

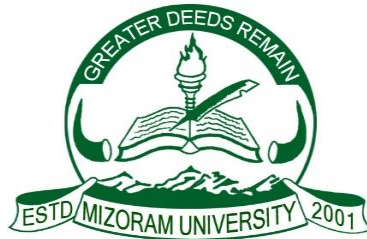
**MATHEMATICAL APTITUDE OF PRE-SERVICE ELEMENTARY
TEACHERS OF SIKKIM IN RELATION TO INTELLIGENCE AND
PROBLEM-SOLVING ABILITY**

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF DOCTOR OF
PHILOSOPHY**

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MZU REGISTRATION NUMBER: 2009433

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DEPARTMENT OF EDUCATION

SCHOOL OF EDUCATION

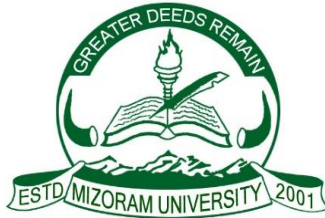
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I hereby certify that Pawan Kumar Ray has complied with all the requirements as laid down by the Ph.D. Regulations of Mizoram University and that the thesis is the original work of the scholar and has not been submitted for any degree to any other University.

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DECLARATION

Mizoram University

October 2023

I, Pawan Kumar Ray, hereby declare that the subject matter of this thesis is the record of work done by me; that the contents of this thesis 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 thesis has not been submitted by me for any research degree in any other University/ Institute.

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LIST OF ABBREVIATIONS

OBC -	Other Backward Class
D.El.Ed-	Diploma in Elementary Education
DIETs-	District Institute of Education and Trainings
I.Q-	Intelligent Quotient
SC -	Schedule Caste
ST-	Schedule Tribe
NEP-	National Education Policy

CHAPTER I

INTRODUCTION

1.0 Introduction

Education needs to focus on all-round development and which is obtained through proper guidance, good skills, aptitude, life experiences etc. It also aims at harmonious development of cognitive, affective and psychomotor domains. There are various agencies which contribute at different stages and to different degrees in achieving the goals and DIETs is one of them. NEP-2020 focuses on teaching and learning that will be conducted in a more interactive manner; questioning will be encouraged and classroom sessions will be more fun for the students for a deeper and more experiential learning. It says that we have to close the gap in achievement of learning outcomes, classroom transactions will shift, towards competency-based learning and education. Though gaining knowledge is an inherent process that occurs naturally a genuine learning experience and aptitude are required. Mathematical aptitude is the most closely related subject in our daily life. It is based on logical thinking and it is very important to be known by teacher trainees because they are the ones to hone the new generation. Mathematical aptitude involves the process for intellectual development of the learners. NEP-2020 also says that Mathematics is required to develop all aspects and capabilities of learners.

Mathematics is the science of measurement, quantity and magnitude. It is the science in which we basically calculate the variables and constant. It is known as “Ganita” in Hindi also which means the science of calculation. Development of mathematical ability amongst the children is the main goal of mathematics education. The precision of school mathematics is to develop 'useful' capabilities, particularly those relating to numeracy–numbers, number operations, measurements, decimals and percentages. The higher aim of mathematics education is to nurture child's resources to think and reason mathematically, to pursue assumptions to their logical conclusion and

to handle abstraction. It includes a mathematical mannerism in way of doing things, and the ability and the attitude to formulate and solve problems.

“Mathematics is a way to settle in the mind the habit of reasoning”–Locke

Mathematics is the most closely related subject in our lifestyle. Its knowledge is exact, systematic, logical and clear. Mathematics involves the method for intellectual development of mental faculties. It is not that mathematical knowledge is needed only by engineers, doctors or business personals. Even the citizen standing at the last in the society like labourers and workers, need the essential knowledge of Mathematics. Besides the mental ability, Mathematics develops some quality like concentration, truthfulness, seriousness and reasoning.

“Mathematics is the gateway and key to all sciences” - Roger Bacon.

The modern era is the era of science and technology. With technology infiltrating many aspects of human life, a person who is unable to use it feels handicapped. Even the most elemental technological know-how, however, necessitates a primary understanding of Mathematics.

Mathematics is, in reality, the universal language of science. The mathematical interpretation of Newton's Law of Gravitation was the sole thing that got the globe into the Satellite Communication Age. Computers, Internet-enabled mobile phones, and modern modes of transportation have transformed the world into a 'Global Village.' As a result, science, which is considered the backbone of technology, relies on Mathematics for its precision and systematic approach. Mathematics is more than just a tool for assisting research in science; rather it is a method for cultivating a scientific mind-set that leads to the highest level of human inquiry. This clearly indicates that **“The progress and improvement of mathematics are linked to the prosperity of the state”** - Napoleon.

1.1 Mathematics education

There is a general perception that Mathematics is only based on formulae but reality is that if the children understand the concept, they may solve the problems of Mathematics and create the formulae themselves. It is also a common belief among research scholars. Teachers and policy makers stated that Methodology of teaching and way of memorizing the formula by learners need to change for 21st century learners and there are many research evidences also. Keeping this in mind a proper strategy and methodology should be developed for learners to achieve all-round development. It can be obtained through real life experience and by providing real life situation related problem. Problem solving ability can play a vital role in it. By learning Mathematics properly, students can be able to develop understanding, logical thinking and reasoning. The developing all these things in learners makes them “Atmanirbhar” and it is going to fulfil object of current Bharat “Atmanirbhar Bharat”. **NEP-2020 also states that Mathematics is required to develop all aspects and capabilities of learners.** Mathematics is the most closely related subject in our daily life. Mathematics involves the process for intellectual development of the learners. 21st century learners require skilled based education and knowing good techniques of Mathematics that is very helpful.

Mathematics is the key to all fields of science. Mathematics has held its important place since the earliest times and it is the only subject which merits this distinction. Home assignment is important part of the teaching -learning of Mathematics. All the students from the very beginning of their education start with language and numerical skills. It is very important for one to teach and learn Mathematics. The applications of Mathematics can be used as a tool in various educational fields and also in our society. The above statement is followed by the argument that studying of Mathematics makes oneself disciplined and enhance their logical reasoning skills. Further the professionals have argued that intellectual and aesthetic satisfaction can be derived only from Mathematics.

In Bharat the practice of Mathematics education was well-established. It is a highly valued subject in Bharat culture and is viewed as a means to measure one's intellectual abilities. The curriculum development in Mathematics has

been in effect since the many past decades. This is due to the development of technology and its increase in popularity among common people that had a huge impact on the society (Kumaravelu.G -2014)

Mathematics at school is the necessity to pursue any higher education program whether it may be undergraduate or postgraduate or research-oriented mathematics, it develops the fundamental skills in a person for the development and swift growth of science and technology around the globe or to fulfil sort of preliminary requirements of any present-day human being (Kapur ,1967). Whether it may be a common man or Prime Minister, everybody requires basic mathematical knowledge to live and advance in their daily lives properly (sidhu ,2007). Mathematics is a thrilling subject which enlightens us with its reasoning and rationality when it is taught properly. It makes the mind reasonable and it forms the basis for working on any intellectual activity and therefore its importance and ability to grant even omnipotence has led to it being omnipresent as a mandatory subject up to secondary level at school curriculum. Zakir Husain committee was formed to formulate the basic educational schemes in Bharat and develop the student's mathematical ability; it too emphasized "Knowledge of mathematics is an essential part of any curriculum. Every child is expected to work out the ordinary calculations required in the course of his craft work or his personal and community concerns and activities." The Secondary Education Commission appointed in 1952 also emphasized the need for mathematics as a compulsory subject in the schools. The National Education Commission also popularly known as the Kothari Commission (1964-1966) recommended mathematics as a compulsory subject for students at school level. It stated, "We cannot overstress the importance of mathematics in relation to science, education and research." This statement still holds true to this day, in spite of the different changes that took place in the content of mathematics taught

over the past decades. The effectiveness of mathematics as a compulsory subject remains constant. The Commission also stated, 'As far as the teaching of mathematics is concerned importance has to be given for the understanding of fundamental principles than on the mere automatic teaching'. The National Policy on Education 1986 stated that mathematics should be a vehicle to prepare a child, to imagine, investigate, reason and to express rationally.

It is not only a single subject instead it is the basis of all subjects related to any subject relating analysis and reasoning. Starting from the elementary concepts of addition, multiplication, subtraction and division school level mathematics prepares the preliminary ground for higher level studies in the same subject. This mathematical knowledge when combined with aptitude really prepares an individual to meet the challenges ahead of them in the field of education. Every individual is expected to have this aptitude in them in order to achieve in their career advancement. Further information processing skills assist the students to use the information intelligently. When the students are in need of information, first he will define the information he needs for; he can select the necessary details related to the task. Then he can locate the prescribed information he needs from the selected information. Then he will organize in patterns the collected information and then he will present the information to the audience. Finally, he will assess and come to the conclusion that what are all the changes he can make so as to make his learning more effective during his next move. Such intelligent move, this information processing skills mold and prepares the individual to cope up with the fast-developing information age environment. The present study intends to discover the levels of information skills and mathematical aptitude of higher secondary students in relation to academic achievement in Mathematics. The present study has great significance, relevance, importance and utility for both parents and teachers because this will encourage them to come forward to understand their children's higher achievement both in information skills and mathematical aptitude. It will be helpful to school authorities including teachers and principals to know and

understand the effect of information skills and mathematical aptitude on their academic achievement in Mathematics as a whole.

In contemporary education, the place of mathematics needs to be determined by an investigation of the modern society. Where information technology determines the place of mathematics in the field of communication and technology. The Kothari Commission Report (1964-66) highlighted that study of mathematics plays a high-flying role in modern education. Mathematics without any doubt seems to be the essential and application-oriented subject for exactly all vocations and also in the course of higher learning.

