptitude than Urdu medium secondary level students. There was no significant difference in the scientific aptitude among the English and Urdu medium female secondary level students. It was also found that Urdu medium female students have significantly higher scientific aptitude than their male counterparts.

Avadivu et al. (2016) performed a pilot study on "Construction and standardization of scientific aptitude test (SAT) for secondary school students." The findings of the study revealed that the scientific aptitude test constructed by the researchers ignited the students' scientific temper and the test can be useful in preparing future competitive examinations.

Stanly (2016) studied "Influence of scientific aptitude on achievement in science of 9 standard boys and girls." The study revealed that the students' scientific aptitude was low. The level of achievement in science was also found to be low. It was also found that girls were better in their scientific aptitude than boys and girls had higher achievement in science than that of boys.

Chakradhara and Bai (2017) conducted a research "A study of science interest of secondary school students in West Tripura district" by using Science Interest Test standardized by L.N. Dubey and Archana Dubey. The findings of the study showed that the students had average level of science interest and no significant difference was found between gender and residence with respect to science interest.

Gomathi and Mohaideen (2017) investigated on the "Influence of scientific aptitude & academic achievement of higher secondary school students on their interest in chemistry" among a sample of 500 students from 19 schools in Thoothukudi. The findings revealed that there was moderate level of interest in chemistry, scientific aptitude and academic achievement of the students.

Furthermore the scientific aptitude and academic achievement of students were found to have significant influence on their level of interest in chemistry.

Naresh and Upadhyaya (2017) conducted a study of "Scientific aptitude of women teachers in relation to social class and marital status." The result of their study revealed that there was significant effect of social class and marital status on the scientific aptitude of higher secondary schools' women teachers. It also resulted that married higher secondary women teachers have significantly higher scientific aptitude than unmarried higher secondary women teachers.

Singh and Bai (2017) conducted a study on the topic of "A study of science interest of secondary school students in West Tripura district." From the findings it was observed that students had an average level of science interest and there was no significant difference in the interest of science in relation to gender and residence. However significant difference was observed in the case of medium of instruction and type of schools where the students of urban secondary schools and English medium schools held slightly higher science interest than those from the rural secondary schools and Bengali medium schools.

Channawar (2018), in her research, "A study of scientific aptitude among government high school students of Raipur," revealed that the level of scientific aptitude is better in boys compared to girls of high school and the study also showed that there is was significant difference in different area/part of scientific aptitude like Reasoning Test, Numerical ability. It can also be seen form the result that there was no significant difference between boys and girls in terms of scientific information and science vocabulary test.

Roy and Goel (2018) conducted a research entitled "Scientific aptitude and attitude in the secondary students" and concluded that scientific pursuits demand qualities such as minute observation, scientific attitude of mind, persistence, perseverance, concentration of mind, accuracy of measurement, patience, logical objective and unprejudiced, respect for others' opinions, respect for truth etc. These disciplinary qualities of mind if cultivated through the teaching of science, may be carried over and manifest in the general behaviour of the learner. This will prove useful for living as an efficient social individual in the society.

Synrem and Syiem (2018) studied the "Relationship between scientific aptitude and achievement in science subject of Class IX students in Ri Bhoi District of Meghalaya." The study was administered among 800 students. The findings of the study resulted in the presence of significant relationship between scientific aptitude and achievement in science of secondary school students.

Anuruba and Krishnamurthy (2019) conducted a research entitled "Scientific aptitude, science interest and learning environment in relation to achievement in chemistry among higher secondary students in Pondicherry" to investigate the scientific aptitude of students using K.K. Agarwal Bareilly and Saroj Aror's Test Battery. The study revealed that higher secondary school students possess high level of scientific aptitude in that male students obtained higher scientific aptitude than female students. The study also revealed that private school students excelled in achievement in Chemistry than government school students and rural students scored better than urban students with respect to achievement in Chemistry.

Avadivu and Delphin (2019) had undertaken a study entitled "Study of scientific attitude, scientific aptitude and intelligence of B. Ed students." The aim of this study was to find out the relationship between scientific attitude, scientific aptitude and intelligence level of B. Ed 1st year students who selected Physical Science, Biological Science and Computer Science as their optional subjects. Their findings revealed the presence of slight difference in scientific attitude, scientific aptitude and intelligence level of the students with respect to variables such as pedagogy, parents and birth order brought slight difference. Students who chose computer science pedagogy had better scientific attitude, scientific aptitude and intelligence.

A study was done by **Gao and Hangsing (2019**) on "Scientific aptitude and academic achievement on tribal students" among 298 Class XII science students from 9 government higher secondary schools. The result revealed the scientific aptitude of the students was positively related to academic achievement of the students in different science subject. The study concluded that students who have high scientific aptitude may achieve higher marks in different science subjects.

Kalaivani (2019) conducted a study entitled "Gender difference in achievement in chemistry and scientific aptitude of higher secondary school students" with an aim to examine gender difference in the level of achievement in chemistry and scientific aptitude of higher secondary students studying in 10^{th} standard. A sample of 300 higher secondary school students in Cuddalore District of Tamil Nadu was taken by using random sampling technique. The study revealed that there was significant difference between male and female students in their achievement in chemistry and scientific aptitude. The higher secondary school students had high level of achievement of chemistry and they had average level of scientific aptitude.

Khushbu and Shah (2019) conducted a study on the topic entitled "Construction and standardization of scientific aptitude of SSC student of Gujarat state" among a sample of 2357 students from 5 zones of Gujarat state. The findings revealed that there was no significant difference between the scientific aptitude of boys and girls of SSC. But significant difference was found between rural and urban students where students of rural area possessed higher scientific aptitude than students of urban area. Significant difference was also found between class IX and X students where class X students possessed more scientific aptitude than class IX students.

Lalmuanzuali et al. (2019) conducted a study on the topic entitled, "Aptitude and achievement in science: A comparative study of higher secondary school students in Mizoram and Meghalaya." Data regarding scientific aptitude and achievement in science were collected from a total sample of 600 students. The result of the study revealed that girls were better in their scientific aptitude than boys but boys scored higher than girls in science. It was also found that the overall level of scientific aptitude was found to be higher in students of Mizoram as compared to students of Meghalaya.

A study on "Correlation among higher secondary students' achievement in chemistry, scientific aptitude and chemistry learning environment," done by **Manickavasagan (2019)**, showed that the higher secondary students had high level of scientific aptitude and showed high achievement in Chemistry. A significant difference was also found between the students in terms gender and locale. However

significant difference was not found between the students in terms of religion of students with respect to their achievement in chemistry and scientific aptitude. Further this study also showed that there was existence of significant positive relationship between the achievement in chemistry and scientific aptitude of higher secondary students.

Patel (2019) conducted a study on the topic entitled "A study of scientific aptitude of secondary school students in context of certain variables." Gender, area and standard were considered as variables and the sample consisted of 3154 students. The tool used was Standardized Scientific Aptitude Test prepared by Kiran Patel. The findings revealed that students having high level of I.Q were more superior in scientific aptitude than students having low level of I.Q. Furthermore, the level of scientific aptitude of boys and girls was found to be equal.

Vyas (2020) conducted "A study of scientific aptitude of secondary schools students in context of certain variables" among 3154 students of Gujarat medium schools. The result showed that the students obtained medium level of scientific aptitude. It was also found that there was no significant difference between boys and girls as well as students of urban and rural areas in their scientific aptitude.

2.2. STUDIES DONE ABROAD

Jones et al. (2000) studied "Gender differences in students' experiences, interests& attitudes toward science and scientists," with an aim to examine 6^{th} grade students' attitudes and experiences related to science among 437 students. The result showed that there were significant gender differences in science experiences, attitudes and perceptions of science courses and careers. The students' perception of science showed that significantly more number of females than males viewed that science was difficult to understand, whereas more number of males reported that science was destructive and dangerous as well as more suitable for boys.

Chuang and Cheng (2002) undertook a study on "The relationships between attitude toward science and related variables of junior high school students" and the result of the study revealed that girls were having higher scientific attitude than boys while boys scored higher on rational thinking ability. It was also found that higher

scores on attitude and aptitude towards biology resulted in higher achievement in biology among the students.

Spelke (2005) studied "Sex difference in intrinsic aptitude for mathematics and science" among human infants, preschool children and students at all levels. It was found that boys and girls possessed equal aptitudes for mathematics and science. The study concluded that the finding that men and women show equal aptitude for mathematics and science does not imply that humans' genetic endowment is irrelevant to these achievement, instead it shows that mathematical and scientific reasoning ability develop from a set of biologically based cognitive capacities that males and females share. These capacities lead males and females to develop equal talent for mathematics and science.

Ariyo (2007) conducted a study on "Construction and validation of general science aptitude test (GSAT) for Nigerian junior secondary school graduates." The Pearson product Moment Correlation, Test difficult index, discriminative index and the Kuder Richardson 21 statistics were used for the analysis of data. The result showed that GSAT was moderately difficult for the sampled students, while the instrument was found to be reliable since internal consistency was found to be 0.90. The inter-correlation among GSAT's sub scale was found to be substantial. GSAT was recommended for use in other part of world.

Akpinar et al. (2009) conducted a study entitled "Students' attitude towards science and technology: An investigation of gender, grade level, and academic achievement." The study was conducted among 658 primary students by using Personal Information Form and Attitude Scale for Science and Technology (ASST). The result revealed that there was significant difference between girls and boys in terms interest in science where girls scored more than boys. However it was found that there was no significant gender difference in terms of other factors such as enjoyment of science, anxiety and enjoyment of science experience.

Gugliotta (2010) performed a research entitled "Gender differences in attitudes towards math and science among elementary students: An exploration of the role of teachers." The study was conducted in different schools in the Knoxville metro area. The result showed that boys enjoyed math and science more than girls. The study made a conclusion regarding the fact that girls showed lower attitude

towards Mathematics and Science may be because of lack of motivation or support from the teachers compared to their male counterparts.

Aderogba and Olatoye (2011) did a research on "Performance of senior secondary school science students in aptitude test: The role of student verbal and numerical abilities" on a sample of 200 senior secondary science students. The study found no significant difference between male and female students in their verbal ability, numerical ability and general aptitude tests. The study also suggested that students should develop high verbal and numerical skills in order to perform better in aptitude test.

Desy et al. (2011) on "Gender differences in science-related attitudes and interests among middle school and high school students" performed a survey of 6^{th} to 12th grade students to measure their science related attitudes and interests. The result showed the existence of significant differences among these students where females were found to have more anxiety about science as well as less motivation in and enjoyment of science compared to their male counterparts.

A study on "Impact of favourite subject towards the scientific aptitude of the students at elementary level" done by **Raza and Shah (2011)** among Class 8 students of District Multan in Pakistan revealed that students having science subject as their favourite subject have more scientific aptitude than those students who have other subjects as their favourite subjects.

Adesoji and Ogini (2012) performed a study "Students' aptitude indices as predictors of learning outcomes in chemistry." The study made recommendations for teachers and parents to make sure that only students having high positive scientific aptitude are encouraged to enroll in science classes. Moreover, government along with relevant agencies should make appropriate provision in terms of facilities necessary for effective teaching and learning science in schools to enhance the development of needed aptitude by students.

Oba and Lawrence (2014) performed a study on "Effect of gender on student' attitude to physics in secondary schools in Oyo stat, Nigeria." The sample consisted of 160 students of senior secondary school 2 (SSS2) and the tool used was Students' Attitude Physics Scale (SAPS). The finding of the study revealed that

gender had no effect on students' attitude but there was slight difference in attitude of the students in favour of females.

Piraksa et al. (2014) conducted a study on "Effect of gender on students' scientific reasoning ability" on a sample of 400 class 11^{th} students from schools in North-Eastern region of Thailand. The study revealed that there was no significant difference between male and female students in their scientific reasoning ability.

Hasni and Potvin (2015) conducted a study on "Students' interest in science and technology and its relationships with teaching methods, family context and self-efficacy" by administering self-developed questionnaire to 1882 students of grade 5 to grade 11. The result indicated that students were having high interest in science and technology and there was preference for student-centered teaching methods among the students rather than teacher-centered methods.

Lin (2015) studied "Gender differences in science performance" among third, fifth and eighth grade students. An independent sample t-test was conducted to compare the performance in male and female students in each grade level. The result showed that gender had significant effect on students' performance in third, fifth and eighth grades where male students outperformed female students in all the three grade levels.

Naidoo and Sibanda (2020) did a research on "Examining science performance of South African grade 9 learners in TIMMS 2015 through a gender lens" with an aim to examine the students' performance in science using Trends in International Mathematics and Science Study (TIMMS) 2015. The result of the research revealed that gender did not influence the learners' achievement in most of the test items. The result also indicated the presence of gender differences where girls performed better than boys in most of the questions. The study concluded that the presence of gender difference could be related to socio-cultural environments and learning experiences.

2.3. OVERVIEW

The investigator collected and reviewed a total of 45 studies related to the topic of scientific aptitude of students conducted in India and abroad between the years 1986 to 2020. From the total studies collected, 30 related studies conducted in India between the years 1980 to 2020 were reviewed and 15 studies conducted abroad between the years 2000-2020 were collected and reviewed.

From the literatures reviewed, different studies related to students' scientific aptitude were conducted by different researchers where their conclusions and findings vary. As the term scientific aptitude has many characteristics such as ability to reason, ability to interpret, scientific interest, scientific attitude, creativity and so on, the investigator expanded the area of literature review. Thus the reviewed literatures for the present study were related to students' scientific aptitude, science interest, reasoning ability, scientific attitude and creativity in terms of age, gender, students' background or locale, type of school management and correlation with students' academic achievements.

Research conducted on students' scientific aptitude by Sudha et al. (2015), Anurabha and Krishnamurthy (2019) and Manickavasagan (2019) revealed that students scored high level of scientific aptitude but Stanly (2015), in his study, concluded that the overall level of scientific aptitude was low. However, in studies done by Rao (2003), Kaur (2013), Vyas (2010), Gomathi and Mohaideen (2017) and Kalaivani (2019), it can be seen that students possessed average level of scientific aptitude. A study conducted by Patel (2019) revealed that students having high level of I.Q were more superior in scientific aptitude than students having low level of I.Q.

Studies conducted by Gosh (1986), Manichander and Brindhamani (2014), Moshahid (2016), Stanly (2016), Lalmuanzuali et al. (2019) and Naidoo and Sibanda (2020) revealed that girls had higher scientific aptitude than boys whereas studies done by Channawar (2018) and Anuruba and Krishnamurthy (2019) found that boys possessed higher scientific aptitude than girls. Significant gender difference was also found in studies done by Sudha et al. (2015). Manickavasagan (2018) and Kalaivani (2019). Study done by Naidoo and Sibanda (2020) concluded that the presence of gender difference could be related to socio-cultural environments and learning experiences.

However, Manjula (2005), Kaur (2013), Spelke (2005), Aderogba (2011), Piraksa et al. (2014), Patel (2019), Vyas (2020) and Khushbu and Shah (2019) found no significant gender difference where boys and girls showed equal level of scientific aptitude. According to Spelke (2005), finding that male and female show equal aptitude for science does not imply that humans' genetic endowment is irrelevant to these achievement, instead it shows that scientific reasoning ability develop from a set of biologically based cognitive capacities that males and females share. These capacities lead males and females to develop equal talent for science.

Barwal (2014), Vyas (2010), and Manjula (2015) compared the scientific aptitude of students in relation to locale and found no significant difference between rural and urban students. Sudha et al. (2015) and Manickavasaga (2019), on the other hand, observed the presence of significant difference between the scientific aptitude of rural and urban student. Gosh (1986), Anuruba and Krishamurthy (2019) and Khushbu and Shah (2019) revealed than students coming from rural areas obtained higher scientific aptitude that students of urban areas whereas Patel (2010), Yeli and Sadiga (2013) and Manichander and Brindhamani (2014) found that urban students scored higher scientific aptitude than rural students.

Yeli and Sadiga (2013) compared students based on the type of school management and found that aided school students scored highest scientific aptitude compared to unaided and government school students. Manichander and Brindhamani (2014) also revealed that aided school students were superior in scientific aptitude than government school students and study done by Anuruba and Krishamurthy (2019) revealed that unaided school students possessed more scientific aptitude than government school students. However, presence of significant difference was found in terms of types of schools in the study done by Sudha et al. (2015).

Regarding studies on students' scientific aptitude with achievement in science, significant positive correlation was in the studies conducted by Banerjee (2016), Synrem and Syiem (2018) and Gao and Hangsing (2019). According to Gomathi and Mohaideen (2017) and Manickavasagan (2019), scientific aptitude of students was found to have significant influence on their level of interest in Chemistry. Chuang and Cheng (2002) concluded that higher aptitude led to higher

achievement in Biology. However, Avadivu (2019) revealed that students who opted for Computer Science were more likely to have better scientific aptitude than students who opted for Physical Science and Biological Science. Raza and Shah (2011) revealed that students having science subject as their favourite subject had higher scientific aptitude than students who have other subjects as their favourite subjects.

Studies conducted by Hasni and Potvin (2015) on students' scientific interest revealed that students possessed high level of scientific interest. According to Charadhara and Bai (2017) and Singh and Bai (2017) students had average level of scientific interest and found no gender significant. But studies done by Akpinar et al. (2009) and Desy et al. (2011) found gender difference where girls had better interest in science than boys whereas study done by Gugliotta (2010) revealed that boys scored higher scientific interest than girls. Furthermore, significant difference between rural and urban students was seen in the study conducted by Singh and Bai (2017) where urban students were having better interest in science than rural students but in terms of type of school management, significant difference was not observed.

Research on scientific attitude of students was also reviewed where study done by Chuang and Cheng (2002) revealed that girls had more scientific attitude than boys while in the study conducted by Gugliotta (2010) boys were superior than girls. Study conducted by Oba and Lawrence (2014) revealed that no significant difference was seen on the scientific attitude of boys and girls.

Review regarding construction of scientific aptitude test done by Avadivu et al. (2016) revealed that Scientific Aptitude Test (SAT) for secondary students ignited their scientific temper and the test could be useful in preparing future competitive examinations. Moreover, research on construction of scientific aptitude test done by Ariyo (2007) concluded that General Scientific Aptitude Test (GSAT) was recommended for use in other part of the world.

CHAPTER III

METHODOLOGY AND PRODEDURE

Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises of the theoretical analysis of the body of methods and the principles associated with the branch of knowledge. Typically, it encompasses concepts such as paradigm, theoretical model, phases and quantitative or qualitative techniques. It describes in details the different aspects through which the research project has under gone for collecting relevant information and data in order to arrive at reliable conclusion.

This chapter presents the research design, data collection procedures and data analysis procedures that were decided to be most suitable for addressing the formulated research questions.

3.1. METHOD OF THE STUDY

The present study aimed to find out the scientific aptitude of higher secondary school science students in Aizawl district and to compare them on the basis of gender, school type management and their locale. Therefore the study adopted a Descriptive Survey Method to study and inquire the students' aptitude in science. It also followed a Quantitative Type of Research as the data were collected and analyzed quantitatively.

3.2. POPULATION OF THE STUDY

The population of the study included all the science students reading in higher secondary schools in Aizawl city.

3.3. SAMPLE OF THE STUDY

The sample of the study consisted of 325 students comprising of 188, 61 and 76 students from private, government and deficit higher secondary schools respectively.

The technique used for selecting the sample was Stratified Random Sampling technique and the sample was selected from each stratum proportionately.

3.4. TOOL USED FOR DATA COLLECTION

For collecting data, the researcher used Scientific Aptitude Test (SAT) developed by Dr. Nagappa. P. Shahapur, Dharwad and Dr. C. R. Rao, Bijapur. The test is an objective type test consisting of 80 questions. Each question carries 1 mark and the test consists of separate answer sheet. The questions in the test were arranged under 8 characteristics of Scientific Aptitude such as:

- Experimental Bent,
- Ability to Reason,
- Detection of Illogical Conclusion,
- Ability to Draw Conclusion from the given Data,
- Ability to interpret,
- Scientific Interest,
- Ability to Solve General Problems,
- Accuracy of Observation

Validity of the test: A test is valid when it measures what it is supposed to measure. Content validity and predictive validity of the test were assessed.

a) *Content Validity* - Opinions of the experts from Sainik School science teachers from Karnataka University, Dharwad were pooled. Content validity was established in terms of consistency of test items with objective and content.
b) *Intrinsic Validity* - This was measured by correlating the scores of 86 students on the test-retest and split-half items. The intrinsic validity for test-retest was 0.96332 and for odd and even numbered items was 0.9229. Hence, the intrinsic validity of the science aptitude test was ranged from 0.9229 to 0.96332.

Reliability of the test: The reliability was measured by split-half method putting all the odd numbered test items into one half and all the even numbered test items into another half, care was taken to put highly comparable items into two halves.

Scores obtained on two halves were correlated and then correction was applied by Spearman Brown formula. The reliability of the test was found to be 0.8518 which was found to be significant at $p < 0.05$ level of significance.

3.5. PROCEDURE OF DATA COLLECTION

Data collection procedure refers to the identification of the subject and the systematic gathering of information relevant to the research purpose.

In the present study the data collection was carried out from the month of August, 2020. Prior to the data collection, the investigator obtained all the necessary information regarding number of higher secondary schools within Aizawl city and number of science students in each school in order to calculate samples needed for the study.

For collection of data online survey process was administered using Google Form as the researcher could not personally go to the field to collect data due to pandemic. The researcher took permission from the principals and heads of the sampled schools to conduct the test. After permission was taken, questionnaire was distributed to the sampled students through Google Form. Detailed instruction was included in the description section of the Google Form. The researcher then collected and recorded the responses after the students submitted their responses. The collected data were tabulated and analyzed through computer by using Microsoft Excel Worksheet 2007 Edition.

3.6. ANALYSIS OF DATA

In the present study, the researcher used percentage method for finding out the different levels of students' scientific aptitude and other statistical technique like t- test was adopted to test the hypotheses.

To find out the difference in the scientific aptitude of students, the researcher distributed the students based on gender, type of school management and locale.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

This chapter describes the analysis and interpretation of the data.In this chapter the data are tabulated, analyzed and interpreted based on the objectives and hypotheses of the study.

Objectives of the study:

- To find out the level of the scientific aptitude of higher secondary school science students in Aizawl district.
- To compare the scientific aptitude of higher secondary school science students of Aizawl district with respect to gender.
- To compare the scientific aptitude of higher secondary school science students of Aizawl district with respect to type of school management.
- To compare the scientific aptitude of higher secondary school science students of Aizawl district with respect to locale.

Hypotheses of the study:

- There is no significant difference between boys and girls with respect to their scientific aptitude.
- There is no significant difference between government and private higher secondary school science students with respect to their scientific aptitude.
- There is no significant difference between private and deficit higher secondary school science students with respect to their scientific aptitude.
- There is no significant difference between government and deficit higher secondary school science students with respect to their scientific aptitude.
- There is no significant difference between urban and rural higher secondary school science students with respect to their scientific aptitude.

The data were collected from 325 higher secondary school science students of Aizawl city to find out their scientific aptitude by using Scientific Aptitude Test (SAT) developed by Dr. Nagappa P. Shahapur. Each score on the questionnaire was analyzed on the basis of gender, type of school management and student's

background/locale and the findings were interpreted according to the norms of the test by dividing points between various stanine grades in accumulated percentage, which can be represent in the following table.

Table 4. Dividing points between various stanine grades in accumulated percentage

Accumulate percentage	**Stanine**	**Interpretation**
Above 96%	9	High Aptitude
Above 89%-Below 96%	8	Above Average
Above 77%-Below 89%	7	Above Average
Above 60%-Below 77%	6	Average
Above 40%-Below 60%	5	Average
Above 23%-Below 40%	4	Average
Above 11%-Below 23%	3	Below Average
Above 4%-Below 11%	2	Below Average
Below 4%	1	Low

The analysis and interpretation of the data is done in accordance with the objectives and hypotheses using the norms of the test which can be presented as follows.

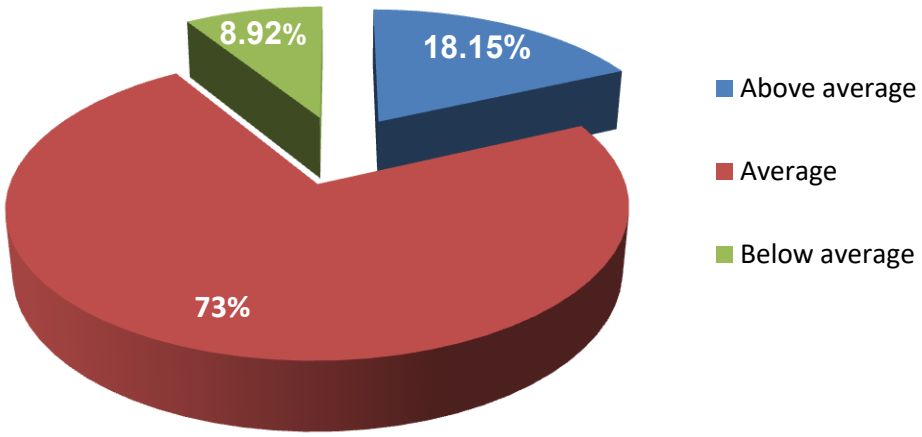
4.1. Level of scientific aptitude of higher secondary school science students in Aizawl district.

The following Table 4.1 and Figure 4.1 show the level of scientific aptitude of higher secondary school science students in Aizawl district.

Table 4.1. Level of the scientific aptitude of higher secondary school science students in Aizawl district

Score Percentage	Level of Scientific Aptitude	No. of Students	Percentage
Above 96%	High	0	0
77%- 96%	Above average	59	18.15%
23%-77%	Average	237	73%
4%-23%	Below average	29	8.92%
Below 4%	Low	0	0
Total		325	

Figure 4.1. Pie-Diagram showing the level of scientific aptitude of higher secondary school science students in Aizawl district.



As shown in Table 4.1 and Figure 4.1, it can be observed that out of 325 higher secondary school science students, 237 students (73%) obtain a score of average level of scientific aptitude, 59 students i.e. 18% are seen to score above average level of scientific aptitude and 29 students (8%) score below average level of scientific aptitude. It can also be detected that there are no students who are having high and low levels of scientific aptitude.

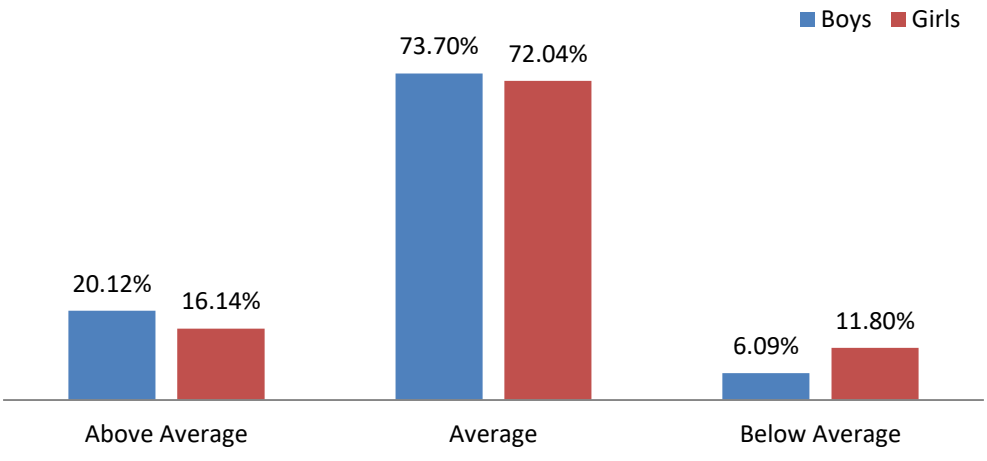
4.2. Comparison of scientific aptitude of higher secondary school science students of Aizawl district with respect to gender.

A comparison of level of scientific aptitude of higher secondary school science students of Aizawl district based on gender was done. The following Table 4.2 and Figure 4.2 show the scientific aptitude level of both boys and girls.

Table 4.2. Level of scientific aptitude of boys and girls

Level of scientific aptitude	N=325	
	Boys	Girls
High	0 (0%)	0 (0%)
Above average	33 (20.12%)	26 (16.14%)
Average	121(73.7%)	116 (72.04%)
Below average	10 (6.09%)	19 (11.8%)
Low	0 (0%)	0 (0%)
Total	164	161

Figure 4.2. Column chart showing level of scientific aptitude of boys and girl



As depicted in Table 4.2 and Figure 4.2, there are 164 boys and 161 girls. Among the students, 33 boys i.e. 20.12% are seen to possess above average level of scientific aptitude whereas 26 girls i.e. 16.14% possess above average level of scientific aptitude. Among the boys, 121 students (73.7%) are found to have average level of scientific aptitude. At the same time among 161 girls, 116 students (72.04%) possess average level of scientific aptitude. There are 10 (6.09%) boys and 19 (11.8%) girls who obtain a score of below average scientific aptitude. No student is found to possess neither high nor low level of scientific aptitude.