Application of mathematics is required in the higher secondary and university stages. There is no subject as important as mathematics that can even act as a substitute for mathematics. Mathematics not only provide new experiences to the pupils but also promotes the organization of ideas that have already been developed from perceptual experience. Even though the concrete material may act as a stimulus, the mathematical reaction is a mental organization of relations. To make this organization of ideas valuable, proper means have to be adopted. In order to meet the requirements of the society, the teaching methods should be given more attention by viewing its various aspects so as to fulfil the requirements of the society. Knowledge of educational values helps the teacher to avoid aimlessness in teaching. Value is the spring board of aim and vice-versa (sidhu, 2007). The growth of any country begins on the soils of mathematics. Since ancient times, the discipline of mathematics and its applications have found its importance. People belonging to different culture, caste, creed, economic status, academic level will definitely agree upon the fact that how important studying and doing mathematics is? Mathematics has had a positive effect upon civilization. The quick growth of technology and the enormous development of science in the last quarter of the twentieth century owe themselves to the applications of mathematics undeniably. The gap between mathematics and other disciplines which existed in the past were filled by applications of mathematics. Today it is the need of anyone who intends to enter the

infinite world of science to be familiar with mathematical concepts. Although Mathematics is truly connected with the field of communication and technology, it is very clear from the wordings of the popular mathematicians of 17th and 18th centuries believed that faith in religion had contributed a lot towards the discovery of mathematical concepts (Bhattacharya. 1995). The way in which the world runs today really makes one feel that world which has followed the path of mathematics has developed significantly. The educational achievement is influenced by quite many factors. Mathematics achievement is much important and valuable aspects of students' academic career. Not only it shapes one's vocational career but also it determines the pattern of one's living. Indian students seriously lag behind their peers in their mathematical aptitude and in order to lesson this achievement gap, enormous changes need take place in terms of pedagogy in classrooms nationwide.

Students need to be in an environment friendly to their learning in which all students have a fair and adequate opportunity to learn, where teachers are focused on the students and where student feel motivated and comfortable to learn. Criticism follows in regards to the minimal time spent on strategies designed to help classroom teachers to enhance the achievement of their students as well as in regards to the lack of specific strategies designed to enhance the education of Indian students (Leder, 1992).

1.1.1 Importance of Mathematics

The study of mathematics inspires and teaches one to practice their ideas in better way. Mathematical skills are necessary for schools and it plays a crucial role in college scenario. In broader terms, the expectancies of the society and the teaching of the mathematics are considerably complex than it was at past. Mathematics is the God of all sciences and holds a great status in modern education. Mathematics which is the science of quantity and space is a way to settle in the mind a habit of learning. Mathematics undeniably is a key part of the school curriculum. The education commission (1964-66) highlighted that right from the school level; the knowledge of mathematics has to be given a proper base. According to them the initiation of

computerization and computer-generated this century symbols the foundation of the new scientific industrial revolution, which seems to be more essential to assign particular interest to the study of mathematics. Mathematics is supposed to be the entryway and input to all sciences without which nothing is possible. Mathematics is not only important today instead it occupied key and prominent position from the very earlier times and it seems to be the only subject which is capable to hold all this merits. Home assignment forms an essential part of mathematics teaching & learning.

1.1.2 Achievement in Mathematics

Mathematics knowledge is required by every individual and a student to achieve effectively with all the abilities in a multiplicity of reliable settings, prosperous with feature bounded by uncertainty, and imbued with a background which is both rational and important. Conversely, student's development will not often be uniform towards the goal of mathematics. Every parent and teacher knows students are different: their temperament at apathetic rates; their learning styles reveal dissimilar strength and weaknesses. Their interests shift impulsively "God is child; and when he began to play, he cultivated mathematics".

1.1.3 The Importance of Achievement in Mathematics at School Level

Developing countries like India must have adequate level of mathematical achievement to ensure that it will continue to compete successfully with the economy of other countries. Students coming out with sufficient mathematical, science and ICT skills are much needed to India's future social and economic development and specially for 21st century learners. Achievement in Mathematics is important because it mainly serves as a base for many other disciplines such as science, economy, technology, business and finance. It is much needed requisite for the growth of the knowledge economy and the development of a world-class research and innovation system in India. Although mathematics has got this much importance, it is found that many students face difficulties in learning Mathematics. Students look it very difficult to understand the

mathematics concepts since it is much abstract in nature. Teachers at this context play a significant role in helping the students to understand the mathematics concepts. They need to make mathematics learning more joyful, interesting and worthwhile. So that student gets involved themselves and actively participate in teaching learning process and try to attain intellectual excitement. But many mathematics teachers are using only chalk and talk method which is found boring as students are only passive listeners. Students need to be actively involved in teaching learning processes to sustain interest and motivate them in learning Mathematics (Singaravelu, 2011). Basic Mathematics is considered as a necessity for success not only in school but also for everyday life. Mathematics, by nature is abstract and it is not possible for all the students to comprehend it in traditional instruction. It is the pressure of failure in Mathematics tests and the caused public embarrassment of the students' those results of tension and anxiety among them. It is the duty of any mathematics teacher to make the concept simpler, lucid and easily understandable for such students. Students' prior negative experiences in mathematics class and at home when learning mathematics cause a lack of understanding of mathematics.

For learning mathematics without anxiety, students must be engaged in exploring, conjecturing, and thinking rather than, engaged only in rote learning of rules and procedures i.e. learning should be more interesting and enjoyable. It should be a fun intellectual rollercoaster rather than a cumbersome process.

1.2 Conceptual Framework

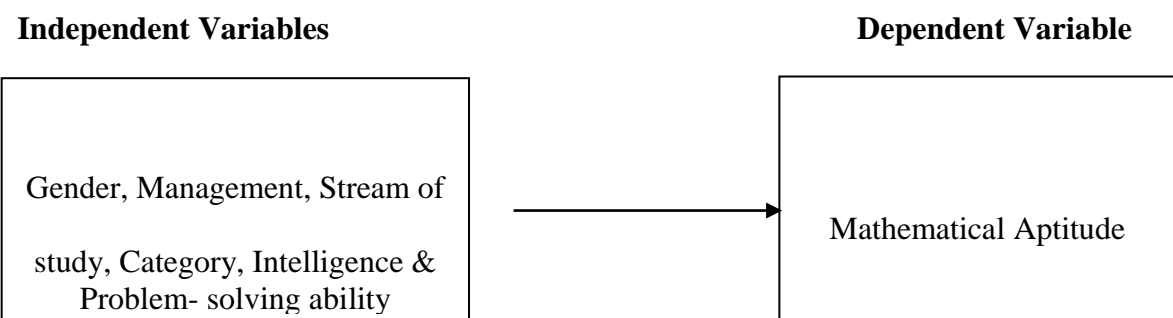
“A conceptual framework is a structure which the researcher believes can best explain the natural progression of the phenomenon to be studied” (Camp, 2001). It is the outline, the scheme, the paradigm of the operation of the all types of variables. The plan is the only scheme of the research. It includes an outline of everything like writing the objective, hypotheses, collection of data and their operational implications to the final analysis of the data. Based on above work Researcher will do investigation. The

structure of the research should be more specific. Strategy is more specific than plan. It includes the methods to be used together and analyses the data.

The objective of this study is to examine the Mathematical aptitude of pre-service elementary Teachers of DIETs, Sikkim in relation to Intelligence and Problem-solving abilities. This study involves an exhaustive study of level of Mathematical aptitude, Intelligence and skills of Problem-solving abilities in the mind of pre-service elementary teachers of DIETs in Sikkim. The researcher focuses different dimensions of skills and aptitude in details. On the basis of the dimensions of skills and aptitude and their professionalism, the researcher develops separate questionnaire for pre-service elementary teachers of DIETs, Sikkim to know their skills, aptitude and knowledge. Mathematical aptitude of pre-service elementary teachers of DIETs Sikkim can determine the course of mathematics education at the elementary level. A considerable number of pre-service teachers belong to the tribal and non-tribal society of the state of Sikkim and their performance in teaching mathematics can lead the mathematics education in the state and it will be betterment for students' community.

Table No. 1.1

Conceptual Framework



1.3 Sources of Mathematics and Role of Mathematician

Mathematics is a subject of the science of structure, order, and relation that has evolved from elemental practices of counting, measuring, and describing the shapes of objects. It deals with logical reasoning and quantitative calculation, and its development has involved an increasing degree of idealization and abstraction of its subject matter. Since the 17th century, Mathematics has been an indispensable adjunct to the physical sciences and technology, and in more recent times it has assumed a similar role in the quantitative aspects of the life sciences.

In many cultures under the stimulus of the needs of practical pursuits, such as commerce and agriculture - mathematics has developed far beyond basic counting. This growth has been greatest in societies complex enough to sustain these activities and to provide leisure for contemplation and the opportunity to build on the achievements of earlier mathematicians.

All mathematical system are combinations of sets of axioms and of theorems that can be logically deduced from the axioms. Inquiries into the logical and philosophical basis of mathematics reduce to questions of whether the axioms of a given system ensure its completeness and its consistency.

As a consequence of the exponential growth of science, most mathematics has developed since the 15th century CE, and it is a historical fact that, from the 15th century to the late 20th century, new developments in mathematics were largely concentrated in Europe & North America.

This does not mean, however, that developments elsewhere have been unimportant. Indeed, to understand the history of mathematics in Europe, it is necessary to know its history at least in ancient Mesopotamia and Egypt, in ancient Greece, and in

Islamic civilization from the 9th to the 15th century. The way in which these civilizations influenced one another and the important direct contributions Greece and Islam made to later developments.