Hypothesis: There is no significant difference between boys and girls with respect to their scientific aptitude.

Comparison of students' scientific aptitude based on gender was done by calculating the t-test among the two groups to find out the differences in their mean value. The following Table 4.2.1 shows the comparison of boys and girls in their scientific aptitude.

Table 4.2.1. t-test for comparison of scientific aptitude of boys and girls.

Gender	N	Mean	SD	SED	df	t-value	Significant level
Boys	164	42.2	16.53	1.88	323	1.4	Not significant
Girls	161	39.56	17.47				

The above Table 4.2.1 shows the comparison of the scientific aptitude of boys and girls. It can be seen from the table that there are 164 boys where their mean score is 42.2 and standard deviation is 16.53 whereas out of 161 girls, the mean score is 39.56 and standard deviation is 17.47 and that the standard error becomes 1.88. The calculated t-value is found to be 1.4 with degrees of freedom 323.

The calculated value of t (1.4) as observed form the table being smaller than the critical value of t (1.97) at the required level of significance (0.05 level) indicates the absence of significant difference between the scores of two groups. So, the null hypothesis "There is no significant difference between boys and girls with respect to their scientific aptitude" is accepted.

Table 4.2.1 also points out that the mean score of boys is slightly higher than the mean score of girls in their scientific aptitude but it can be concluded that the difference that appears in the mean scores of both the two groups could be due to by chance factor.

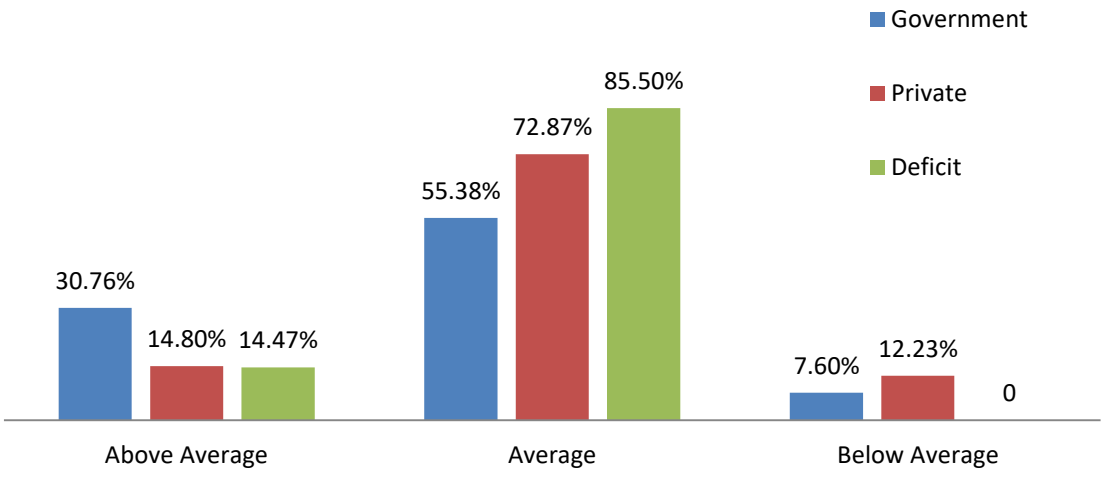
4.3. Comparison of scientific aptitude of higher secondary school science students of Aizawl district with respect to type of school management.

Comparison of scientific aptitude of higher secondary school science students of Aizawl district was done base on the type of school management (Government, private and deficit). The following Table 4.3 and Figure 4.3 show the scientific aptitude level of science students of government, private and deficit higher secondary schools in Aizawl district.

Table 4.3. Level of scientific aptitude of higher secondary school science students based on type of school management.

Level of scientific aptitude	**Type of school management**		
	Government	**Private**	**Deficit**
Above average	20 (30.76%)	28 (14.8%)	11 (14.47%)
Average	36 (55.38%)	137 (72.87%)	65 (85.5%)
Below average	5 (7.6%)	23 (12.23%)	0 (0%)
Total No. of students	61	188	76

Figure 4.3. Column Chart showing level of scientific aptitude of higher secondary school science students based on type of school management



From Table 4.3 and Figure 4.3, there are 61 students from government higher secondary school, 188 students from private higher secondary schools and 76 students from deficit higher secondary schools. From the students of government higher secondary schools, 20 students (30.76%) are seen to score above average level, 36 students (55.38%) have a score of average level and 5 students (7.6%) obtain a score of below average level of scientific aptitude. From the students of private higher secondary schools, 28 students (14.8%) are found to possess above average level, 37 students (19.6%) possess average level and 23 students (12.23%) obtain below average level of scientific aptitude. On the other hand, among the students of deficit higher secondary schools 11 students (4.47%) obtain above average level, 65 students (85.5%) show average level and no student is seen to score below average level of scientific aptitude.

4.3.1. Comparison of government and private higher secondary school science students with respect to their scientific aptitude.

Hypothesis: There is no significant difference between government and private higher secondary school science students with respect to their scientific aptitude.

Comparison of students' scientific aptitude of government and private higher secondary schools was done by calculating the t value to find out the differences in their mean value. The following Table 4.3.1 shows the comparison of the scientific aptitude of government and private higher secondary school science students.

Table 4.3.1. t-test for comparison of scientific aptitude of government and private higher secondary school science students.

School	N	Mean	SD	SED	df	t-value	Significant level
Government	61	48.68	19.3	2.74	247	3.9	Significant at 0.01 level
Private	188	37.97	16.46				

Table 4.3.1 reveals the comparison of scientific aptitude of government and private higher secondary school science students in Aizawl district. As per the table, it can be observed that there are 61 students of government higher secondary school where their mean score is 48.68 and standard deviation is 19.3 whereas out of 188 students of private higher secondary school, the mean score is 37.97 and standard deviation is 16.46 and that the standard error becomes 2.74. The calculated t-value is found to be 3.9 with degrees of freedom 247.

Since the calculated value of t (3.9) becomes greater than the critical value of t (2.60) at the required level of significance (0.01 level), this shows that there exists significant difference between the scores of two groups. So, the null hypothesis "There is no significant difference between government and private higher secondary school science students with respect to their scientific aptitude" is rejected.

As seen from Table 4.3.1 the mean score of students of government higher secondary school is higher than the mean score of students of private higher secondary school. This means that the aptitude score of government students is more favourable than that of the aptitude score obtained by private school students since a lower mean score denotes unfavourable aptitude and higher mean score denotes favourable aptitude. Therefore it can be concluded that government higher secondary school science students have higher scientific aptitude than private higher secondary school science students.

4.3.2. Comparison of private and deficit higher secondary school science students with respect to their scientific aptitude.

Hypothesis: There is no significant difference between private and deficit higher secondary school science students with respect to their scientific aptitude.

Comparison of students' scientific aptitude of private and deficit higher secondary schools was performed by applying t-test to find out if there is difference in their mean value. The following Table 4.3.2 shows the comparison of the scientific aptitude of private and deficit higher secondary school science students.

Table 4.3.2. t-test for comparison of scientific aptitude of private and deficit higher secondary school science students.

School	N	Mean	SD	SED	df	t-value	Significant level
Private	188	37.97	16.46	2.04	262	1.91	Not Significant
Deficit	76	41.88	14.41				

A perusal study of Table 4.3.2 highlights the comparison of scientific aptitude of private and deficit higher secondary school science students of Aizawl district. It can be observed that a total of 188 private higher secondary school science students obtain a mean score of 37.97 and standard deviation 16.46 while among 76 deficit higher secondary school science students, the mean score is 41.88 and standard deviation is 14.41 and that the standard error becomes 2.04. The calculated t-value is found to be 1.91 with degrees of freedom 262.

The obtained value of t (1.91) being lesser than the critical value of t (1.97) at the expected level of significance (0.05 level) designates that there exists no significant difference between the scores of two groups. So, the null hypothesis "There is no significant difference between private and deficithigher secondary school science students with respect to their scientific aptitude" is accepted.

From Table 4.3.2, it can also be noticed that the mean score of deficit school students is faintly higher than the mean score of private school students in their scientific aptitude. However it can be concluded that the occurrence of slight difference between the mean scores of the two groups could be due to by chance factor.

4.3.3. Comparison of government and deficit higher secondary school science students with respect to their scientific aptitude

Hypothesis: There is no significant difference between government and deficit higher secondary school science students with respect to their scientific aptitude.

Here, the scientific aptitude of government and deficit higher secondary school science students is compared by using t-test to find out the differences of their mean value. The following Table 4.3.3 shows the comparison of the scientific aptitude of government and deficit higher secondary school science students.

Table 4.3.3. t-test for comparison of scientific aptitude of government and deficit higher secondary school science students.

School	N	Mean	SD	SED	df	t-value	Significant level
Government	61	48.68	19.3	2.97	135	2.28	Not Significant
Deficit	76	41.88	14.41				

Table 4.3.3 depicts the comparison of scientific aptitude of government and deficit higher secondary school science students of Aizawl district. Thus from the table it can be known that a total of 61 government higher secondary school science students secure a mean score of 48.68 and standard deviation 19.3 while out of 76 deficit higher secondary school science students, the mean score is 41.88 and standard deviation is 14.41 and that the standard error becomes 2.97. The calculated t-value is found to be 2.28 with degrees of freedom 135.

As the obtained value of t (2.28) appears to be lower than the critical value of t (2.62) at the expected level of significance (0.01 level) it can be stated that there is an absence of significant difference between the scores of two groups. So, the null hypothesis “There is no significant difference between government and deficit higher secondary school science students with respect to their scientific aptitude” is accepted.

The table also points out that the mean score of government school students is slightly higher than that of deficit school students. However, it can be brought to a

conclusion that the presence of only little difference in the mean score between government and deficit higher secondary school science students of Aizawl district could be due to by chance factor.

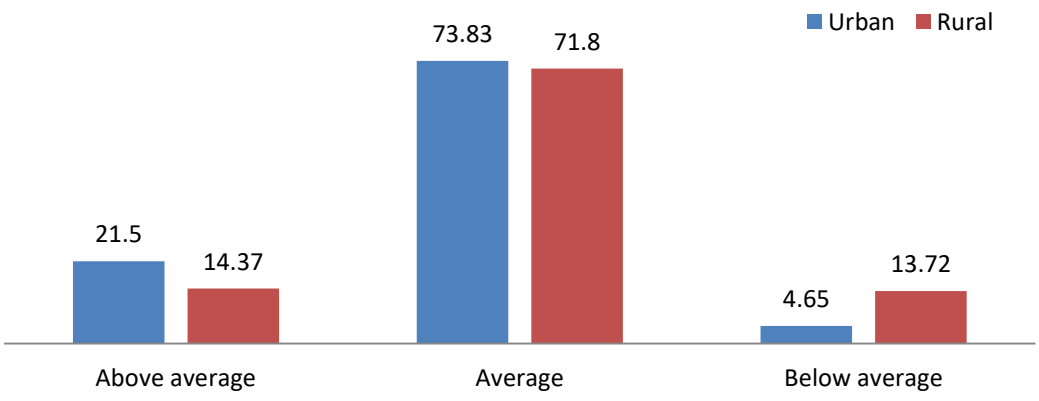
4.4. Comparison of scientific aptitude of higher secondary school science students of Aizawl district with respect to locale.

A comparison of scientific aptitude between urban and rural higher secondary school science students of Aizawl district was conducted. The following Table 4.4 and Figure 4.4 show the scientific aptitude level of urban and rural science students of higher secondary schools of Aizawl district.

Table 4.4. Level of scientific aptitude of higher secondary school science students based on locale

Level of Scientific Aptitude	Locale(N=325)	
	Urban	Rural
Above average	37 (21.51%)	22 (14.37%)
Average	127 (73.83%)	110 (71.89%)
Below average	8 (4.65%)	21 (13.72%)
Total	172	153

Figure 4.4. Column chart showing the level of scientific aptitude of higher secondary school science students based on locale



From Table 4.4 and Figure 4.4 it can be observed that there are 172 students coming from urban areas and 153 students coming from rural areas. 37 students (21.5%) coming from urban areas and 22 students (14.37%) coming from rural areas are seen to possess above average level of scientific aptitude. 127 students (73.83%) coming from urban areas and 110 (71.8%) from rural areas obtain above average level of scientific aptitude. Furthermore there are 8 students (4.65%) coming from urban areas and 21 students (13.72%) from rural areas who score below average level of scientific aptitude.

Hypothesis: There is no significant difference between urban and rural higher secondary school science students with respect to their scientific aptitude.

Here, comparison of students' scientific aptitude based on locale was conducted by calculating t value to find out the differences of their mean value. The following Table 4.4.1 shows the comparison of the scientific aptitude of higher secondary school science students coming from rural and urban areas respectively.

Table 4.4.1. t-test for comparison of scientific aptitude of urban and rural higher secondary school science students.

Locale	N	Mean	SD	SED	df	t-value	Significant level
Urban	172	44.75	16.56	1.83	323	4.46	Significant
Rural	153	36.57	16.57				

Table 4.4.1 reveals the comparison of the scientific aptitude of urban and rural higher secondary school science students of Aizawl district. From the table it can be noticed that there are 172 students with urban background where their mean score is 44.75 and standard deviation is 16.56 and in the meantime there are 153 students having rural background where their mean score is 36.57 and standard deviation is 16.57 and that the standard error becomes 1.83. The calculated t-value is found to be 4.46 with degrees of freedom 247.

The occurrence of higher calculated value of t compared to the critical t-value (2.59) at the expected level of significance (0.01) denotes the presence of significant

difference between the scores of the urban and rural students. So, the null hypothesis "There is no significant difference between urban and rural higher secondary school science students with respect to their scientific aptitude" is rejected.

From Table 4.4 it is also evident that the score obtained by students coming from urban areas is better than the score obtained by the students coming from rural areas, where a higher mean score denotes better aptitude and a lower mean score denotes lesser aptitude. Therefore it can be concluded that students coming from urban areas are better in their scientific aptitude than students coming from rural areas.

CHAPTER V

MAJOR FINDINGS AND DISCUSSION, RECOMMENDATIONS SUGGESTIONS FOR FURTHER STUDIES

This chapter deals with the major findings and discussion of the findings followed by recommendations and suggestions for further studies. As the present study is designed to analyze the scientific aptitude of higher secondary school science students of Aizawl district, students' scientific aptitude scores of government, private and deficit higher secondary schools were examined. The findings were discussed in relation to the objectives, reviewed literatures, hypotheses and conceptual framework.

5.1. MAJOR FINDINGS OF THE STUDY

The following are the major findings of the study.