India's contributions to the development of contemporary mathematics were made through the considerable influence of Indian achievements on Islamic mathematics during its formative years. A separate article, *South Asian Mathematics*, focuses on the early history of mathematics in the Indian subcontinent and the development there of the modern decimal place-value numerical system. The article *East Asian Mathematics* covers the mostly independent development of mathematics in China, Japan, Korea, and Vietnam.

It is important to be aware of the character of the sources for the study of the history of mathematics. The history of Mesopotamian and Egyptian mathematics is based on the extant original documents written by scribes. Although in the case of Egypt these documents are few, they are all of a type and leave little doubt that Egyptian mathematics was, on the whole, elementary and profoundly practical in its orientation. For Mesopotamian mathematics, on the other hand, there are a large number of clay tablets, which reveal mathematical achievements of a much higher order than those of the Egyptians. The tablets indicate that the Mesopotamians had a great deal of remarkable mathematical knowledge, although they offer no evidence that this knowledge was organized into a deductive system. Future research may reveal more about the early development of mathematics in Mesopotamia or about its influence on Greek mathematics, but it seems likely that this picture of Mesopotamian mathematics will stand.

From the period before Alexander the Great, no Greek mathematical documents have been preserved except for fragmentary paraphrases, and, even for the subsequent period, it is well to remember that the oldest copies of Euclid's *Elements* are in Byzantine manuscripts dating from the 10th century CE. This stands in complete contrast to the

situation described above for Egyptian and Babylonian documents. Although, in general outline, the present account of Greek mathematics is secure, in such important matters as the origin of the Axiomatic Method the pre-Euclidean theory of ratios, and the discovery of the conic section, historians have given competing accounts based on fragmentary texts, quotations of early writings culled from non-mathematical sources, and a considerable amount of conjecture.

Many important treatises from the early period of Islamic mathematics have not survived or have survived only in Latin translations, so that there are still many unanswered questions about the relationship between early Islamic mathematics and the mathematics of Greece and India. In addition, the amount of surviving material from later centuries is so large in comparison with that which has been studied that it is not yet possible to offer any sure judgment of what later Islamic mathematics did not contain, and therefore it is not yet possible to evaluate with any assurance what was original in European mathematics from the 11th to the 15th century.

In modern times the invention of printing has largely solved the problem of obtaining secure texts and has allowed historians of mathematics to concentrate their editorial efforts on the correspondence or the unpublished works of mathematicians. However, the exponential growth of mathematics means that, for the period from the 19th century on, historians are able to treat only the major figures in any detail. In addition, there is, as the period gets nearer the present, the problem of perspective. Mathematics, like any other human activity, has its fashions, and the nearer one is to a given period, the more likely these fashions will look like the wave of the future. For this reason, the present article makes no attempt to assess the most recent developments in the subject.

1.4 Skills used in Mathematics

Mathematics has a wide range of applications in acquiring a variety of skills that can be used to a variety of jobs. These abilities serve as a foundation for solving complicated problems in various industries.

Critical thinking: The ability to analyze difficult circumstances using logic and reasoning to comprehend the situation and take appropriate actions, as well as form inferences and interpretations.

Problem-solving: The ability to analyze and comprehend problems, evaluate potential solutions and to solve them.

Analytical thinking: The ability to solve issues rapidly and efficiently with the use of visual thinking.

Quantitative reasoning: The ability to apply and understand fundamental and elementary mathematics principles in order to solve quantitative reasoning problems.

Time management: The ability to prioritize tasks and successfully manage time.

Logical argument and illogical argument: The ability to analyze logical and illogical errors, as well as logical and illogical arguments. In reasoning, logic is a process that supports a valid conclusion, whereas illogic is a way that supports a false conclusion.

1.5 Aims of The Elementary School Mathematics Education

The secondary school mathematics curriculum continues the evolution of elementary mathematics learning. To enable students to confidently access the mathematics needed in their future study, work or daily life in an information and technology-rich society, the program aims to develop in students: the ability to conceptualize, investigate, reason and communicate mathematically, and use mathematics to form and solve problems in everyday life in mathematical contexts; the ability to manipulate numbers, symbols and other mathematical objects; numerical, symbolic, spatial and measure mental sense, as well as the ability to appreciate structures and patterns; a positive attitude towards mathematics and an ability to appreciate the aesthetic and cultural nature of mathematics.

1.6 Objectives of Learning Mathematics

Knowledge and understanding domain: Knowledge and understanding are essential to study mathematics and make a base from where one can conceptualize the ability of problem-solving skills. Students develop mathematical reasoning to make deductions and solve problems with this elaborated perception and understanding of mathematics.

Attitude domain: An attitude to be interested in learning mathematics is to be supported and encouraged by being confident in their abilities to do mathematics. One should apply mathematical knowledge willingly and admire that mathematics has a dynamic area with its roots in various cultures. One should appreciate the appropriate and aesthetic aspect of mathematics. The role of mathematics in human life is to be appreciated and must be adhered in solving problems. One must work with people in cooperation of others willingly and value the contributions of all.

Skill domain: To broaden the subsequent competencies and skills in fundamental computations in actual numbers and symbols and an ability to choose reasonableness of results; the usage of the mathematical language to share ideas; reasoning mathematically, i.e. they must conjecture, test and build arguments about the validity of a proposition; making use of mathematical information to solve various problems; managing statistics and producing information; number sense and spatial experience; the usage of modern age technology as it should be to research and do mathematics; gaining knowledge of mathematics independently and collaboratively for the whole life.

Investigating patterns: Investigating patterns permits students to experience the exhilaration and pleasure of mathematical discovery. Mathematical inquiry spurs the students to be a risk-taker, inquirer and vital thinkers. Through using mathematical investigations, students are given the possibility to use mathematical expertise and problem-fixing strategies to investigate a problem, generate and/or examine information,

discover relationships and patterns, describe them mathematically as general rules and justify or prove them.

Communication in mathematics: Mathematics provides an effective and wide-spread language. Students are expected to use mathematical language – both orally and in writing. Students are recommended to choose and use ICT tools as suitable and where available, to enhance communication in their mathematical ideas. ICT tools can include picture, display calculators, screenshots, graphing, spreadsheets, databases, drawing and word-processing software.

Reflection in mathematics: Mathematics encourages students to mirror upon their findings and problem-solving procedures. Students are recommended to share their thoughts with instructors and friends and to evaluate distinctive trouble fixing strategies. Vital reflection in mathematics facilitates student's advantage perception into their strengths and weaknesses as learners and to comprehend the price of mistakes as effective motivators to enhance gaining knowledge and understanding.

1.7 Values of Teaching Mathematics

The Value of Mathematics is used in each step for our life. We cannot survive without Mathematics. It gives happiness in our life when we make our career with help of Mathematics.

Practical or Utilitarian Value: Everybody uses mathematics in their daily life. Any person who is ignorant of mathematics can be easily cheated. He will always be at the mercy of others. We have to make purchases daily. We buy cloth, food items, fruit, vegetables, grocery etc. We have to calculate how much we have to pay for everything. Mathematics is needed by everyone whether rich or poor, high or low.

Intellectual values: Develops intellectual powers, imagination, Memorization, Observation, Invention, Concentration, Originality, Creativity, reasoning. If a child faces mathematical problems, his mind become active in solving that problem.

Social values: Social values can be acquired like: Tolerance, Open mindedness, Objectivity, Honesty, Truthfulness, Co-operation, Will power, Organization and maintenance of social institutions, banks, Railways, post offices etc.

Moral values: Ability in arguing on the correctness and incorrectness of a statement. Develops moral qualities, Honesty, Truthfulness, Justice, Dutifulness, Punctuality, self-confidence, power of distinguishing between right and wrong, Cleanness, Patience, listening to others, Respect to others, Deprives off the feelings of jealousy, Hate etc.

Disciplinary Values: As mathematical knowledge is exact, logical, real and to that point, it creates discipline in a human mind. Develops an ability to grasp a situation, to analyse the situation and to perceive correctly the state of affairs. Helps the students to imbibe qualities, Simplicity, Accuracy, Certainty of results, Originality, Similarity to reasoning in life, Verification of results, Concentration of mind.

Cultural values: “Mathematics is the mirror of civilization” By the culture of a nation or society we mean the mode of living of its inhabitants. Helps in promoting cultural heritage a transmitting it to future generation. The welfare of our civilization is almost depending upon scientific and mathematical developments. Helped in the development of various subjects and occupations.

International values: Mathematicians research their mathematical ideas from one nation to another nation. Mathematician’s books and journals are circulated among almost all the nations of the world.

Aesthetic values: “Education as a whole should foster the higher impersonal pleasures”
-Thorndike gets pleasure in solving mathematical problems, especially when he gets correct answers to his problems. Different symmetric designs by Ramanujan are a source of great pleasure Eg: Mathematics is closely related with arts like drawing, painting, music etc. All musical instruments like harmonium, drum, flute, guitar, violin etc. are played with the rules of mathematics.

Vocational values: Mathematics has great vocational values. Study of mathematics prepares the students for a wide variety of vocations. It finds extensive application in all vocations like: Agriculture, Accountancy, Banking, Business, Engineering, information technology, Tailoring, Carpentry and Surveying etc.

Psychological values: Mathematics helps to develop positive attitudes such as open mindedness, reasoning etc. The learning of mathematics is based on fundamental principles of psychology such as learning by doing learning through experiences and problem solving etc.

Teaching of mathematics, results in the development of a number of fruitful values in the students. Only a resourceful teacher of mathematics with his deliberate efforts and planning can make it possible for the students to realize these values. So, we have to realize the value & product good civilian for our nation and for the betterment of society.

1.8 Vision for School Mathematics: NCF 2005

- Children should enjoy the Mathematical calculation rather to fear.
- Children should be taught in a way that they understand that Mathematics is much more than the formulas and mechanical procedures.
- Content of the Mathematics for children should be designed in such a way that the children see mathematics as something to talk about, something to be discussed and something to communicate through. Children pose and solve meaningful problems.