5.1.1. Findings in relation to level of scientific aptitude of higher secondary school science students in Aizawl district.

Out of a total of 325 higher secondary science students majority of the students i.e. 73% was found possess average level of scientific aptitude. 18.15% of the students were found to have above average level of scientific aptitude. Only 8.92% were found to have below average level of scientific aptitude. There were no students having high or low level of scientific aptitude.

Discussion in relation to level of scientific aptitude of higher secondary school science students in Aizawl district.

The science students of higher secondary schools in Aizawl district were found to possess average level of scientific aptitude. Some of the students were having above average aptitude while very little number of students had below average. High or excellent scientific aptitude was not obtained by any student which was quite unsatisfactory because science students of higher secondary level of education are typically expected to have high level of aptitude in science. There is a felt need for improvement of scientific aptitude among higher secondary school science students as a whole in order to have improvement in their studies and to

achieve future success. The level of scientific aptitude in a student may depend on a variety of factors such as the level of interest in science, motivation, intelligence and other related skills of a student. Study conducted by Patel (2019) revealed that students with high level of I.Q were more superior in scientific aptitude than students having low level of I.Q. Furthermore, Aderogba and Olatoye (2011) also made suggestion in their study that students should develop high verbal and numerical skills in order to perform better in aptitude test.

5.1.2. Findings in relation to comparison of students' scientific aptitude with respect to gender.

Out of 164 boys, majority of the boys i.e. 73.7% were found to have average level of scientific aptitude. A quarter of boys i.e. 20.12% possessed above average level of scientific aptitude and at the same time, only a few numbers of them i.e. 6.09% were found to have below average level of scientific aptitude.

Out of 161 girls, majority of the girls i.e. 72.04% were found to have average level of scientific aptitude. Few number of them i.e. 16.14% were found to be in the above average level category of scientific aptitude and 11.8% of the girls scored below average level of scientific aptitude. In the meantime,when comparison was made between the two groups, no significant difference was found between the scientific aptitude of boys and girls.

Discussion in relation to comparison of students' scientific aptitude with respect to gender.

In the present study regarding students' scientific aptitude in relation to gender, no significant difference was found between boys and girls. The reason behind this could be due to equal opportunities given to both the gender to receive the same learning in science and participate in activities related to science and science learning. Spelke (2005) also found that boys and girls showed equal scientific aptitude. According to her, finding that male and female show equal aptitude for science does not imply that humans' genetic endowment is irrelevant to these achievements, instead it shows that scientific reasoning ability develops from a set of biologically based cognitive capacities that males and females share. However the result of the present study is contrary with the findings of previous studies done

by Srivasta (1992), Sudha et al. (2015), Manickavasagan (2018) and Kalaivani (2019) where significant difference was seen between boys and girls. Study done by Naidoo and Sibanda (2020) concluded that the presence of gender difference could be related to socio-cultural environments and learning experiences.

5.1.3. Findings in relation to comparison of students' scientific aptitude with respect to type of school management.

Among a total of 61 government higher secondary schools science students, a large number of the students i.e. 55.38% were found to have average level of scientific aptitude, a good number of students i.e. 30.76% obtained above average level of scientific aptitude but only 7.6% students showed below average level of scientific aptitude.

Out of 188 private higher secondary school science students, majority of the students i.e. 72.87% were found to possess average level of scientific aptitude while 14.8% students were having above average level and 12.23% of the students possessed below average level of scientific aptitude.

Out of 76 deficit higher secondary school students, majority of the students i.e. 85.5% were found to obtain average level of scientific aptitude and very few students i.e. 14.47% scored above average level of scientific aptitude while none of the students scored below average level of scientific aptitude.

Significant difference was found between government and private higher secondary school science students in their scientific aptitude. The government higher secondary school science students have higher scientific aptitude than private higher secondary school science students. No significant difference was detected between private and deficit higher secondary school science students in their scientific aptitude. At the same time, it was also found that there existed no significant difference between government and deficit higher secondary school science students in their scientific aptitude.

Discussion in relation to comparison of students' scientific aptitude with respect to type of school management.

From the comparison of students' scientific aptitude based on the type of school management it was found that significant difference did not exist between government and deficit higher secondary school science students as well as between private and deficit higher secondary school science students. However significant difference was found between government and private higher secondary school science students where government school students were having higher scientific aptitude than private school students. So it can be said that government school students scored highest in their scientific aptitude compared to private and deficit school students. This could be due to factors such as teacher quality and better infrastructures available in the schools. In the state of Mizoram most of the teachers in government schools are trained and experienced and so their students are susceptive to perform better than students who are under the guidance of untrained and inexperienced teachers. Moreover, government schools, as compared to aided and unaided schools, have better school campus well equipped with spacious building, laboratories, good libraries etc. for providing a conducive environment for better learning and quality teaching. Due to this, government school students may be superior in possessing high scientific aptitude than private and aided school students.

But the case can be different according to the area of study because previous study done in Karnataka by Yeli and Sadiga (2013) compared students' scientific aptitude based on the type of school and found that aided school students were superior in scientific aptitude compared to unaided and government school students. Different result was also seen in the study conducted by Manichander and Brindhamani (2014) in Tamil Nadu where aided school students possessed higher scientific aptitude than government school students while study done by Anuruba and Krishnamurthy (2019) revealed that unaided school students possessed more scientific aptitude than government school students.

5.1.4. Findings in relation to comparison of students' scientific aptitude with respect to locale.

Out of 170 urban students, majority i.e. 73.83% were found to have average level of scientific aptitude. 21.51% of urban students were having above average level of scientific aptitude whereas only very little number of students i.e. 4.65% were detected to have below average level of scientific aptitude.

Among 153 students of rural areas, a greater number of rural students i.e. 71.89% possessed average level of scientific aptitude while only 14.37% of the rural students were found to have above average level and at the same time 13.72% scored below average level of scientific aptitude.

Significant difference was found between urban and rural students in their scientific aptitude. Students coming from urban areas have higher scientific aptitude than students coming from rural areas.

Discussion in relation to comparison of students' scientific aptitude with respect to locale.

The comparison of students' scientific aptitude based on locale revealed that urban students showed better scientific aptitude than rural students. In the present study urban students refer to students who permanently reside in Aizawl city whereas rural students refer to those students who temporarily reside within Aizawl city. The findings of the present study is in agreement with the findings made by Patel (2010), Yeli and Sadiga (2013) and Manichander and Brindhamani (2014) where their studies revealed that urban students possessed higher scientific aptitude than rural students. The reason for low aptitude score among rural student may be because of lack of equal opportunity in education among students of different location within the state. As complete equal opportunity could not have been achieved there is no doubt that schools in rural areas are inadequate in terms of opportunities. Furthermore schools in urban areas are more exposed in educational activities especially science related activities such as science fairs, exhibitions etc. As students are involved in these kinds of science related activities in schools they become more prone to increase their scientific knowledge and scientific aptitude.

However findings from previous studies conducted by Gosh (1986), Anuruba and Krishamurthy (20190 and Khushbu and Shah (2019) revealed that students coming from rural areas possessed higher scientific aptitude than students of urban areas. But there are other findings made by Barwal (2014), Manjula (2015) and Vyas (2010) that revealed the absence of significant difference between rural and urban students in which both students belonging to urban and rural areas obtained equal scientific aptitude.

5.2. RECOMMENDATIONS

On the basis of the findings of the present study the following recommendations are made:

1. The present study results in slightly low level of scientific aptitude among science students of higher secondary schools within Aizawl district. Therefore, adoption of modern and innovative scientific methods of teaching in the classrooms by teachers is strongly recommended in order to develop higher aptitude in science among the students.
2. It is recommended that all teachers teaching science subject in school must have minimum qualification prescribed by the National Council for Teacher Education (NCTE) and must possessed professional qualification in teaching.
3. Scientific aptitude test must be conducted as far as possible for admission into higher secondary level of science education. This will help in reducing the practice of forcing learners who excel in their matriculation to simply opt for science stream without proper knowledge about their aptitude in science.
4. At the time of admission to higher secondary level of science education, proper guidance must be given to the students in choosing the different subjects in science stream.
5. Activity based learning must be encouraged in science education in order to enhance students' critical thinking and scientific aptitude.
6. Schools must be equipped with better infrastructure in terms of buildings, classrooms, laboratories, and equipment as well as qualified/trained teachers.
7. Educational programs like science fairs, science exhibitions, science congress etc. must be introduced and organized in schools so that students will have better opportunity to engage in science related activities and gain more

knowledge thereby increasing their interest in science as well as overall learning.

5.3. SUGGESTIONS FOR FURTHER STUDIES

From the findings of the present study the following suggestions are made for further studies and researches in the field:

1. The present study deals with the study of students' scientific aptitude within Aizawl district only. So it is suggested that comparison of students' scientific aptitude among different districts of Mizoram can be conducted.
2. The scientific aptitude of students of other levels of education i.e. primary to college level can be studied.
3. Further studies regarding the relationship between student's scientific aptitude with other variables like achievement in other school subjects, parents' occupation, parents' educational qualification, home environment of the students can be conducted.
4. A study on the influence of learning styles and problem solving ability of students on their scientific aptitude can be conducted.
5. A study can be conducted to investigate the relationship between intelligence and scientific aptitude of students.
6. The quality and attitude of teachers play an important part in imparting and promoting the scientific aptitude of students. Therefore a study on science teachers' attitude towards science and science teaching may be conducted.
7. A study can be further taken up to analyze the effect of different teaching methods on the scientific aptitude of students.
8. A study can be conducted to explore the role of different educational programmes to promote the scientific aptitude of students.
9. Construction and standardization of more scientific aptitude test may be conducted for students of different educational levels in English and Mizo languages.

CHAPTER VI

SUMMARY AND CONCLUSON

This chapter deals with brief introduction, restatement of the problem followed by objectives of the study, research questions, hypotheses and methodology of the study with the major findings. It also includes the conclusion made on the basis of the findings of the study.

6.1. SUMMARY

6.1.1. INTRODUCTION

Science education imparts training in the scientific method and develops scientific aptitude which is very important in helping the children to have higher achievement in science. An individual with high aptitude towards science will have the capability to perform better in science and this will help in choosing the right path and selecting a career.

Science as a subject of study is often assumed to be much tougher and vaster as compared to the other streams of study, especially in Mizoram. With the growing number of students opting for science subject at the higher secondary level, it has become crucial to create awareness on the importance and significance of scientific aptitude and the impact that it could have on the future endeavor of an individual.

Aptitude is the innate or acquired capacity, capability, ability to do something, in other words, talent. It can be understood as a person's readiness or quickness in learning. It also refers to the state of being apt or in other words special fitness in doing things. So aptitude can be referred to those qualities showing one's way of behavior which serve to specify how good he is in encountering and solving different kinds of problems. For example, if a person has an aptitude for teaching, it means that that person has the capacity or ability to acquire proficiency in teaching under appropriate condition. Similarly if an individual has an aptitude for science, his present condition or ability reveals that if he were to take up science subject he would excel in the subject which leads to better achievement in his studies. In this way the knowledge of aptitude helps in prediction of future success of an individual,

in a particular area of activity, under suitable training or experiences. Aptitude tests are used to estimate the extent to which an individual would benefit from a specific course or training. For example, a scientific aptitude test would be able to indicate whether a student would do well as a science student after appropriate training and with the right motivation.

According to Rao (1996; as cited in Naresh & Upadhyaya, 2017, p. 79), scientific aptitude means ability in science according to some hereditary and environmental determinants. Therefore a person's future accomplishment in science can be predicted through these abilities. The determinants of scientific aptitude can be of different types including motivation, factors like socioeconomic and cultural background as well as persistence in learning science. Developing scientific aptitude amongst young people should be the major aim of science teaching and education. The knowledge of science and deeper understanding of science can completely change the mind-set and attitude of child. Effective teaching in science in order to develop scientific aptitude in children can bring about the desirable changes in the child. School is the only institution where children can be trained to develop this aptitude. Science teaching is not just a simple presentation of facts, in certain; it helps in development of new ways of thinking. This development reveals in itself increased skills, improvement in characters and desirable aptitudes.

Scientific aptitude test, which is the main focus for the present study, is an example of specialized aptitude tests and it is designed to test the individual's potential and capacity in the area of science. This kind of aptitude test is administered to determine if an individual possess the skills to excel in science subject or how skilled and knowledgeable the person is at science. It reveals whether or not a person has the potential to encounter the problems of science. Thus scientific aptitude test can be understood as a tool to determine the probability of success in science and science related subjects. It also helps in measuring the students' abilities in science. These are of great importance for the students studying in school or those who want to choose their career.

Scientific aptitude tests are important for having better knowledge of strengths and weaknesses of the learners. Knowledge of one's strengths and weaknesses in the subjects is very important step in learning. Without it, students

cannot know if they are leading the right path or not. Scientific aptitude test is one reliable tool for children and parents as well as the teachers to have a better understanding of the students' strengths and weaknesses in science. Accordingly, the results of the tests will provide parents and teachers with better understanding of the students' abilities and condition in science. In this ways necessary actions can be taken by the parents and teachers in developing and improving the scientific aptitude of the students. Moreover the scientific aptitude tests are also useful for professional development of students and also help in highlighting the hidden talents of children.

Many factors can be found to be responsible for influencing students' scientific aptitude including gender, parental and teachers' influence, curricula, cultural, regional, availability of infrastructures and other variables. Therefore, keeping in mind these factors and the multifaceted possibilities of creating awareness, generating new knowledge and providing information that would be useful for further studies etc., the present study aims to analyze the Scientific Aptitude of Higher Secondary School Science Students in Aizawl district.

6.1.2. RATIONALE OF THE STUDY

Science education has been playing one of the major roles in the school curriculum as one of the school subjects for the preparation of the learner. As stated by the UNESCO, science has a specific role, as well as a variety of functions for the benefit of the society: creating new knowledge, improving education, and increasing the quality of every life. Therefore science contributes significantly for the development of nation and prepares the learner to lead a quality life as an intellectual citizen. Teaching of science imparts training in the scientific method and develops scientific aptitude which is very important in helping the children to have higher achievement in science. An individual with high aptitude in science will have the capability to perform better in science and this will help in choosing the right path and selecting a career. A student who is scientific minded and has aptitude for science is curious to solve problems, curious to know things and raise significant questions with reference to observed phenomenon. Therefore it is quite obvious that the scientific aptitude predicts the achievement in science and interest in science education.