- Children use abstract ideas to perceive relationships, to see structures, for reasoning of things, to argue the authenticity of statements.
- Children should know and understand the basic ideas of Mathematics: Arithmetic, Algebra, Geometry and Trigonometry. The basic content areas of school Mathematics, all offer a methodology for abstraction, structuration and generalization.
- Teachers should engage each and every student in class with the assurance that everyone can learn mathematics.

1.9 Vision of Teaching Mathematics: NEP 2020 (Source: NEP 2020 documents)

It stated that Mathematics education should involves in learning in such a way that children mind is going to become creative and they think logically. It is going to happen to know the fundamental concepts such as numbers and their operations, geometry, algebra, probability, and statistics. It also aims to nurture the fundamental mathematical capacities of learners to find the patterns, providing explanations through logical reasoning, creativity, problem-solving ability, computational thinking, and logical communication. Communication in mathematics may apply through both modes like oral and written.

There are four stages to get learning

- **Foundational stage:** In this stage learner is attaining foundational numeracy it means understanding the Indian numerals, adding and subtracting the Indian numerals and represents the key focus of Mathematics Education.
- **Preparatory stage:** In this stage learner focuses shifts to the development of concepts such as numbers, basic operations in multiplication and division, shapes, and measurement.
- **Middle stage:** In this stage learner emphasis moves towards abstracting some of the concepts learned in the preparatory stage in order to make them more widely applicable.
- **Secondary stage:** In this stage learner focuses on developing the ability to justify claims and arguments through logical reasoning.

The aims of Mathematics Education NEP 2020

1. Develop the capacities such as finding patterns in Arithmetic, making conjectures, justification with logical reasoning, develop the creativity, applying problem solving abilities, computational thinking, and clear communication in both modes i.e., oral and written.

2. Develop the conceptual and procedural knowledge of numbers, operations of numbers, geometry, algebra, probability, and statistics knowledge in learners.
3. Values such as strictness and integrity in communication and formulation of arguments; and dispositions such as curiosity, wonder, and perseverance in learners.

Recommendation in methods of teaching Mathematics NEP 2020

Play-way (activity based) method: This method develops desirable attitudes and skills in learners. It gives confidence to children to play many types of games and toys are now available to children which have their roots in mathematical concepts or ideas. This method focuses the concept of learning by doing. They are an active part in the acquisition of their own mathematical knowledge. The model is based on a pragmatic basis of “hands on” – something very similar to the process of learning a trade: a shoemaker apprentice learns working in a shoemaker’s workshop not in a classroom. Thus, students are like mathematician apprentices that learn applying their previous knowledge in a sort of mathematics workshop. Learning arises in a social context of collaboration and harmony, and the teacher is a guide that leads the process, designs the teaching activities and monitors the whole process.

Discovery/Inquiry-based method: This method allows learners to explore the academic content by posing, investigating and answering the questions.

It involves finding out by the students. The teacher’s role is to provide timely guidance and supplementary materials and ask thought provoking questions to lead them in right direction.

This method is more important from educational point of view because in this method students work like a researcher and solve the problems. By use of this method, spirit of enquiry, scientific and mathematical attitude can be developed in learners.

Problem solving method: Through a problem-solving approach, this aspect of mathematics can be developed. Presenting a problem and developing the skills needed to solve that problem is more motivational than teaching the skills without a context. The problem methods aim at presenting the knowledge to be learnt in the form of a problem.

The children are curious by nature. They want to find out solutions of many problems, which sometimes are puzzling even to the adults. The problem-solving method is one, which involves the use of the process of problem solving or reflective thinking or reasoning. Problem-solving method, as the name indicated, begins with the statement of a problem that challenges the students to find a solution. Simple puzzles

can help develop in students' skills of logical and creative thinking in an enjoyable manner (DNEP 2020, Sec. 4.6.5 pg.93).

Inductive method: This method is based on principle of induction. Induction means to establish a universal truth by showing that if it is true for a particular case and is further true for a reasonably adequate number of cases then it is true for all such cases. It leads us from known to unknown, concrete to abstract, particular to general, observation to theory and example to formula. An Inductive approach to instruction is a more child - centered approach.

Deductive method: This method is based on principle of deduction. Deduction means to know the process by which a particular fact is derived from some general known truths.

It leads us from unknown to known, the learner proceeds abstract to concrete, general to particular, theory to observation and formula to examples. A deductive approach to instruction is a more teacher-centered approach.

1.2 Meaning of Aptitude

Aptitude is nothing but a natural ability. An innate or acquired character of capacity for a specific rationale, action to a particular effect, as oil an aptitude is a zeal to burn. An aptitude is a dimension of an ability to carry out specific kind of work at a specific level, in other words it is a measure of hidden "talent". Aptitude can be physical or intellectual. Aptitude is not just information, sympathetic, academic or any other acquired special skills. The inborn personality of aptitude is in compare to academic achievement, that characterizes facts or capability that is acquired.

Aptitude is a person's ability acquired or innate, to learn or develop knowledge or a skill in some specific area (Singh, 1987). We can find peoples with special abilities or talents which makes them to perform well in certain fields. Those people have special types of aptitude and therefore, they are able to learn and acquire the necessary skills in a specialized field. They are also interested in such activities as per their liking; further success or achievement in a given field of knowledge or activity depends to a great

extent upon attitude and interests. Aptitude is inferred for relative levels of achievement. If individuals given comparable opportunities to acquire a skill differ in the case of acquiring it or in the level of proficiency attained, then it is inferred that they differ in their aptitude for a particular work. Aptitude is more or less specific. An individual may have a high degree of aptitude for one line of work and not for certain others. There are of course people having a wide range of aptitudes. Some good scholars are also versatile in other directions. A farmer may not only be good at farming but also a successful person in business, music, athletics etc. There are people with a very narrow range of aptitudes. These can do only a few things well. Those with high aptitudes for particular types of work and those with low aptitude are relatively few in number. Most people have an intermediate degree of aptitude and in a large unselective group.

School education in recent times, has emerged as an important segment of the total educational system expected to contribute significantly to the individual as well as national development processes. Today the important need of India, is to produce the right type of grown-up children who will one day take the responsibility of their own and also handle the problems of our country and lead the uneducated masses to the right path of social and economic development. Our dreams can only be true if and when educated boys and girls are equipped with sterling qualities of head and high to lead the masses and to take the work of future development in their own hand. It can only be possible by classifying them according to their abilities, qualities through aptitude test. Aptitude can be considered as the phase or area of an individual's mental ability in which he can be expected to continue to improve to a point of exceptional performance. The word 'Aptitude' has been derived from the word "Aptos" which means "fitted for". Whenever we talk of an individual aptitude, we are looking for his or her future by considering his or her abilities or capacities. Hence to put it in simple words, it may be said that an aptitude is a special ability or special capacity of an individual. Consider a child having liking for mathematics but this is not enough for him, he should also have aptitude for the subject. Thus, when an individual's aptitude for a given type of activity

is to be taken into consideration, we mean his or her potentialities at present, as revealed by his performance on select tests which have a predictive value.

1.2.1 Types of aptitude: Some of the well-known aptitude tests are –

Professional aptitude

When we perform various activities based on professions and occupations are included in this category. This aptitude is able to help an individual for predicting the future success in this field of profession. If the teacher has profession aptitude, then he/she is the best teacher for making the better future for students and he or she will be a successful teacher in terms of teaching. Teachers are going to perform better in the classroom by using professional aptitudes. It is a good opportunities and training for students who is going to get education by professional aptitude teachers.

Creative aptitude

Creative aptitude can be used to analyze our creative potential. It is an area of strong current interest in creativity. Some interest has been generated because of the importance of creativity in certain occupations for the betterment of learners. Through this test usually contains questions related to sketching, drawing, storytelling, etc. This test is administrated to know the skills of learners. Power of observation, innovative ideas of learners, constructive approach of learners.

Scholastic aptitude

Scholastic aptitude can be used to predict performance in academic situations. They differ from general intelligence primarily by having a more limited focus, concerning academic performance. However, both general intelligence and multiple aptitudes tests predict academic success and as basic intellectual skills are important determiners of success in most educational settings. Through this test usually contains questions related to verbal and non-verbal reasoning, general mathematics questions, etc.

This test is administrated to know the reasoning skills of learners and capability of learners to perform better in academics.

Vocational aptitude

Vocational aptitude can be used to know the individual's potential for success and satisfaction in a variety of occupations. The concept of vocational aptitude is much broader, covering vocational and occupational aptitudes. Through this test usually contains questions related to verbal reasoning, numerical reasoning, etc. This test is administrated to know the vocational skills of learners and capacity to work in different situations. To develop the practical skills and apply in industries for the betterment of organization. It focuses on vocational skills and emphasis prediction of vocational rather than academic criteria.

Mechanical aptitude

Mechanical aptitude can have administrated to know the individual's mechanical understanding and mechanical knowledge for success and satisfaction in a variety of

occupations specially to industries. It is a combination of sensory and motor capacities plus perception of spatial relations, the capacity to acquire information and knowledge about mechanical matters and the capacity to comprehend mechanical relationships. This test includes various questions based on forces, levers, pulleys, gears, springs, simple electrical circuits, hydraulics, tools, etc.

Some of the well - known mechanical aptitude tests are –

1. Minnesota Mechanical Assembly Test.
2. Minnesota Spatial Relations Test
3. Bennet Tests of Mechanical Comprehension.
4. S.R.A. Mechanical Aptitude Test.

Clerical aptitude

Clerical aptitude can have administrated to know the individual's ability for administrative competencies and clerical roles. Through this test usually contains questions related to verbal ability, numerical ability, reasoning, etc.

According to Bingham (1973), it involves several specific abilities like:

- **Perceptual ability:** Ability to perceive word and numbers with speed and accuracy.
- **Intellectual ability:** Ability to grasp the meaning of words and symbols.
- **Motor ability:** Ability to use various types of machines and tools like typewriter, duplicator, cyclostyle machine; punching machine etc.

Some of the popular clerical aptitude tests are –

1. Detroit Clerical Aptitude Examination.
2. Minnesota Vocational test for clerical workers.
3. The Clerical Ability Test prepared by the department of psychology, University of Mysore, Mysore.
4. Test of Clerical Aptitude prepared by the Parsee Panchayat Guidance Bureau 209, Hornyby Road, Bombay -1.

1.2.2 Mathematical aptitude

Mathematical aptitude refers to an individual's capacity to quickly perform mathematical operations. It is one of several cognitive abilities that a person can have a strong preference for, or capacity, to perform. A person with Mathematical aptitude can perform mathematical computations quickly. Individuals with strong numerical aptitude may excel at jobs in accounting, engineering, sales, or finance. Aptitude tests are designed to detect an individual's cognitive strengths and weaknesses. Since the 1930's, the U.S. Department of Labour has used various forms of these aptitude tests to help job seekers discover their work-related abilities. Other organizations also use aptitude tests to assess individuals. The results of aptitude tests can be used by job seekers and

employers to help pair employees with jobs that are a good fit for their cognitive capabilities. Numerical aptitude indicates that a person has strengths related to numbers and mathematics. Using this information, a career counsellor or trainer can help an individual to find jobs that can use his or her particular skill set.

Mathematics is a subject which provides the master key to almost all the subjects whether be of arts and science streams. Mathematics is omnipresent in almost every part of our life. Mathematical power requires the enhancement of self-confidence, a disposition to pursue and use quantitative and spatial information for solving problems and making decisions. Student's interests, curiosity and flexibility also affect the acquisition of mathematical power. This power will help the students to advance in their life, skills and career. "Mathematics as an expression of human mind, reflects the active will, the contemplative reason and the desire for aesthetic perfection. Its basic elements

are logic and intuition, analysis and construction, generality and individuality." -Courant and Robbins, 1941 Mathematics disciplines the mind, systematizes ones thought and reasoning. The subject has also rich potentialities of affording true enjoyment to its students. Mathematics has practical and utilitarian values. It disciplines the mind plays an important role in the advancement of culture and civilization, develops all our intellectual powers, teaches truthfulness, honesty, patience, self-control and self-confidence, develops power of reasoning, gives shape and definiteness to the properties of matter. A part from this it has aesthetic, psychological, international, social, vocational and research values. Mathematics is an important subject in school curriculum. It is more closely related to one's daily life as compared to other subjects. Except one's mother tongue there is no other subject which is more closely related to one's daily life as mathematics. Mathematics is considered to be the father of all sciences. In fact, it starts right from kindergarten and holds a key position among other subjects even at primary and high school level. Today children are sent to schools for achieving different goals and it is assumed that the child will be able to achieve the following objectives: -

1. Acquisition of knowledge and skills.
2. Acquisition of various values on discipline and tolerance etc.
3. Acquisition of desired attitudes and ideas.

In post-Independence India, great emphasis has been placed on mathematics teaching and learning. The Indian education commission (1964-1966) has recommended “mathematics and science should be taught in compulsory basis to all pupils as a part of general education.”

Mathematics is widely recognized not only as a core component of the curriculum but also as a critical contributor to many educational and career opportunities. Central among the nation’s education goals is to help the child to discover himself, to develop his innate abilities and above all to cultivate desirable aptitudes. Aptitude also plays a very important role in the development of the personality of an individual.

Aptitude refers to those qualities characterizing a person’s way of behaviour which serve to indicate how well he can learn to meet and solve a certain specified kind of problem. Hence it becomes one of the most important functions of the counsellor to find a particular aptitude in child. Also, we are entering in an era where aptitude for a particular subject field is being given weightage. Mathematics now dominates almost every field of our life and our activities. In this age of science and technology. It has permeated through the human life in such a way that, it has now become every man’s everyday concern. To excel in mathematics aptitude towards it is mandatory.

1.3 Meaning of the Intelligence

Intelligence is cognitive potentiality which helps to increase the learning abilities in the students. It is defined as general cognitive problem-solving skills. A mental ability involved in reasoning, perceiving relationships and analogies, calculating, learning quickly etc. Some psychologists have divided intelligence into subcategories. For example, Howard Gardner maintained that it is comprised of seven components:

musical, bodily-kinesthetic, logical-mathematical, linguistic, spatial, and interpersonal. Other definitions are: “Intelligence is what you do when you don’t know what to do.” “Intelligence is a hypothetical idea which we have defined as being reflected by certain types of behavior. The word intelligence forms part of our ordinary stock of words which we use every day. In the field of psychology too, the word intelligence finds fairly comprehensive use but it has been defined in a number of ways by the scientists. “Intelligence as the ability to make profitable use of past experience. In other words, Intelligence is the ability to learn. It is Intelligence is the capacity to learn and it is the ability to adapt to one’s surroundings and adjust to relatively new and changing conditions. It is the property of recombining our behaviour pattern so as to act better in a novel situation.

Intelligence may be the considered as functional effectiveness of mental process perceiving, remembering, reasoning and helps the individual to adjust and adapt his thinking to changing environment and his conditions of his life.

1.4 Meaning of Problem-solving ability

The productive work involved in the evaluation of the situation and the strategy worked out to reach one’s set goals is collectively termed as problem-solving. This is an essential exercise for individual advancement and the advancement of society. A child is not born with these abilities, but has to develop these abilities through course of his life time with the help of his parents, teachers and society at large. Therefore, it is very important for the parents and teachers to understand the psychology of problem-solving. Problem-solving ability is highly correlated with intelligence, reasoning ability and mathematical ability. It is the ability to think and reason on given level of complexity. Problem-solving in mathematics is a fruitful exercise for the development of one’s mental abilities as the process of problem solving involves the scientific method of thinking and reasoning. Problem-solving take place when there is an obstruction of some sort in the achievement of an objective. If the path towards the goal is straight and open,

then there is no problem. It is the frame work or pattern within which creative thinking and reasoning takes place.

Problem solving is a mental process which is the concluding part of the larger problem process that includes problem finding and problem shaping where problem is defined as a state of desire for the reaching of a definite goal from a present condition that either is not directly moving toward the goal, is far from it or needs more complex logic for finding a missing description of conditions or steps toward the goal **(Robertson)**.

1.4.1 Procedure for Problem-solving

1. Identifying and defining the problem

The student should be able to identify and clearly define the problem. The problem that has been identified should be interesting challenging and motivating for the students to participate in exploring.

2. Analysing the problem

The problem should be carefully analyzed as to what is given and what is to be find out. Given facts must be identified and expressed, if necessary, in symbolic form.

3. Formulating tentative hypothesis

Formulation of hypothesis means preparation of a list of possible reasons of the occurrence of the problem. Formulating of hypothesis develops thinking and reasoning powers of the child. The focus at this stage is on hypothesizing – searching for the tentative solution to the problem.

4. Testing the hypothesis

Appropriate methods should be selected to test the validity of the tentative hypothesis as a solution to the problem. If it is not proved to be the solution, the students are asked to formulate alternate hypothesis and proceed.

5. Verifying of the result or checking the result

No conclusion should be accepted without being properly verified. At this step the students are asked to determine their results and substantiate the expected solution. The students should be able to make generalizations and apply it to their daily life. Most

of the time, the teachers are held responsible for the poor performance of the students in mathematics. Furthermore, the Mathematics education at primary level determines the performance of students at secondary stage.

1.4.2 Problem-solving strategy

On the other hand, we use "answer" to mean a number, quantity or some other entity that the problem is asking for. Finally, a "solution" is the whole process of solving a problem, including the method of obtaining an answer and the answer itself.

Some problems in School Mathematics education as follows: -

1. Most of students have a sense of fear and anxiety regarding Mathematics. Therefore, they give up early on, and drop out of serious mathematical learning.
2. The curriculum is disappointing not only to this non-participating majority, but also to the talented minority by offering them no challenges.
3. Problems, exercises and methods of evaluation are mechanical and repetitive, with too much emphasis on computation. Areas of Mathematics such as spatial thinking are not developed enough in the curriculum.
4. Lack of confidence, preparation and support of Teachers.

1.4.3 Problem-solving makes mathematics useful

As noted earlier, the belief that mathematics should be useful, outside of school, has a long history. The current version of this approach emphasizes the presentation of real-world problems as a major part of the curriculum (Boud & Feletti, 1991a; Cognition and Technology Group at Vanderbilt, 1990; Streefland, 1991). The logic of this approach usually runs as follows. Mathematics is useful if it helps to solve professional or everyday tasks. Students will be more likely to see appropriate applications if they spend considerable time working in applied situations and, in fact, will acquire domain-specific knowledge while doing so. Problems then become valued to the extent that they embed mathematics in outside-of-school contexts. Prawat (1991) expressed concern that the emphasis on solving problems can easily become too utilitarian. He says when useful

mathematics becomes synonymous with learning strategies for solving problems, attention shifts to procedures and away from ideas. Practical skills become overvalued and important ideas are neglected. Our critique is somewhat different than Prawat's (1991). We believe that real-life problems provide a legitimate context for problematize mathematics. If students are engaged in solving as reflective activity, then the concern about an overemphasis on skills disappears. Our concern rests with the narrowness of this approach. Real-life or everyday problems are one context, but only one context, for reflective inquiry. The value of a problem depends on two things: whether students problematize the situation and whether it offers the chance of leaving behind important residue. The first depends not so much on the task as on the culture of the classroom. This issue will be revisited in the next section. The second does depend on the task. Tasks with different content are likely to leave behind different residues. But the residues identified earlier depend as much on the mathematical ideas embedded in the task as on the way it is packaged. Of course, important mathematical residues can be left by grappling with real-life problems. We argue only that the mathematical content be considered seriously when selecting tasks and that the definition of usefulness be expanded to a variety of problem situations, including those contextualized entirely within mathematics.