Science as a subject of study is often assumed to be much tougher and vaster as compared to the other streams of study, especially in Mizoram. With the growing number of students opting for science subject at the higher secondary level, it has become crucial to create awareness on the importance and significance of scientific aptitude and the impact that it could have on the future endeavors of every individual. This study attempts to reveal the scientific aptitude of science students which is highly expected to derive findings that would be useful for students, parents and teachers and create awareness in future students to give importance to aptitude before choosing their streams of study. The study is also considered to be a potential generation of information that could be used for further studies where the determinants as well as impact of scientific aptitude could be taken up.

The researcher is interested to conduct this study since it will reveal the true potential of science students in Aizawl district. This is important to tackle the practice of forcing learners who excel in their matriculation to simply opt for science stream without proper knowledge about their potential, interest or of their aptitude in total. The researcher also feels that the findings of this study will enable the parents and the caretakers as well as the teachers to provide guidance and would enable the students to be aware of their own potential and have an impact on the career choices in the future. The findings of this study will also provide an answer to several underlying questions and misconceptions about the subject of science. With the help of this study, the teachers can also plan their interventions appropriately to suit the need of all students with different levels of scientific aptitude.

Moreover, scientific aptitude in the field of education is an area of study that has not been widely studied, especially among the science students of Aizawl. So, the researcher is eager to conduct this study that can enrich the field of research. Therefore the multifaceted possibilities of creating awareness, generating new knowledge and providing information that would be useful for further studies etc. has compelled the researcher to take up this study. A reliable finding generated from this study can prove useful not only on planning the current learning experiences for the students based on their ability and aptitude, but it will also help the teachers and parents to provide accurate and meaningful guidance for further studies and future career. This study will, therefore, pave the way for a more meaningful and directive

academic endeavor for the science students of Aizawl district. Thus, the researcher, with a view to improve science education by creating awareness about scientific aptitude that can have a huge impact on the academic life of students has decided to conduct an in-depth study on the scientific aptitude of higher secondary science students in Aizawl district.

6.1.3. STATEMENT OF THE PROBLEM

The problem of the present study is stated as, ***"A Study on the Scientific Aptitude of Higher Secondary School Science Students in Aizawl District."***

6.1.4. RESEARCH QUESTIONS

The following research questions are formulated for the present study.

1. What is the level of scientific aptitude of higher secondary school science students in Aizawl district?
2. Is there any significant difference between the scientific aptitude of higher secondary school science students of Aizawl district with respect to gender?
3. Is there any significant difference between the scientific aptitude of higher secondary school science students of Aizawl district with respect to type of school management?
4. Is there any significant difference between the scientific aptitude of higher secondary school science students of Aizawl district with respect to locale?

6.1.5. OBJECTIVES OF THE STUDY

The objectives of the present study are as follows:

1. To find out the level of scientific aptitude of higher secondary school science students in Aizawl district.
2. To compare the scientific aptitude of higher secondary school science students of Aizawl district with respect to gender.
3. To compare the scientific aptitude of higher secondary school science students of Aizawl district with respect to type of school management.
4. To compare the scientific aptitude of higher secondary school science students of Aizawl district with respect to locale.

6.1.6. HYPOTHESES OF THE STUDY

The following hypotheses for the present study are highlighted as follows.

1. There is no significant difference between boys and girls with respect to their scientific aptitude.
2. There is no significant difference between government and private higher secondary school science students with respect to their scientific aptitude.
3. There is no significant difference between private and deficit higher secondary school science students with respect to their scientific aptitude.
4. There is no significant difference between government and deficit higher secondary school science students with respect to their scientific aptitude.
5. There is no significant difference between rural and urban higher secondary school science students with respect to their scientific aptitude.

6.1.7. METHODOLOGY OF THE STUDY

The present study adopted a descriptive survey method to study and inquire the students' aptitude in science. Quantitative type of research was also adopted as the data were collected and analyzed quantitatively.

The population of the study included all the science students reading inhigher secondary schools in Aizawl city.

The sample of the study consisted of 325 students comprising of 188, 61 and 76 students from private, government and deficit higher secondary schools respectively. The technique used for selecting the sample was Stratified Random Sampling technique and the sample was selected from each stratum proportionately.

Scientific aptitude scores of science students of government, private and deficit higher secondary schools within Aizawl district were investigated and Science Aptitude Test (SAT-NS) developed by Dr. Nagappa. P. Shahapur, Dharwad and Dr. C. R. Rao, Bijapur was used for measuring the students' scientific aptitude. Data analysis was performed by using percentage method for finding out the different levels of students' scientific aptitude and other statistical technique like t-test to test hypotheses.

6.1.8. FINDINGS OF THE STUDY

The overall level of scientific aptitude of higher secondary school science students of Aizawl district was 'Average.' Out of 325 students, majority of the students (73%) were found possess average level of scientific aptitude. 18.15% of the students were found to have above average level of scientific aptitude. Only 8.92% were found to have below average level of scientific aptitude. There were no students having high or low level of scientific aptitude.

In the comparison of scientific aptitude based on gender it was found that there were 164 boys and 161 girls. Out of 164 boys, 73.7% were found to have average level of scientific aptitude. A good number of them possessed above average level of scientific aptitude but only 6.09% were found to have below average level of scientific aptitude. Out of 161 girls, 72.04% were found to have average level of scientific aptitude. Small number of the girls was found to be in the above average level category of scientific aptitude and only 11.8% of the girls scored below average level of scientific aptitude. In the meantime, when comparison was made between the two groups by applying t-test it was revealed that no significant difference was found between the scientific aptitude of boys and girls.

When comparison was made on the scientific aptitude of students based on type of school management it was found that there were 61, 188 and 76 students from government, private and deficit higher secondary schools respectively. Out of 61 government school students it was found that a large number of the students i.e. 55.38% were found to have average level of scientific aptitude, a good number of students i.e. 30.76% obtained above average level of scientific aptitude but only 7.6% students showed below average level of scientific aptitude.

From 188 private higher secondary school science students, it was found that majority of the students i.e. 72.87% possessed average level of scientific aptitude while very few were having above average level and below average level of scientific aptitude each. Out of 76 deficit higher secondary school students, majority of the students i.e. 85.5% were found to obtain average level of scientific aptitude and very few students i.e. 14.47% scored above average level of scientific aptitude while none of the students scored below average level of scientific aptitude.

It was also found that there existed significant difference between government and private higher secondary school science students where government school students have higher scientific aptitude than private school students. At the same time it was also found that there existed no significant difference between government and deficit higher secondary school science students as well as between private and deficit higher secondary school science students in their scientific aptitude.

When comparison was made on the scientific aptitude of students based on locale it was found that there were 170 urban students and 153 rural students. Out of the total rural students majority of the students (73.83%) were found to have average level of scientific aptitude, few students were having above average level of scientific aptitude and only 4.65% students were detected to have below average level of scientific aptitude. In the meantime among 153 rural students, a greater number (71.89%) possessed average level of scientific aptitude while only 14.37% were found to have above average level and at the same time 13.72% scored below average level of scientific aptitude. Moreover when t-test was applied to test if there was significant difference between the scores of the two groups it was found that there was an occurrence of significant difference between urban and rural students in their scientific aptitude where students coming from urban areas have higher scientific aptitude than students coming from rural areas.

6.2. CONCLUSION

Scientific aptitude is both inborn and acquired ability of an individual. It is a combination of characteristics of individuals that indicate their capacity to acquire some specific knowledge and skill in science. Scientific aptitude encompasses certain characteristics such as creative ability, capacity for critical thinking, level of intelligence, ability to see relationships, problem solving ability, suspended judgment, reasoning ability, and open-mindedness. An individual having high degree of scientific aptitude can understand the phenomena of nature and human behavior and develops special intellectual ability to comprehend scientific knowledge and understanding. All these qualities and features portray a person’s manner of behavior which serves to signify how well he can learn to encounter and solve different kinds of problems and lead a successful life.

The present study tests the scientific aptitude of higher secondary science students in Aizawl district and found that majority of the students have average level of scientific aptitude where boys and girls shows equal aptitude in science. The fact that students did not have above average or high level of scientific aptitude is unsatisfactory since all students under study are from science discipline only. The type of school and different components involved in the school was also found to have an influence in shaping and developing the scientific aptitude of students. It was also found that student's geographical background affects their level of scientific aptitude which clearly shows that there is lack of equal opportunity in education among students of different location within the state of Mizoram.

Science learning in schools engages students with exciting material and experiences and provides training in scientific methods thereby developing scientific aptitude of the mind in the learner. The school must realize the needs and interests of the child in developing scientific aptitude and promote science learning. Necessary steps and important measures may be taken by teachers to motivate their students in developing positive aptitude and attitude towards science. More steps may also be taken in order to aware the communities of geographically backward areas about the importance of science education and education in general for their children to have successful future.

APPENDICES

APPENDIX I

Scientific Aptitude Test

REUSABLE BOOKLET

OF

SCIENTIFIC APTITUDE TEST

SAT–NS

(English Version)

DR. NAGAPPA P. SHAHAPUR
DHARWAD
AND
DR. C. R. RAO
BIJAPUR

T. M. Regd. No. 564838
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PART–I

Following are the learning situations in brief. Some possible situations are given under. According to your understanding tick in the Answer Sheet for the suitable situation.

1. You like to study science from that science teacher who :

(a) Explains by writing on blackboard.

(b) Teaches by doing experiments himself.

(c) Who makes the students do experiments under his costody.

2. If you want to know about the characteristics of Hydrogen gas then what will you do ?

(a) We will take information about H_2 gas from our science teacher.

(b) We will try to get information about it by doing experiment ourself under the guidance of our science teacher.

(c) We will ask our classmate about it.

3. If you want to know about the cells of an onion, then what will you do ?

(a) We will ask our science teacher about it.

(b) We will get necessary information from some science book.

(c) We will see ourselves the cells onion by keeping it under the microscope.

4. While performing an experiment, if your physical balance suddenly gets disturbed then what will you do ?

(a) We will try to make it up by finding the reason for its' disturbance.

(b) We will tell our classmate about it.

(c) We will tell our science teacher about it.

5. If you want to find the melting point of pure glucose and you have some confusion due to different melting points then what will you do ?

(a) We will ask our chemistry teacher about it.

(b) We will consider the average of all the melting points as true value.

(c) We will find the melting point of it by an experiment.

PART–II

6. **A hunter finds 15 birds perching on a branch of a mango tree. He fires with his gun and 3 birds fell on the ground. How many birds are left sitting on the tree now ?**

   (a) 12 (b) 10
   (c) 8 (d) None

7. **A, B, C, D and E are 5 gases. Gas A is more poisonous than gas B, but less poisonous that gas D. Gas B is more poisonous than gas E and E is more poisonous that gas C. Which is most poisonous among all ?**

   (a) A (b) B
   (c) C (d) D

8. **Some elements are given in a series, according to some manner sodium element comes at 15th position from both the sides. How many elements are there in total ?**

   (a) 15 (b) 29
   (c) 30 (d) 31

9. **There are 4 rods made of copper, iron, graphite, and silver. Copper rod is smaller than iron rod, but is greater than graphite rod, silver rod is smaller than graphite rod. Which is smallest rod among all ?**

   (a) Copper rod (b) Iron rod
   (c) Graphite rod (d) Sliver rod

10. **If 2 hr and 15 min ago the hour hand of the watch was near 11 and minute hand was at 3, then what will be the time on the watch after 1 and half an hour.**

    (a) 1 : 15 (b) 2 : 30
    (c) 3 : 00 (d) 3 : 15

11. **How many times does 5 comes in the counting, when we count from 1 to 100 by hand ?**

    (a) 10 (b) 11
    (c) 19 (d) 20

12. **A, B, C and D are 4 elements. Atomic weight of A is greater than At. weight of B. At. weight of C is greater than atomic weight of D but less than At. weight of B. Which element has the highest At. weight ?**

    (a) A (b) B
    (c) C (d) D

13. Which of the following alphabet reflects as it is in a plane mirror ?

(a) N (b) I
(c) L (d) C

14. A boat is moving north ward with a speed of 10 miles/hr. Suddenly a wind starts blowing with a speed of 10 miles/hr in eastern direction. Now the boat will travel :

(a) in the north-east direction with the uniform speed
(b) in the north-east direction with the uniform acceleration
(c) wind will not have any effect on the speed of the boat
(d) boat will come to rest

15. When we subject an atomic gas into an electric field :

(a) atoms will gain the charge (b) atoms will loose the charge
(c) electrons get excited (d) no effect of electric field

Given are the sets with 4 related terms. Identify the fourth related term.

16. Velocity Acceleration Force ?

(a) Pressure (b) Displacement
(c) Work (d) Power

17. Meter Kilometer Millimeter ?

(a) Grams (b) Seconds
(c) Centimeter (d) Dyne

18. Red Blue Violet ?

(a) White (b) Gray
(c) Black (d) Green

19. Convex lens Concave lens Plano convex lens ?

(a) Virtual (b) Real
(c) Inverted (d) Concavo convex

Study the relationship between the first two words and find the fourth word related to third word.

20. Carbohydrates : Energy : : Proteins : ?

(a) Growth (b) Weight
(c) Height (d) Disease

21. Liver : Digestion : : Kidney : ?

(a) Respiration (b) Reproduction
(c) Circulation (d) Excretion

Pick out the add man out.

22. (a) Capillary (b) Ureter
(c) Vein (d) Artery

23. (a) Gallbladder (b) Stomach
(c) Intestine (d) Kidney

24. **It is dangerous to be under the tree at night because :**
(a) There is drak and no photosynthesis takes place
(b) Plants release CO_2 at night
(c) We feel suffocated
(d) Plants release excess O_2

25. **A doctor prescribes soyabean stuffs to a thin and weak person because it contains :**
(a) Proteins (b) Fats
(c) Carbohydrates (d) It is cheaper

PART–III

Following are sets in which 3 sentences are given in each set. Write if the last sentence of each set gives logical or illogical conclusion. Mark A if it is logical and mark B if it is illogical in the Answer Sheet.

26. (a) Magnet attracts magnetic objects towards it.
(b) If abonite rod is rubbed with skin of cat, then small pieces of paper are attracted towards it.
(c) It means abonite rod is also a magnet.

27. (a) Metals have shine and they are good conductors of electricity.
(b) Graphite has a shine and passes electricity through it.
(c) It means graphite is also a metal.

28. (a) Those substances in which heat cannot easily be passed are called bad conductor of heat.
(b) When a huge piece of ice is wrapped with husk or wood powered, then the ice does not melt for a long time.
(c) Husk or wood powder is a bad conductor of heat.

29. (a) Some gases are so poisonous that living beings when they breathe in cannot survive.
(b) If there is only nitrogen in atmosphere, then living beings cann't survive.
(c) It means nitrogen is a poisonous gas.

30. (a) Acids react with alkalis to produce salt and water.
(b) Acetic acid reacts with an alkali, hence it is an acid.
(c) Methyl alcohol does not react with alkali, hence it is not an acid.

31. (a) Radiant heat passes from one object to another without heating its medium.
(b) Heat from sun reaches us by radiant process.
(c) It means radiant heat can also pass through vaccum.

32. (a) Objects contract on cooling—their volume decreases.
(b) Objects expand on heating—their volume increases.
(c) It means when ice is made by cooling water it's volume decreases and when it melts it's volume increases.

33. (a) All carnivores are healthy.
(b) All carnivores eat flesh.
(c) Flesh is good for health.

34. (a) All oily substances have more fats.
(b) People prefer to buy food containing fats.
(c) People are willing to become fatty.

35. (a) A cell divides into two cells—mitosis.
(b) A cell forms 4 gametes—meiosis.
(c) Two gametes can form a cell.

PART–VI

Suppose the length of a root and stem of a neem tree have been as followed :

Length of Root	Length of Stem
6 cm	12 cm
9 cm	18 cm
12 cm	24 cm
24 cm	48 cm

36. If increase in the length of root and stem continuous and the length of the roots becomes 25 cm. What will be the length of the stem ?

(a) 25 (b) 50
(c) 75 (d) 100

37. If length of the root is denoted by R and the length of stem is denoted by S, then based on the given values deduce an algebraic expression.

(a) $R \propto S$ (b) $R \propto 1/S$
(c) $R = S$ (d) $R \neq S$

When a force of 500 dyne is applied for 5 second on objects of different masses the acceleration produced is

Masses of Object	*Acceleration Produced*
10 gm	50 cm/sec
20 gm	25 cm/sec
25 gm	20 cm/sec
50 gm	10 cm/sec
500 gm	1 cm/sec

38. Based on the above data calculate the acceleration produced by an object whose mass is 1 kg ?

(a) 1 (b) 1.5
(c) 0.5 (d) 2

39. If the mass of on object is denoted by m and acceleration denoted by a, then express the relationship of the two in an algebraic fashion.

(a) $m \propto a$ (b) $m \propto 1/a$
(c) $m = a$ (d) $m \neq a$

In an Ohm's law experiment the voltage, current variations were recorded as under :

Voltage in Volts	*Current in Amps*
0.15	0.05
0.30	0.10
0.42	0.14
0.84	0.28
0.90	0.30

40. Calculate the resistance of the conductor in ohms.

(a) 6 (b) 3
(c) 9 (d) 10

PART–V

I. Read the following passage carefully and answer the following items in the Answer Sheet :

Great scientist Sir Newton while lying on the bed under an apple tree observed that an apple fell from the tree on to the ground. His mind started thinking why it was so and not going upward. This theory of Newton was then came out as Newton's gravitational law. According to this law, $F = G \frac{m_1 \times m_2}{d^2}$ here every symbol has its own meaning, G is called universal gravitational constant. Gravitational force is that force due to which two bodies on earth are attracted towards each other. Gravity also is a force. Due to this force, earth attracts any object towards it. When an object is freely falling from some height towards earth, some acceleration is produced. This type of acceleration is called acceleration duw to gravity. It is denoted by 'g'. Now it is clear that earth attracts every object towards its center but still we have doubt that objects having more weight fall on the ground earlier than bodies having less weight. In 1590 Galileo proved this fact and said that if two objects made of same matter and have different masses. Both will reach the ground at the same time during their free fall.

41. Which is true among the following :

(a) The force with which the earth attracts any other objects towards it is called gravity.
(b) The force with which one body attracts other body towards it is called gravity.
(c) The force with which sun attracts the earth is called gravity.

42. Identify the symbol for gravitational constant :

(a) g (b) G
(c) a

43. From a height of 40 mt two stones weighing 50 kg and 10 kg are dropped in a state of free fall. Which stone will reach the ground first ?

(a) 10 kg stone (b) 50 kg stone
(c) both reach at the same time

II. The equivalent weight of an element is the number of parts by weight of it which combines with or displaces 1.008 parts by weight of hydrogen or 8 parts by weight of oxygen or 35.5 parts by weight of chlorine.

For example, the formula of Magnesium oxide is MgO. Here one atom of magnesium and oxygen combine. Therefore weight ratio is Mg : O is 24 : 16. So the number of parts by weight of Mg that combines with 8 parts by weight of O is $24/16 \times 8 = 12$. Equivalent weight does not possess any units since it is a relative number. Based on the given illustration, pick out the correct choice.

44. In CO_2, what is the equivalent weight of carbon (atomic weight of carbon is 12) ?

(a) 3 (b) 6
(c) 12 (d) 32

45. In CaO, what is the equivalent weight of calcium (atomic weight of Ca = 40) ?

(a) 20 (b) 20 gm
(c) 40 gm (d) 40

PART–VI

46. Who among the given was a scientist ?

(a) Lakshmi Bai (b) Madam Curie
(c) Florence Nightingale (d) Sarojini Naidu

47. Which object is used to measure Atmospheric Pressure ?

(a) Calorimeter (b) Thermometer
(c) Barometer (d) Lactometer

48. Which one represents Velocity correctly ?

(a) 60 km (b) 60 km/h
(c) 60 km/h due North (d) 60 km/h^2

49. Which one among the given is a scalar quantity ?

(a) Velocity (b) Displacement
(c) Momentum (d) Speed

50. Which liquid is used in Fortein's Barometer ?

(a) Mercury (b) Alcohol
(c) Water (d) Milk

51. If a body is taken upward from a deep mine, then

(a) It's mass will increase (b) It's mass will decrease
(c) It's weight will decrease (d) It's weight will increase

52. Liquids exert pressure equally on all the sides. This principle is known as

(a) Archimedes principle (b) Pascal's law
(c) Boyle's law (d) Avogadro's principle

53. A pencil immersed in water appears to be broken, why ?

(a) Due to reflection of light (b) Due to refraction of light
(c) Due to reflection and refraction of light
(d) Due to inner reflection of light

54. In which type of medium, velocity of sound is least ?

(a) Air (b) Vacuum
(c) Water (d) Alcohol

55. At what temperature water can remain in both solid as well as in liquid state ?

(a) –50°C (b) 0°C
(c) 0°F (d) 100°C

56. Identify the king of chemicals among the given

(a) HCl (b) HNO_3
(c) H_2SO_4 (d) CH_3COOH

57. Among the given which gas is the lightest ?

(a) SO_2 (b) CO_2
(c) N_2 (d) NH_3

58. Which of the following metal in its reaction with cold water produces hydrogen ?

(a) Zn (b) Na
(c) Fe (d) Mg

59. Which of the following word represents chemical compound ?

(a) Symbol (b) Formula
(c) Equation (d) Radical

60. Which of the following substance produces heat when added to water ?

(a) NaCl (b) NaOH
(c) NH_4OH (d) NH_4Cl

61. Which compound of silver is used in photography ?

(a) Silver nitrate (b) Silver bromide
(c) Silver acetate (d) Silver sulphide

62. Which of the following is a process for preparation of nitric acid on industrial scale ?

(a) Contact process (b) Ostwald' process
(c) Haber' process (d) Lead chamber process

63. Which of the following is mineral acid ?

(a) Sulphuric acid (b) Tartaric acid
(c) Acetic acid (d) Citric acid

64. Which of the following has high solubility in water ?

(a) NaCl (b) Na_2SO_4
(c) Na_2CO_3 (d) $NaHCO_3$

Given are set of 5 substances in which 4 substances are like and one is different. Pick out that different substance.

65. (a) HCl (b) H_2SO_4
(c) H_2CO_3 (d) HNO_3
(e) NaOH

66. (a) Cl (b) Br
(c) I (d) He
(e) F

67. (a) Na (b) K
(c) U (d) Ca
(e) Mg

68. Which one of the following has only one species living on the earth ?

(a) Bacteria (b) Virus
(c) Man (d) Insect
(e) Reptile

69. Which one of the following is considered as having most specialized brain ?

(a) Fox (b) Elephant
(c) Dog (d) Ape
(e) Man

70. Vaccination helps to prevent the spread of small pox by

(a) Destroying the germs in the body (b) Increasing the WBC
(c) Adding antibodies (d) Increasing RBC

PART–VII

71. **To 1/3rd weight of a person if we add 60 kg, we get his weight what is the weight of the person in kg ?**

(a) 63 (b) 80
(c) 90 (d) 100

72. **If two hens lay two eggs in two days, then how many eggs will be laid by the six hens in six days ?**

(a) 12 (b) 18
(c) 24 (d) 36

73. **Find a number which when we divide by 4 and substract 6, get the same result**

(a) 6 (b) 8
(c) 10 (d) 24

74. **Convert – 20° C to Fahrenheit scale by using °C/5 = (F – 32)/9**

(a) 68° (b) 66°
(c) 70° (d) 64°

75. **A person goes from city A to city C which is situated at a distance of 120 km at an average velocity of 60 km/hr. On the way when he reaches city B he stops there to fill petrol in his car. Then travelling a distance of 15 km from city B he remembers that the has left his bag near the petrol pump at city B. Then with an average velocity of 60 km/hr. he goes back to city B and after getting his bag he reaches city C. Find out the total time taken during the hole journey ?**

(a) 2 hr (b) 2 hr 15 min
(c) 2 hr 50 min (d) 2 hr 30 min

76. **The distance between the two cities X and Y is 180 km. A bus starts from city X and travels towards city Y with an average velocity of 60 km/hr. After 50 min a car starts from city X and travels towards city Y with an average velocity of 80 km/hr, which among the two will reach the city Y first and by how much time ?**

(a) Bus : 5 min (b) Car : 5 min
(c) Car : 10 min (d) both reach at the same time

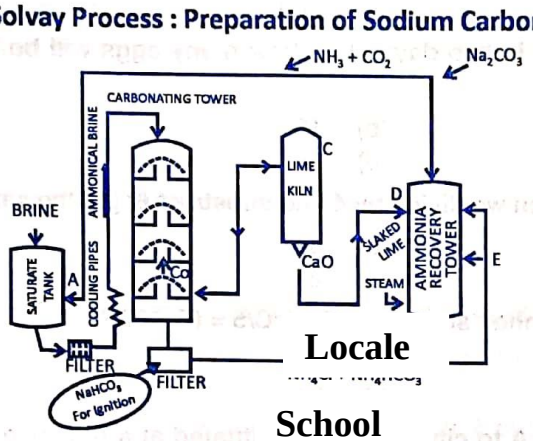
77. **The distance between a neem tree and mango tree is 80 mt. A body starts walking towards the mango tree from the neem tree with a uniform velocity of 25 mt/min. At the same time another boy starts walking towards the neem tree from the mango tree with a uniform velocity of 15 mt/min. At what distance from the neem tree both the boys will meet and after how much time.**

(a) 50 mt; 2 min (b) 30 mt; 1 min
(c) 40 mt; 1 min (d) 65 mt; 2 min

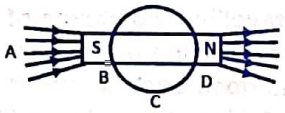
PART–VIII

In the below given three sketches identify the structural defects and mark your answer

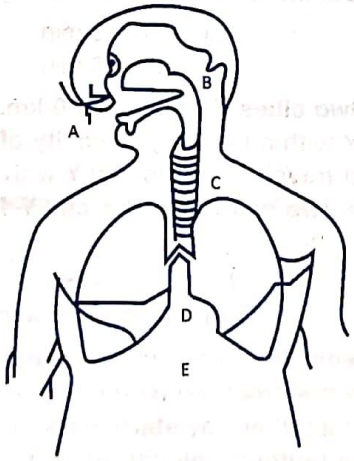
78.



79. **Magnetic Field Lines Around a Bar Magnet**



80. **Human Respiratory System**



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APPENDIX II

Answer Sheet of Scientific Aptitude Test

ANSWER SHEET

of

S A T-NS

(English version)

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Dr. Nagappa P. Shahapur *(Dharwad)*

Dr. C. R. Rao *(Bijapur)*

Please fill up the following informations :–

Name.....

Age..... **Permanent Address** .....

Sex.....

Class.....

Parent's Education.....

INSTRUCTION

. There are some statement in this test. Each statement have three or five alternative answer, marked as A, B, C, D, E are given, out of which only one is correct and the candidate has to record his / her choice of right answer on a separate answer sheet by blackening the respective circle.