1.4.4 Problem-solving engages students

A common argument for problem-solving is that good problems are motivational. Intriguing or relevant problems will pique the interests of students and engage them in mathematics. There is an overlap between the advocates of this view and the previous one because it is often proposed that the problems with which students will become most easily engaged are those which are taken from their everyday lives. Our concern with this view is that it can easily lead to the belief that the source of interest and motivation is the task. We believe that the basis for engaging a task is not the task itself but the prior knowledge of the student and the conditions under which the task is completed (Hatano, 1988). Whether students perceive a task as a problematic situation and whether they become actively involved in searching for solutions depends on the knowledge they

bring to the task, the opportunities that are provided for solving it, and the values and expectations that have been established in the classroom (Ball, 1993; Cobb, Wood, Yackel, & McNeal, 1992; Fennema, Franke, Carpenter, & Carey, 1993; Fuson, Fraivillig, & Burghardt, 1992; Lampert, 1991; Murray, Olivier, & Human, 1992, 1993; Resnick, Bill, & Lesgold, 1992). If presented at an appropriate time, tasks such as the difference between 62 and 37, tasks that some teachers might see as boring and routine, can be engaged by students as genuine problems. The students in Ms. Hudson's class were intensively engaged in the task, not because they had a burning interest in how much taller Jorge was, but because the class had established a culture in which the students knew they had the freedom and responsibility to develop their own methods of solution. Earlier we noted that this view represents a departure from Dewey. In particular, it represents a departure from his belief that outside-of-school tasks have a higher interest value for students and are more likely to be treated problematically. Much of his essay *The Child and the Curriculum* (1956) is devoted to critiquing the curriculum in the schools as lifeless, predigested by adults, and unconnected to the lives of children. The tasks, Dewey said, are dull and do not allow children to experience the subject. Later, when pointing to real-life tasks as more naturally engaging, he said, "Probably the most frequent cause of failure in school to secure genuine thinking from students is the failure to ensure the existence of an experienced situation of such a nature as to call out thinking in the way in which these out-of-school situations do" (1933, p. 99).

We agree that genuine thinking is too often absent from classrooms, but we believe that the source of the problem is not so much the tasks themselves as the way in which students are expected and allowed to treat them. Too often students are shown a procedure and asked to apply it in a straightforward way. They have few opportunities to treat situations of any kind problematically. Outside-of-school problems can provide contexts for important mathematical work, but the packaging of the task is not the primary determinant for engagement.

1.4.5 Relation of problem-solving ability with intelligence and mathematical aptitude

Problem solving ability is highly correlated with intelligence, reasoning ability and mathematical aptitude. It is the ability to think and reason on given level of complexity. Problem solving in mathematics is a fruitful exercise for the development of one's mental faculties as the process of problem solving involves the scientific method of thinking and reasoning. A thorough understanding of mathematical concepts is essential for solving problems in mathematics. A student having good problem-solving ability will be properly adjusted in the class as well as at home. Mathematics is an essential discipline because of its practical role to the individual and society. Through a problem-solving approach, this aspect of mathematics can be developed. Presenting a problem and developing the skills needed to solve that problem is more motivational than teaching the skills without a context. The problem methods aim at presenting the knowledge to be learnt in the form of a problem.

The child is curious by nature. He/ She wants to find out solutions of many problems, which sometimes are puzzling even to the adults. The problem-solving method is one, which involves the use of the process of problem-solving or reflective thinking or reasoning. Problem-solving method, as the name indicated, begins with the statement of a problem that challenges the students to find a solution.

1.4.6 Mathematical aptitude in relation to intelligence and problem-solving ability

Despite the fact that mathematics is important for our cultural growth as well as our personal development, it is not a favorite subject among many pupils. Mathematics is taught as if it were a mechanical topic, with no creativity or practical methods.

Students are rarely taught how to build mathematical calculating skills. They are not encouraged to improve their problem-solving skills or increase their mathematical thinking aptitude. The All-India survey regarding achievement of Mathematics (1970) indicates that children's mathematical cognition at the basic level is below the expected level. So, role of Mathematics teacher is the most important to transect knowledge

amongst the learner. The best teacher is the one who teaches less but inspires more and more. Teachers should teach based on their experience not only through books and abstraction.

If the answer books from the secondary school examination are inspected, it may be noticed that a large proportion of students failed mathematics. Who is to blame for such an ugly situation: the pupils, the parents, or the teachers? Is a fear of science and mathematics an inherited or acquired trait? The answer is debatable. In our society, there is a widespread belief that the more intellectual a person is, the better his mathematics skills will be. However, despite having a similar I.Q., two persons may have different perceptions, judgments, reasoning, word fluency, vocabulary, spatial orientation, and so on. On the one hand, intelligence is concerned with general mental capacity, whereas aptitude is focused with sensory motor, mechanical, creative, or professional skill. We can tell the likelihood of the branch of profession more fit for the individual by understanding their intellectual level based on an intelligence test or school progress.

Mathematical aptitude is a person's capacity to solve logical, intellectual, abstract, or any other practical challenge that arises in everyday life. Essentially, aptitude is a combination of natural attributes that point to a person's ability in a particular profession. Intelligence, on the other hand, is an innate talent that helps an individual in making adjustments, abstract thinking, and acquiring knowledge. As a result, intellect may have a role in the development of a person's mathematical aptitude. Several researches have been conducted to assess the effect of intelligence on the development of mathematical aptitude.

1.5 Rationale of the Study

We know that all scientific education is based on the subject of Mathematics and their application. Its neglect means to remain ignorant about all other sciences. We should not forget that right from morning till evening, all our activities and engagements are controlled and fashioned by mathematics. Mathematics is an exact science and involves high cognitive abilities and powers. Mathematics is a form of reasoning and consists of thinking in a logical manner, formulating and testing conjectures, making sense of concepts, formulating inferences, conclusions and judgments as well as justifying them. Mathematics is more than calculation and memorization of basic facts and manipulation of symbols. Students who truly understand or make sense of mathematical concepts are not just manipulating symbols or following rules invented by others to solve problems. They are applying rules and inventing solutions by using logical thinking and reasonableness of solutions. National Policy on Education (1986):- has considered the importance of mathematics in general education and suggested that, “Mathematics should be visualised as the vehicle to train a child to think, reason, analyse and to articulate logically.” Mathematics helps us to develop our intellectual powers like power of imagination, memorization, logical thinking and reasoning. Student’s flexibility, interest, curiosity and creativity also affect the acquisition of mathematical power. Study of mathematics is helpful in learning most of school subjects. Also, prosperity of a nation and human resource development largely depends upon the development of the creativity of an individual. The school climate provides the framework within which students, teachers, administrators and parents function co-operatively and creatively. In an educational system, creativity in the student is monthly neglected. Teachers in the school are so busy in their academic routine that they find little time to think of creativity and the means to foster it. Therefore, proper learning styles established during the academic years have a lasting impact. There are many factors, which may influence the learning styles like - effective study, reading, observation, conclusion, self- confidence etc. If the teachers provide the rich learning experiences through magazines, newspapers, journals, books and other mass media. It

will definitely help in good learning styles among students and create them interest in learning.

Mathematics is very essential in any learning programme. It is most important school subject because of its utility in personal use, home, finance, clerical work, book keeping, teaching, statistical engineering etc. Mathematical aptitude measurement gives an indication of ability to succeed in mathematics such as achievement in mathematics. It is more important for the researcher so, that they can capitalize the opportunities according to the interest, taste and aptitude of the trainees. A control goal for all levels of mathematics education is the development of mathematical power for all the trainees. In particular, mathematical power include the ability to explore, conjecture and reason logically; to solve non – routine problem's, to connect concepts within mathematics and between mathematics and real–world situations, to read, write, listen and speak mathematically. This power will help the learners in their future life.

The primary education of Sikkim is entirely depending upon the teachers trained in different DIETs of Sikkim. The Mathematical aptitude of pre-service teachers of DIETs can determine the course of mathematics education at the primary level. A considerable number of pre-service elementary teachers belong to the tribal society of Sikkim and their performance in teaching mathematics can lead the mathematics education in the state.

Therefore, it is important to study the aptitude level of the pre-service teachers of DIETs and make a comparison of the mathematical aptitude, intelligence and problem-solving aptitude between tribal and non-tribal pre-service elementary teachers. The study is also going to compare between male and female; government and private colleges; mathematical and non- mathematical background trainees of their mathematical aptitude, intelligence and problem-solving aptitude. Such study can help the state govt. to design better training module to equip pre-service elementary teachers in mathematics education. So, that they can impart proper mathematical skills on the learners at primary level which can further improve mathematics education at secondary and tertiary level.

Findings of the present study will be helpful to state government and DIETs authorities including teachers and principals to know and understand the level of mathematical aptitude, intelligence and problem-solving aptitude for their academic performance and better future.

Individuals' perspectives are changing today, and they are becoming more motivated to acquire a passion for mathematics. Mathematics has been acknowledged as a symbol of human progress by all great educators, like Herbert, Pestalozzi, and others. Given the enormous importance of mathematics in everyday life, we can say that understanding of mathematics is essential and will continue to grow as requirements grow. The question is what are the variables that are most likely to lead to the development of mathematical aptitude? As soon we locate them, we will be able to begin orienting our children in order to help them in conquering their fear of mathematics and build an enthusiasm in it.