Estd. : 1971 **☎ : (0562) 2464926**

NATIONAL PSYCHOLOGICAL CORPORATION

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◉ Check

Q. No.	A	B	C	D	E	Q. No.	A	B	C	D	E	Q. No.	A	B	C	D	E
1.	☐	☐	☐	☐	☐	28.	☐	☐	☐	☐	☐	55.	☐	☐	☐	☐	☐
2.	☐	☐	☐	☐	☐	29.	☐	☐	☐	☐	☐	56.	☐	☐	☐	☐	☐
3.	☐	☐	☐	☐	☐	30.	☐	☐	☐	☐	☐	57.	☐	☐	☐	☐	☐
4.	☐	☐	☐	☐	☐	31.	☐	☐	☐	☐	☐	58.	☐	☐	☐	☐	☐
5.	☐	☐	☐	☐	☐	32.	☐	☐	☐	☐	☐	59.	☐	☐	☐	☐	☐
6.	☐	☐	☐	☐	☐	33.	☐	☐	☐	☐	☐	60.	☐	☐	☐	☐	☐
7.	☐	☐	☐	☐	☐	34.	☐	☐	☐	☐	☐	61.	☐	☐	☐	☐	☐
8.	☐	☐	☐	☐	☐	35.	☐	☐	☐	☐	☐	62.	☐	☐	☐	☐	☐
9.	☐	☐	☐	☐	☐	36.	☐	☐	☐	☐	☐	63.	☐	☐	☐	☐	☐
10.	☐	☐	☐	☐	☐	37.	☐	☐	☐	☐	☐	64.	☐	☐	☐	☐	☐
11.	☐	☐	☐	☐	☐	38.	☐	☐	☐	☐	☐	65.	☐	☐	☐	☐	☐
12.	☐	☐	☐	☐	☐	39.	☐	☐	☐	☐	☐	66.	☐	☐	☐	☐	☐
13.	☐	☐	☐	☐	☐	40.	☐	☐	☐	☐	☐	67.	☐	☐	☐	☐	☐
14.	☐	☐	☐	☐	☐	41.	☐	☐	☐	☐	☐	68.	☐	☐	☐	☐	☐
15.	☐	☐	☐	☐	☐	42.	☐	☐	☐	☐	☐	69.	☐	☐	☐	☐	☐
16.	☐	☐	☐	☐	☐	43.	☐	☐	☐	☐	☐	70.	☐	☐	☐	☐	☐
17.	☐	☐	☐	☐	☐	44.	☐	☐	☐	☐	☐	71.	☐	☐	☐	☐	☐
18.	☐	☐	☐	☐	☐	45.	☐	☐	☐	☐	☐	72.	☐	☐	☐	☐	☐
19.	☐	☐	☐	☐	☐	46.	☐	☐	☐	☐	☐	73.	☐	☐	☐	☐	☐
20.	☐	☐	☐	☐	☐	47.	☐	☐	☐	☐	☐	74.	☐	☐	☐	☐	☐
21.	☐	☐	☐	☐	☐	48.	☐	☐	☐	☐	☐	75.	☐	☐	☐	☐	☐
22.	☐	☐	☐	☐	☐	49.	☐	☐	☐	☐	☐	76.	☐	☐	☐	☐	☐
23.	☐	☐	☐	☐	☐	50.	☐	☐	☐	☐	☐	77.	☐	☐	☐	☐	☐
24.	☐	☐	☐	☐	☐	51.	☐	☐	☐	☐	☐	78.	☐	☐	☐	☐	☐
25.	☐	☐	☐	☐	☐	52.	☐	☐	☐	☐	☐	79.	☐	☐	☐	☐	☐
26.	☐	☐	☐	☐	☐	53.	☐	☐	☐	☐	☐	80.	☐	☐	☐	☐	☐
27.	☐	☐	☐	☐	☐	54.	☐	☐	☐	☐	☐						

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Answer Sheet of Scientific Aptitude Test (SAT-ne) English Version

APPENDIX III

Proof Document of Plagiarism Check

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APPENDIX IV

Certificate of Paper Presentation in National Webinar

MIZORAM EDUCATIONAL FOUNDATION

CERTIFICATE

This is to Certify that ***Ms. Rebeck Lalrinpuii,*** Research Scholar, Institute of Advanced Studies in Education, Aizawl, has presented a paper titled "***Gender Difference on the Scientific Aptitude of Higher Secondary School Science Students in Aizawl City***" in the Two Day National Webinar on '***Contemporary Issues and Trends in Indian Education – II***', Organized by Mizoram Educational Foundation on 18th and 19th November, 2020.

(Dr.LALZARMAWII)
Gen. Secretary

(Prof. LALBIAKDIKI HNAMTE)
President

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A STUDY ON THE SCIENTIFIC APTITUDE OF HIGHER SECONDARY SCHOOL SCIENCE STUDENTS IN AIZAWL DISTRICT

ABSTRACT

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ABSTRACT

INTRODUCTION

Education is one of the most important factors for the development of a country. It is a tool to improve and change one's life which further leads to development and improvement of a country. Countries with higher literacy rates also tend to be in better economic situations. Likewise, India has always put focus on increasing the literacy rate of a country since its independence (Bhagat, 2017). The government of India carries out and operates many programs to improve different levels of education. Education is the influence of the environment on the individual with a view of producing a permanent change in his habits or behavior, or of thought and attitude (Thompson, n.d., as cited in Sodhi, 2017). Through education society passes along its accumulated knowledge, values and skills from one generation to the next. Education plays an important role in a country's economic, political, cultural, science and technological growth.

In today's world, scientific advancement leads to rapid economic development, technological and societal progress. Every citizen has to have knowledge of science for effective living. As science is intertwined with everyday life one cannot survive and lead a successful life without science. That is why an individual must be acquired with adequate knowledge of science to enjoy material happiness (Roy and Goel, 2018, p. 399). The knowledge of science provides the ability to reflect aspects of validity and reliability which ordinary knowledge cannot bring about. It is a logically related and clearly arranged knowledge of items about which any one can experiment and apply tests for validity and reliability. Science is the systematic knowledge of a particular thing. The principles of science are clear, definite, broad-based, valid, pure, real and reliable in all respects.

The term 'Science' usually refers to a way of pursuing knowledge, not just the knowledge itself. The word 'Science' is taken from Latin word 'Scientia' which means 'Knowledge'. The Columbia Encyclopedia defines science as "An accumulated and systematized learning, in general usage restricted to natural phenomena." According to Oxford English Dictionary, "Science is mainly about the

phenomena of the material world. Science fills and replenishes our minds with curiosity and at the same time, understanding and the inclination to answer or solve various problems."

Science is an accumulated and systemized learning in general usage restricted to natural phenomena. The progress of science is marked by the emergence of scientific method and of the scientific attitude (Sharma, 1990).

Anuraba and Krishnamurthy (2019) presented a three-fold nature of science as; a body of knowledge, a method of inquiry, a way of investigating and an attitude towards life, a way of thinking.

Science as one of the subjects of study in education bears its place in the process of teaching and learning accordingly with other subjects. Science is an integrated curriculum that includes Chemistry, Physics, Biology and Mathematics in the form of general principles. Since the general principles of science are linked to the everyday experiences of all the children, this integrated curriculum is compulsory for all children.

Science is an important subject in the curriculum which lays an important part of foundation for education for all children (Das et al., 2014, p. 15). Science should continue to be encouraged and supported in schools and not marginalized by trendy topics that encompass the curriculum. Scientific concepts typically proceed with an idea followed by an experiment to prove that idea through scientific methods and analysis. It exhibits a logical way of approaching unfamiliar topic by making certain that students can learn how to perform practical and theoretical work. In this ways it proves that science enhances critical thinking and helps in cultivation of a passion for learning. It nourishes the children with natural curiosity and encourages them to venture in the fields of science and technology.

Science elevates many disciplines. For one to understand science, a reasonable understanding of other disciplines and area of study is required. For instance, the knowledge of mathematical concepts is a fundamental prerequisite which can be of use for qualitative and quantitative analysis. Moreover, science holds the key to future and opens numerous career opportunities for the youth. Ultimately one of the main reasons why students go to school is to enrich themselves

with knowledge and prepare themselves in finding a good job. Through the enhancement of logic and mathematics based skill, students with science background are able to explore enormous opportunities ahead of them. These account for professions both within and outside of scientific fields, extending to related fields such as engineering, information technology (IT), business and healthcare.

Children and adolescents receive science education at school and participate in science related activities such as various workshops, projects, camps, fairs and exhibitions. Along with these, students can gain better chance to develop cognitive skills and problem solving with better understanding the construction of knowledge and the scientific processes. These skills help them to manage themselves better in the present society. Science education can also generate an interest in university studies and increase their positive attitude towards science in society (Timonen, 2020, para. 4).

The knowledge of science is essential in supporting the daily lives of every human being. The ways and means of life on earth have been changing rapidly with the progress in science. An individual without scientific aptitude finds it hard to adjust himself to this unstable situation. But, an individual with scientific aptitude can easily make use of his knowledge in science for solving different problems in his daily life and make his life happier and comfortable. Hence science must be taught from young age and the traditional responsibility for strengthening the young to develop scientific aptitude lies with the education system so that the new generation leads better and comfortable ways of living in the world of science.

Scientific aptitude test, which is the main focus for the present study, is a kind of aptitude test and it is designed to test the individual's potential and capacity in the area of science. This kind of aptitude test is administered to determine if an individual possess the skills to excel in science subject or how skilled and knowledgeable the person is at science. Scientific aptitude tests are important for having better knowledge of strengths and weaknesses of the learners. Knowledge of one's strengths and weaknesses in the subjects is very important step in learning. Without it, students cannot know if they are leading the right path or not. Scientific aptitude test is one reliable tool for children and parents as well as the teachers to have a better understanding of the students' strengths and weaknesses in science.

Accordingly, the results of the tests will provide parents and teachers with better understanding of the students' abilities and condition in science. In this ways necessary actions can be taken by the parents and teachers in developing and improving the scientific aptitude of the students. Moreover the scientific aptitude tests are also useful for professional development of students and also help in highlighting the hidden talents of children.

Test of aptitude in science also helps in academic improvement of the students. The result of the scientific aptitude test directly reveals the level of strengths and weakness of the students. The students will therefore work on their weak points in order to have improvements. Thus it becomes easier for the students to boost the chances of success in the future.

Rationale of the study

Science education has been playing one of the major roles in the school curriculum as one of the school subjects for the preparation of the learner. As stated by the UNESCO, science has a specific role, as well as a variety of functions for the benefit of the society: creating new knowledge, improving education, and increasing the quality of every life. Therefore science contributes significantly for the development of nation and prepares the learner to lead a quality life as an intellectual citizen. Teaching of science imparts training in the scientific method and develops scientific aptitude which is very important in helping the children to have higher achievement in science. An individual with high aptitude in science will have the capability to perform better in science and this will help in choosing the right path and selecting a career. A student who is scientific minded and has aptitude for science is curious to solve problems, curious to know things and raise significant questions with reference to observed phenomenon. Therefore it is quite obvious that the scientific aptitude predicts the achievement in science and interest in science education.

Science as a subject of study is often assumed to be much tougher and vaster as compared to the other streams of study, especially in Mizoram. With the growing number of students opting for science subject at the higher secondary level, it has become crucial to create awareness on the importance and significance of scientific aptitude and the impact that it could have on the future endeavors of every

individual. This study attempts to reveal the scientific aptitude of science students which is highly expected to derive findings that would be useful for students, parents and teachers and create awareness in future students to give importance to aptitude before choosing their streams of study. The study is also considered to be a potential generation of information that could be used for further studies where the determinants as well as impact of scientific aptitude could be taken up.

The researcher is interested to conduct this study since it will reveal the true potential of science students in Aizawl district. This is important to tackle the practice of forcing learners who excel in their matriculation to simply opt for science stream without proper knowledge about their potential, interest or of their aptitude in total. The researcher also feels that the findings of this study will enable the parents and the caretakers as well as the teachers to provide guidance and would enable the students to be aware of their own potential and have an impact on the career choices in the future. The findings of this study will also provide an answer to several underlying questions and misconceptions about the subject of science. With the help of this study, the teachers can also plan their interventions appropriately to suit the need of all students with different levels of scientific aptitude.

Moreover, scientific aptitude in the field of education is an area of study that has not been widely studied, especially among the science students of Aizawl. So, the researcher is eager to conduct this study that can enrich the field of research. Therefore the multifaceted possibilities of creating awareness, generating new knowledge and providing information that would be useful for further studies etc. has compelled the researcher to take up this study. A reliable finding generated from this study can prove useful not only on planning the current learning experiences for the students based on their ability and aptitude, but it will also help the teachers and parents to provide accurate and meaningful guidance for further studies and future career. This study will, therefore, pave the way for a more meaningful and directive academic endeavor for the science students of Aizawl district. Thus, the researcher, with a view to improve science education by creating awareness about scientific aptitude that can have a huge impact on the academic life of students has decided to conduct an in-depth study on the scientific aptitude of higher secondary science students in Aizawl district.

Statement of the problem

The present study is entitled, **"A Study on the Scientific Aptitude of Higher Secondary School Science Students in Aizawl District."**

Operational definitions of the key terms

Aptitude: Aptitude is a specific ability or a specific capacity that helps and individual in acquiring the degree of proficiency or achievement in a particular field.

Science: Science is the study of the nature and behavior of natural things and the knowledge that we obtain about them. Science refers to one of the streams offered in higher secondary level of education.

Scientific Aptitude: Scientific aptitude refers to ability in science comprising of curiosity, observation, identification, description, experimental study and theoretical description of phenomena. Thus for the present study, Scientific Aptitude refers to the scores obtained by the students after performing the test given to them.

Higher Secondary School: Higher secondary school refers to the educational institution imparting formal education which offers Science stream for class XI and XII.

Science Students: Science students are learners who are studying in class XI and class XII of Science stream in the higher secondary school.

Aizawl district: Aizawl district is one of the districts in Mizoram state where the present study is conducted.

Research questions

1. What is the level of scientific aptitude of higher secondary school science students in Aizawl district?
2. Is there any significant difference between the scientific aptitude of higher secondary school science students of Aizawl district with respect to gender?
3. Is there any significant difference between the scientific aptitude of higher secondary school science students of Aizawl district with respect to type of school management?

4. Is there any significant difference between the scientific aptitude of higher secondary school science students of Aizawl district with respect to locale?

Objectives of the study

1. To find out the level of scientific aptitude of higher secondary school science students in Aizawl district.
2. To compare the scientific aptitude of higher secondary school science students of Aizawl district with respect to gender.
3. To compare the scientific aptitude of higher secondary school science students of Aizawl district with respect to type of school management.
4. To compare the scientific aptitude of higher secondary school science students of Aizawl district with respect to locale.

Hypotheses of the study

1. There is no significant difference between boys and girls with respect to their scientific aptitude.
2. There is no significant difference between government and private higher secondary school science students of Aizawl district with respect to their scientific aptitude.
3. There is no significant difference between private and deficit higher secondary school science students of Aizawl district with respect to their scientific aptitude.
4. There is no significant difference between government and deficit higher secondary school science students of Aizawl district with respect to their scientific aptitude.
5. There is no significant difference between urban and rural higher secondary school science students with respect to their scientific aptitude.

REVIEW OF RELATED LITERATURE

In the present study the related literatures reviewed were Related studies reviewed were separated into two categories; (i) Studies conducted in India and (ii) Studies conducted abroad.

The researcher collected and reviewed a total of 45 studies related to the topic of scientific aptitude of students conducted in India and abroad between the years 1986 to 2020. From the total studies collected, 30 related studies conducted in India between the years 1980 to 2020 were reviewed and 15 studies conducted abroad between the years 2000-2020 were collected and reviewed.

From the literatures reviewed, different studies related to students' scientific aptitude were conducted by different researchers where their conclusions and findings vary. As the term scientific aptitude has many characteristics such as ability to reason, ability to interpret, scientific interest, scientific attitude, creativity and so on, the investigator expanded the area of literature review. Thus the reviewed literatures for the present study were related to students' scientific aptitude, science interest, reasoning ability, scientific attitude and creativity in terms of age, gender, students' background or locale, type of school management and correlation with students' academic achievements.

METHOD OF THE STUDY

The present study aimed to find out the scientific aptitude of higher secondary school science students in Aizawl district and to compare them on the basis of gender, school type management and their locale. Therefore the study adopted a Descriptive Survey Method to study and inquire the students' aptitude in science. It also followed a Quantitative Type of Research as the data were collected and analyzed quantitatively.

Population of the study

The population of the study included all the science students reading in higher secondary schools in Aizawl city.

Sample of the study

The sample of the study consisted of 325 students comprising of 188, 61 and 76 students from private, government and deficit higher secondary schools respectively.

The technique used for selecting the sample was Stratified Random Sampling technique and the sample was selected from each stratum proportionately.

Tool used for data collection

For collecting data, the researcher used Scientific Aptitude Test (SAT) developed by Dr. Nagappa. P. Shahapur, Dharwad and Dr. C. R. Rao, Bijapur. The test is an objective type test consisting of 80 questions. Each question carries 1 mark and the test consists of separate answer sheet. The questions in the test were arranged under 8 characteristics of Scientific Aptitude such as:

- Experimental Bent,
- Ability to Reason,
- Detection of Illogical Conclusion,
- Ability to Draw Conclusion from the given Data,
- Ability to interpret,
- Scientific Interest,
- Ability to Solve General Problems,
- Accuracy of Observation

Validity of the test: A test is valid when it measures what it is supposed to measure. Content validity and predictive validity of the test were assessed.

a) *Content Validity*- Opinions of the experts from Sainik School science teachers from Karnataka University, Dharwad were pooled. Content validity was established in terms of consistency of test items with objective and content.
b) *Intrinsic Validity*- This was measured by correlating the scores of 86 students on the test-retest and split-half items. The intrinsic validity for test-retest was 0.96332 and for odd and even numbered items was 0.9229. Hence, the

intrinsic validity of the science aptitude test was ranged from 0.9229 to 0.96332.

Reliability of the test: The reliability was measured by split-half method putting all the odd numbered test items into one half and all the even numbered test items into another half, care was taken to put highly comparable items into two halves.

Scores obtained on two halves were correlated and then correction was applied by Spearman Brown formula. The reliability of the test was found to be 0.8518 which was found to be significant at $p < 0.05$ level of significance.

Interpretation of the scores on the test can be done according to the norms of the test given in the manual by dividing points between various stanine grades in accumulated percentage, which can be represent in the following table.

Dividing points between various stanine grades in accumulated percentage

Accumulate percentage	**Stanine**	**Interpretation**
Above 96%	9	High Aptitude
Above 89%-Below 96%	8	Above Average
Above 77%-Below 89%	7	Above Average
Above 60%-Below 77%	6	Average
Above 40%-Below 60%	5	Average
Above 23%-Below 40%	4	Average
Above 11%-Below 23%	3	Below Average
Above 4%-Below 11%	2	Below Average
Below 4%	1	Low

Procedure of data collection

In the present study the data collection was carried out from the month of August, 2020. Prior to the data collection, the investigator obtained all the necessary information regarding number of higher secondary schools within Aizawl city and number of science students in each school in order to calculate samples needed for the study.

For collection of data online survey process was administered using Google Form as the researcher could not personally go to the field to collect data due to pandemic. The researcher took permission from the principals and heads of the sampled schools to conduct the test. After permission was taken, questionnaire was distributed to the sampled students through Google Form. Detailed instruction was included in the description section of the Google Form. The researcher then collected and recorded the responses after the students submitted their responses. The collected data were tabulated and analyzed through computer by using Microsoft Excel Worksheet 2007 Edition.

Analysis of data

In the present study, the researcher used percentage method for finding out the different levels of students' scientific aptitude and other statistical technique like t- test was adopted to test the hypotheses.

To find out the difference in the scientific aptitude of students, the researcher distributed the students based on gender, type of school management and locale.

MAJOR FINDINGS OF THE STUDY

The following are the major findings of the study.

1. **Findings in relation to level of scientific aptitude of higher secondary school science students in Aizawl district.**

The overall level of scientific aptitude of higher secondary school science students of Aizawl district was 'Average.' Out of 325 students, majority of the students (73%) were found possess average level of scientific aptitude. 18.15% of the students were found to have above average level of scientific aptitude whereas only

8.92% were found to have below average level of scientific aptitude. There were no students having high or low level of scientific aptitude.

2. Findings in relation to comparison of students' scientific aptitude with respect to gender.

Out of 164 boys, majority of the boys i.e. 73.7% were found to have average level of scientific aptitude. A quarter of boys i.e. 20.12% possessed above average level of scientific aptitude and at the same time, only a few numbers of them i.e. 6.09% were found to have below average level of scientific aptitude.

Out of 161 girls, majority of the girls i.e. 72.04% were found to have average level of scientific aptitude. Few number of them i.e. 16.14% were found to be in the above average level category of scientific aptitude and 11.8% of the girls scored below average level of scientific aptitude.

When comparison was made using t-test among the two groups to find out the differences in their mean value the calculated t-value was found to be 1.4. The calculated value of t (1.4) being smaller than the critical value of t (1.97) at the required level of significance (0.05 level) designated the absence of significant difference between the scores of two groups. Therefore, no significant difference was found between the scientific aptitude of boys and girls.

3. Findings in relation to comparison of students' scientific aptitude with respect to type of school management.

Among a total of 61 government higher secondary schools science students, a large number of the students i.e. 55.38% were found to have average level of scientific aptitude, a good number of students i.e. 30.76% obtained above average level of scientific aptitude but only 7.6% students showed below average level of scientific aptitude.

Out of 188 private higher secondary school science students, majority of the students i.e. 72.87% were found to possess average level of scientific aptitude while 14.8% students were having above average level and 12.23% of the students possessed below average level of scientific aptitude.

Out of 76 deficit higher secondary school students, majority of the students i.e. 85.5% were found to obtain average level of scientific aptitude and very few students i.e. 14.47% scored above average level of scientific aptitude while none of the students scored below average level of scientific aptitude.

When the students' scientific aptitude of government and private higher secondary schools was compared using t-test it was found that the calculated t-value was 3.9 with degrees of freedom 247. Since the calculated value of t (3.9) was found to be greater than the critical value of t (2.60) at the required level of significance (0.01 level), it indicated that the null hypothesis was rejected meaning there existed significant difference between the scores of two groups. As the mean score of students of government higher secondary school was found to be higher than the mean score of students of private higher secondary school it can be said that government higher secondary school science students have higher scientific aptitude than private higher secondary school science students.

When comparison of scientific aptitude of private and deficit higher secondary school science students was done by t-test it was detected that the calculated t-value was 1.91 with degrees of freedom 262. Since the obtained value of t (1.91) was lesser than the critical value of t (1.97) at the expected level of significance (0.05 level) the null hypothesis was accepted which resulted in the absence of significant difference scientific aptitude of private and deficit higher secondary school science students.

When comparison of scientific aptitude of government and deficit higher secondary school science students was performed using t-test it was found that the calculated t-vale was 2.28 with degrees of freedom135. As the obtained value of t (2.28) was noticed to be lower than the critical value of t (2.62) at the expected level of significance (0.01 level) the null hypothesis was accepted which means that there existed no significant difference between government and deficit higher secondary school science students in their scientific aptitude

4. Findings in relation to comparison of students' scientific aptitude with respect to locale.

Out of 170 urban students, majority i.e. 73.83% were found to have average level of scientific aptitude. 21.51% of urban students were having above average level of scientific aptitude whereas only very little number of students i.e. 4.65% were detected to have below average level of scientific aptitude.

Among 153 students of rural areas, a greater number of rural students i.e. 71.89% possessed average level of scientific aptitude while only 14.37% of the rural students were found to have above average level and at the same time 13.72% scored below average level of scientific aptitude.

Comparison of the scientific aptitude of urban and rural higher secondary school science students using t-test revealed that the calculated t-value was found to be 4.46 with degrees of freedom 247. The occurrence of higher calculated value of t compared to the critical t-value (2.59) at the expected level of significance (0.01) showed that the null hypothesis can be rejected. This resulted in the presence of significant difference between urban and rural higher secondary school science students. As the mean score obtained by students coming from urban areas was detected to be greater than the score obtained by the students coming from rural areas it can be concluded that students coming from urban areas have higher scientific aptitude than students coming from rural areas.

DISCUSSION OF THE FINDINGS

1. Discussion in relation to level of scientific aptitude of higher secondary school science students in Aizawl district.

The science students of higher secondary schools in Aizawl district were found to possess average level of scientific aptitude. Some of the students were having above average aptitude while very little number of students had below average. High or excellent scientific aptitude was not obtained by any student which was quite unsatisfactory because science students of higher secondary level of education are typically expected to have high level of aptitude in science. There is a felt need for improvement of scientific aptitude among higher secondary school science students as a whole in order to have improvement in their studies and to

achieve future success. The level of scientific aptitude in a student may depend on a variety of factors such as the level of interest in science, motivation, intelligence and other related skills of a student. Study conducted by Patel (2019) revealed that students with high level of I.Q were more superior in scientific aptitude than students having low level of I.Q. Furthermore, Aderogba and Olatoye (2011) also made suggestion in their study that students should develop high verbal and numerical skills in order to perform better in aptitude test.

2. Discussion in relation to comparison of students' scientific aptitude with respect to gender.

In the present study regarding students' scientific aptitude in relation to gender, no significant difference was found between boys and girls. The reason behind this could be due to equal opportunities given to both the gender to receive the same learning in science and participate in activities related to science and science learning. Spelke (2005) also found that boys and girls showed equal scientific aptitude. According to her, finding that male and female show equal aptitude for science does not imply that humans' genetic endowment is irrelevant to these achievements, instead it shows that scientific reasoning ability develops from a set of biologically based cognitive capacities that males and females share. However the result of the present study is contrary with the findings of previous studies done by Srivasta (1992), Sudha et al. (2015), Manickavasagan (2018) and Kalaivani (2019) where significant difference was seen between boys and girls. Study done by Naidoo and Sibanda (2020) concluded that the presence of gender difference could be related to socio-cultural environments and learning experiences.

3. Discussion in relation to comparison of students' scientific aptitude with respect to type of school management.

From the comparison of students' scientific aptitude based on the type of school management it was found that significant difference did not exist between government and deficit higher secondary school science students as well as between private and deficit higher secondary school science students. However significant difference was found between government and private higher secondary school science students where government school students were having higher scientific aptitude than private school students. This could be due to factors such as teacher

quality and better infrastructures available in the schools. In the state of Mizoram most of the teachers in government schools are trained and experienced and so their students are susceptive to perform better than students who are under the guidance of untrained and inexperienced teachers. Moreover, government schools, as compared to aided and unaided schools, have better school campus well equipped with spacious building, laboratories, good libraries etc. for providing a conducive environment for better learning and quality teaching. Due to this, government school students may be superior in possessing higher scientific aptitude compared to students of other types of school management.

But the case can be different according to the area of study because previous study done in Karnataka by Yeli and Sadiga (2013) compared students' scientific aptitude based on the type of school and found that aided school students were superior in scientific aptitude compared to unaided and government school students. Different result was also seen in the study conducted by Manichander and Brindhamani (2014) in Tamil Nadu where aided school students possessed higher scientific aptitude than government school students while study done by Anuruba and Krishnamurthy (2019) revealed that unaided school students possessed more scientific aptitude than government school students.

4. Discussion in relation to comparison of students' scientific aptitude with respect to locale.

The comparison of students' scientific aptitude based on locale revealed that urban students showed better scientific aptitude than rural students. In the present study urban students refer to students who permanently reside in Aizawl city whereas rural students refer to those students who temporarily reside within Aizawl city. The findings of the present study is in agreement with the findings made by Patel (2010), Yeli and Sadiga (2013) and Manichander and Brindhamani (2014) where their studies revealed that urban students possessed higher scientific aptitude than rural students. The reason for low aptitude score among rural student may be because of lack of equal opportunity in education among students of different location within the state. As complete equal opportunity could not have been achieved there is no doubt that schools in rural areas are inadequate in terms of opportunities. Furthermore schools in urban areas are more exposed in educational activities especially science related activities such as science fairs, exhibitions etc. As students

are involved in these kinds of science related activities in schools they become more prone to increase their scientific knowledge and scientific aptitude.

However findings from previous studies conducted by Gosh (1986), Anuruba and Krishamurthy (20190 and Khushbu and Shah (2019) revealed that students coming from rural areas possessed higher scientific aptitude than students of urban areas. But there are other findings made by Barwal (2014), Manjula (2015) and Vyas (2010) that revealed the absence of significant difference between rural and urban students in which both students belonging to urban and rural areas obtained equal scientific aptitude.

RECOMMENDATIONS

On the basis of the findings of the present study the following recommendations are made:

1. The present study results in slightly low level of scientific aptitude among science students of higher secondary schools within Aizawl district. Therefore, adoption of modern and innovative scientific methods of teaching in the classrooms by teachers is strongly recommended in order to develop higher aptitude in science among the students.

2. It is recommended that all teachers teaching science subject in school must have minimum qualification prescribed by the National Council for Teacher Education (NCTE) and must possessed professional qualification in teaching.

3. Scientific aptitude test must be conducted as far as possible for admission into higher secondary level of science education. This will help in reducing the practice of forcing learners who excel in their matriculation to simply opt for science stream without proper knowledge about their aptitude in science.

4. At the time of admission to higher secondary level of science education, proper guidance must be given to the students in choosing the different subjects in science stream.

5. Activity based learning must be encouraged in science education in order to enhance students' critical thinking and scientific aptitude.

6. Schools must be equipped with better infrastructure in terms of buildings, classrooms, laboratories, and equipment as well as qualified/trained teachers.

7. Educational programs like science fairs, science exhibitions, science congress etc. must be introduced and organized in schools so that students will have better opportunity to engage in science related activities and gain more knowledge thereby increasing their interest in science as well as overall learning.

SUGGESTIONS FOR FURTHER STUDIES

From the findings of the present study the following suggestions are made for further studies and researches in the field:

1. The present study deals with the study of students' scientific aptitude within Aizawl district only. So it is suggested that comparison of students' scientific aptitude among different districts of Mizoram can be conducted.

2. The scientific aptitude of students of other levels of education i.e. primary to college level can be studied.

3. Further studies regarding the relationship between student's scientific aptitude with other variables like achievement in other school subjects, parents' occupation, parents' educational qualification, home environment of the students can be conducted.

4. A study on the influence of learning styles and problem solving ability of students on their scientific aptitude can be conducted.

5. A study can be conducted to investigate the relationship between intelligence and scientific aptitude of students.

6. The quality and attitude of teachers play an important part in imparting and promoting the scientific aptitude of students. Therefore a study on science teachers' attitude towards science and science teaching may be conducted.

7. A study can be further taken up to analyze the effect of different teaching methods on the scientific aptitude of students.

8. A study can be conducted to explore the role of different educational programmes to promote the scientific aptitude of students.

9. Construction and standardization of more scientific aptitude test may be conducted for students of different educational levels in English and Mizo languages.