1.6 Research Questions

1. What is the Mathematical aptitude level, Intelligence and Problem-solving ability of tribal and non -tribal pre-service elementary teachers of Sikkim?
2. What is the relationship among of Mathematical aptitude with the variables like Intelligence and Problem-solving ability of tribal and non-tribal pre-service elementary teachers of Sikkim in relation to their gender, management and stream of study?

1.7 Statement of the Problem

It is universal truth that mathematics is related to every kind of subject. India like any other developing countries must have an exceptional or at least adequate level of mathematical achievement to ensure that it can easily compete with and win over other economies. Youngsters coming with proper mathematical skills play a vital role in India's future social and economic development. Achievement in mathematics is important because it underpins many other fields such as science, technology, business and finance. It is a fundamental requirement for the growth of knowledge, economy and

the development of a world-class research and innovation system in India but even then, we can find in students feel of fear and tough towards learning Mathematical concepts since they are abstract in nature. It is highly expected and even it is the duty of every Mathematics teacher to make the concept simple, lucid and easily understandable. But quiet many of the mathematics teachers use the boring chalk and talk method where the students are passive listeners. Instead, the students should be active while teachers should be more passive and understanding. Teacher should help them to learn and improve. Students of present era need to be actively involved in teaching learning process to sustain interest, hence make the learning more concrete and enjoyable which satisfies their changing needs and thereby enabling independent lifelong learning which contributes to the development of the students' academic performance. It is required for students to develop mathematical skills to even bring progress in their academic performance. It can be seen that Mathematics is a product of developing skills of changing information and changing needs and Mathematical learning is based on basic mathematical aptitude, intelligence and problem-solving abilities. The gradual organization of various ideas and concepts will lead to learning being more effective and bring success in their lives. Therefore, it is true that level of mathematics performance depends upon the presence of mathematical aptitude, intelligence and problem-solving abilities. Can the Concept of mathematical aptitude, intelligence and problem-solving abilities be effectively used for mathematics instruction? Is it really feasible for the academic performance of the students? Can the performance of trainees be better using mathematical aptitude, intelligence and problem-solving abilities? Can mathematical aptitude, intelligence and problem-solving-abilities be effectively used for developing cognitive skills? When the studies were reviewed, it was found that the mathematical aptitude, intelligence and problem-solving abilities are correlated and work in building an effective strategy for better learning, but whether or not it can make a steady progress in the learning is dependent on the trainees who constitute a considerable number in the classroom situation. The researcher assumes that mathematical aptitude, intelligence and problem-solving abilities are effective for the pre-service elementary teachers of Sikkim.

Based on this assumption, the following problem for this study is formulated.
“Mathematical Aptitude of Pre-service Elementary Teachers of Sikkim in relation to Intelligence and Problem-Solving Ability”

1.8 Objectives of the study

1. To construct a mathematical aptitude standardized scale for pre-service elementary teachers of Sikkim.
2. To study the mathematical aptitude, intelligence and the problem-solving ability of pre-service elementary teachers of Sikkim.
3. To compare the mathematical aptitude of tribal and non-tribal pre-service elementary teachers of Sikkim.
4. To examine the correlation between mathematical aptitude and intelligence of pre-service elementary teachers of Sikkim.
5. To examine the correlation between mathematical aptitude and problem-solving ability of pre-service elementary teachers of Sikkim.
6. To examine the correlation between intelligence and problem-solving ability of pre-service elementary teachers of Sikkim.
7. To examine the test of significance relationship between mathematical aptitude, intelligence and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.

1.9 Hypothesis of the study

1. There is no significant difference between the mathematical aptitude and intelligence of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.
2. There is no significant difference between mathematical aptitude and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.

3. There is no significant difference intelligence and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.

4. There is no significant difference between mathematical aptitude, intelligence and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.

1.10 Operational Definitions of the Key Terms: The key terms used in this study are given below: -

Mathematical Aptitude: It is a special ability of a person to counter the logical, intellectual, abstract or any other practical problem of daily life.

Intelligence: It is also an innate ability that helps one make adjustment, do abstract thinking and acquire the ability to understand.

Problem-solving ability: It is an ability to solve the difficulty or problem in the respective subject.

DIETs: District Institute of Education and Trainings. It is a nodal agency for providing academic and resource for elementary education where students are getting trainings after passing the class 12.

Tribal and non-Tribal: Tribal refers to ST (schedule tribe) and non-tribal refers to General, OBC (other backward class) & SC (Schedule Caste).

Pre-service elementary teachers: Students who are enrolled in D.El.Ed /Elementary teachers training course in different teacher training Institutions.

CHAPTER II

REVIEW OF RELATED LITERATURE

2.1 Meaning of review of related literature

It is an important to review literature related to the study in order to learn more about the study, determine the context in which the study might have been researched previously and obtain guidance that will help in putting the research efforts more swiftly.

Review of literature serves several purposes in research. Knowledge from related literature is used in stating the significance of the problem, developing the research design, relating the results of the study to previous knowledge and suggestions for further research. It enables the researcher to define and limit the problem and helps in placing the problem in a historical and associational perspective. A thorough search of the related literature enables the researcher to avoid unintentional and unnecessary replication. Previous investigations provide a rationale and insight for the research design. Review of related literature helps in relating the findings to previous knowledge and suggest for further research. Keeping in mind the importance of review of related literature, investigator reviewed various primary sources of information and secondary sources of information. They are listed below:

Alibraheim and Al-hussary (2021) studied on investigating pre-service elementary teachers' mathematical power. The findings showed that pre-service teachers had a low level of mathematical power, and there were three factors that contributed to the pre-service elementary teachers' low level of mathematical power. It could improve pre-service teachers' mathematical power domains including mathematical communication, connection, and reasoning.

Bindu (2021) studied on problem-solving ability among 9th standard students in relation to their emotional intelligence and achievement in Mathematics. It was found that problem- solving ability of 9th standard students is positive. There is significant influence of emotional intelligence at 0.01 level on the problem-solving ability of 9th standard students and there is also significant influence of achievement in mathematics at 0.05 level on the problem-solving ability of 9th standard students. It was also

observed that performance of high age group students is better than low age group students, performance of urban students is better than rural students, the private school students performed better than the government school students and performance of high emotional intelligence group is better than low emotional intelligence group.

Dhoundiyal and Rawat (2021) conducted a study of Mathematical aptitude in relation to intellectual abilities of secondary level students. The study found that mathematical aptitude is an inborn construct not strictly independent and to some extent it is subjected to environmental influences and intellectual ability of an individual. It is also found that ascertain either a high or a moderate positive correlation between intellectual abilities and mathematical aptitude along with all its five dimensions like Numerical ability, Numerical reasoning, Abstract reasoning, Spatial ability and Ability to use symbols.

Milan (2021) conducted a study of problem-solving ability aptitude and interest in the achievement of Mathematics among secondary school students. The result of the present study found that problem solving ability in mathematics and achievement in mathematics have very low positive correlation with each other. The study results also found that the aptitude in mathematics and achievement in mathematics have found very low positive correlation with each other and the study interest in mathematics and achievement in mathematics have found very low positive correlation with each other. The above findings concluded that the very low positive correlation of problem-solving ability in mathematics, aptitude in mathematics, interest in mathematics with achievement in mathematics, therefore we can conclude that problem-solving ability in mathematics, aptitude in mathematics, interest in mathematics all the variables will predict the student's achievement in mathematics among secondary school students.

Sarkar (2021) studied on impact of problem-solving skills to achieve in mathematical ability of the female students of secondary level of education. Researcher was collected 400 samples from four high schools at Habra Block II, North 24 Parganas district and Haringhata block, Nadia district. These samples were taken from class IX and X students of the age group 14-17 years. Stratified random sampling method were followed for collection of data. The statistical methods Mean, Standard deviation, Pearson product moment of correlation coefficient is applied. The study found that the problem-solving skills has a positive impact on achievement in mathematics of the female students of secondary level of education.

Voskoglou (2021) studied on problem-solving and mathematical modelling. The present study on problem solving and mathematical modelling from the scope of Education and it is a review of the most important results reported in the literature from the 1950's until nowadays. Its real goal is that it presents in a systematic way and in a few pages only the results of many years' research on the subject. This is going to help researcher to get a comprehensive idea about a very important topic belonging to the core of Mathematics education, which is very useful to those wanting to study deeper the subject and get directions for further research in the area.

Nagajothi (2020) studied on effect of self-regulatory training module to enhance the mathematical problem-solving ability of pre service teachers. The present study revealed that post test scores of the pre-service teachers of mathematics out performed pre-test scores in problem solving ability and self-regulatory awareness. It was also found that there was a significant mean difference between the pre-test and the post-test in problem solving ability and self-regulatory awareness among the pre-service teachers of mathematics in DIET, which clearly shows the positive influence of self-regulatory strategies with multimedia learning materials on problem solving ability in mathematics.

Borja, Ompoc, Temblor and Torello (2019) studied on the challenges among pre-service elementary teachers. The study revealed that there is a remarkable difference in the pre-service elementary teachers and the challenges they encountered when grouped according to age and gender and advised to engage the pre-service elementary teachers in different seminar-workshop that caters with the existing aspect as well as providing them with containing and development in teaching.

Ghatak and Mittal (2019) studied the topic on the problem-solving ability of school students in relation to their academic performance. Studies were reviewed to explore the bond between problem-solving ability and academic performance of students going to school. It was discovered that for the last few years, there is a notable positive relation between problem-solving ability and academic performance of students going to school. The study found that the problem-solving ability of school boys is significantly higher than that of the school girls.

Karademir (2019) studied on pre-service teachers' problem-solving skills and curiosity levels. The study found that pre-service teachers' problem-solving skills are seen to be

above the average value. It was determined that there was a significant difference in terms of gender according to scores obtained from the “monitoring” sub dimension and the “Problem-Solving Inventory”. It was determined that there was no significant difference in terms of grade level according to scores obtained from the problem-solving inventory. It was also found that pre-service teachers’ curiosity levels for “depth” sub dimensions are seen to be above the average value and there is an increase in the problem-solving skills scores of the pre-service teachers, the curiosity scores will increase.

Kumar and Kumari (2019) conducted a study of Mathematical aptitude of students in relation to achievement motivation at secondary level. The study found that there was significant difference between the mathematical aptitude of government and private; boys and girls; and the achievement motivation of government and private schools’ students at secondary level respectively but no significant difference was found between the achievement motivation of boys and girls; urban and rural; and the mathematical aptitude of urban and rural schools’ students at secondary level respectively. Also, significant relationship was found between achievement motivation and mathematical aptitude of students at secondary level.

Wassem (2019) studied on a study of the ways children solve Mathematical problems. It was found that children shown different strategies to solve the addition problems i.e. tallies or lines strategy, count all strategy, count on from smaller number strategy, count on from larger number strategy, column strategy, row strategy, decomposition and composition strategy, known and derived facts strategy, group of 10s and 5s strategy, and mental strategy. Data shown that children came up different strategies to solve the subtraction problems i.e., column strategy, tallies or lines strategy, counting bigger crossing smaller strategy, counting forward from smaller number strategy, counting backward from larger number strategy, number line strategy, V method or rainbow method or row strategy, decomposition and composition strategy, and mental strategy. Analysis revealed that children used different strategies to solve the multiplication problems i.e., column strategy, row strategy, repeated addition with decomposition strategy, repeated addition strategy, known and derived facts with subtraction or addition

strategy, splitting strategy, doubling strategy, mental strategy. It was found that children arrived at different strategies to solve the division problems i.e., tallies or lines strategy, grouping strategy, halving strategy, multiplication strategy, repeated addition strategy, short or long division strategy, and mental strategy. Analysis also shown that children also know various other names for the arithmetic operations like for addition they use plus, jma, jod, ikatha krna, for subtraction they use minus, ghata, kam krna, katna, for multiplication they use multiply, times, guna, cross wala, tables padna, for division they use divide, sharing, batna, kaatna, which directly or indirectly helped them to solve the problems. Interviewed with teachers also revealed that mostly teachers agreed upon it that most of the children of their classes are able to solve the problems orally or mentally though they may face difficulties in solving in written form. Researcher concluded that some of the ways which found to be differentiated from the routine classroom strategies and those mentioned in the textbooks are depicted here related with addition, subtraction, multiplication and division.

Hudda and Devi (2018) studied on effect of problem-solving ability on Mathematics achievement among secondary school students: an empirical study. The purpose of the present study is to investigate the mathematics achievement of students from secondary school in association to problem solving ability and gender. Descriptive survey method was used. Problem-solving ability and gender were treated as independent variables whereas Mathematics achievement was treated as dependent variables. The study revealed that problem solving ability and gender has a significant main effect on the mathematics achievement of secondary school students. However, no significant double interaction effect of problem-solving ability and gender on mathematics achievement of the secondary school students was found. Thus, efforts should be made to help the students to improve their problem-solving ability which will help them in improving their mathematics achievement.

Lubis, Syahputra and Siagian (2018) studied on improving students' ability in Mathematical problem solving through problem-based learning model in tenth grades state senior high school 7 of Medan. In the study PBL (problem-based learning) model had taken for experimental class and traditional learning had taken as a control class.

The significance value for Mathematical problem-solving ability in experimental and control class is 0.00 and it is less than 0.05. So null hypothesis is rejected. The study found that problem-based learning model is better than traditional learning for improving the Mathematical problem-solving abilities.

Aher (2017) studied on co-operative learning strategies academic achievement interest and problem-solving ability of students. The researcher showed that the developed intervention programme (including the lesson notes, the support material and the achievement test) was suitable to be implemented in the classroom. It is also found that co-operative learning strategies improves academic achievement, interest and problems solving ability in Mathematics.

Dandagal and Yarriswami (2017) studied on a study of intelligence in relation to academic achievement of secondary school students. The present study aimed at evaluating the academic achievement of students from secondary school in association to their intelligence. The study found that there is a notable relationship between academic achievements. The study also indicated that there is no significant difference in academic achievement of boys and girls in case different levels of intelligence achievement differs as a classroom affects the academic achievement of the students while students with different types of family climate also differ in their achievements.

Lizzie (2017) studied on problem-solving ability in association to their academic achievement among higher senior secondary students. It was revealed that there is a positive relationship between problem-solving ability in Mathematics and academic achievement. It is concluded that the academic achievement among higher secondary students is average as hypothesized. There is a significant difference between male and female higher secondary students in their problem-solving ability and academic achievement.

Mallart, Font and Diez (2017) conducted the study on case study on Mathematics pre-service teachers' difficulties in problem posing. Participants in the study were 10 pre-service teachers who were successful in problem solving. Data were gathered through qualitative techniques: classroom observations, sequences of tasks, questionnaires, student focus groups and discussion. The case study illustrated some of pre-service

teachers' difficulties in problem posing: creating problems that students recognize as relevant to their everyday lives, problems adapted to the school curriculum at a specific educational level, and problems that can be self-corrected. Problem-solving is very much a part of mathematics teaching classes, but problem posing is not addressed to the same extent. The Study also found that the pre-service teachers did not feel prepared to pose mathematics problems, because they had only been trained to solve them. They confessed that they did not have suitable resources or tools.

Mishra (2017) studied on scientific aptitude and achievement in Mathematics of students in Sikkim. It was found that boys have more scientific aptitude than girls. It is also found that scientific aptitude of urban students is more than rural students and positive real correlation exists between scientific aptitude and achievement in Mathematics.

Nahil M. Aljaberi and Eman Gheith (2016) conducted the study on “pre-service class teacher’ ability in solving Mathematical problems and skills in solving daily problems. The researcher aims to investigate the ability of pre-service class teacher for solving the mathematical problems by using Polya’s techniques and their level of problem-solving skills in daily-life issues at university of Petrain. This study is also trying to know the correlation between their ability to solve mathematical problems and their level of problem-solving skills in daily-life issues. The study sample consisted of 65 female students majoring in class teacher. Two questionnaires are used for data collection: the mathematical problem-solving test which was developed self-tools by the researchers and daily life problem solving scale which was developed by (Hamdi, 1998). The findings showed that students had high level skills in solving daily problems; there are no statistically significant differences in daily problem solving in relation to their academic year or high-school stream. Conversely, the findings also showed the weaknesses in students’ skills in solving mathematical problems, with no statistically significant differences among students in solving mathematical problems according to Polya’s problem-solving techniques/steps. However, there were statistically significant differences in students’ performance in solving mathematical problems in relation to the

mathematical topic, and in favor of measurements and algebra; in addition to statistically significant differences in students' ability to solve mathematical problems in relation to academic year and high-school stream, but no correlation between students' abilities in solving mathematical problems and those in solving daily problems. The findings revealed that the two were not correlated; however, students' high performance in solving daily problems but low performance in solving mathematical ones point out to a gap in transferring and using these acquired daily problem-solving skills knowledge and skills in solving mathematical ones. It can say in other words, mathematical inclination and mathematical problem-solving skills are completely separated from students' reality and daily life activity of responder.

Pyari, Mishra and Dua (2016) conducted a study of impact of aptitude in Mathematics as stream selection at senior secondary level. Present study explores the aptitude among higher secondary students. It is aimed to find out the effect of stream selection in terms of aptitude. A sample of 100 students has been taken from a government senior secondary school of Agra, Uttar Pradesh-India. Data is collected by administering Differential Aptitude Test (DAT). First of all, mean was calculated from the marks obtained by students in all the sections of the tool including Verbal Reasoning (V.R.), Numerical Reasoning (N.R.), Language Spelling (L.S.), Language Grammar (L. G.), Clerical Speed (C.S.), Clerical Accuracy (C.A), Mechanical Reasoning (M.R.), Abstract Reasoning (A.R), and Spatial Aptitude (S.A.). Researcher defines the percentile ranges i.e., 66th percentile and 33rd percentile according to this categorize students in three different categories. On the basis of above table, the percentage of students who lied in high, middle and low levels of different aptitude. The finding showed that there is found significant effect of aptitude in the stream selection process of the students and for mathematics numerical reasoning, clerical speed and accuracy, mechanical and verbal reasoning constitute the significant role for mathematics as careers option at higher secondary level. It concludes that Mathematics stream comprises high level of aptitudes such as numerical reasoning, mechanical reasoning and abstract reasoning. It had medium level of aptitude such as language-grammar, clerical speed and accuracy and

spatial aptitude. It also achieved low level in the aptitudes like verbal reasoning and language-spelling. So, Mathematics as a stream plays a significant role for selection numerical reasoning, mechanical reasoning, abstract reasoning, verbal reasoning, clerical speed and accuracy, spatial ability etc.

Roy (2016) studied on cooperative learning strategy for effective teaching to pre-service teachers. The study showed that the intervention programme based on cooperative learning teaching techniques was effective as a teaching strategy for the pre-service teachers.

Gupta, Pasrija and Kavita (2015) studied on effect of problem-solving ability on academic achievement of secondary school students: a comparative study. The present investigation has been planned out to examine the effect of problem-solving ability on the academic achievement of high school students. The study revealed that problem-solving ability had a significant result on academic performance of secondary school students. It is further revealed that the performance of female students was better than male students. Although, no interaction effect of problem-solving ability and gender was found on academic achievement of secondary school students.

Pathak (2015) conducted a study of problem-solving ability in relation to academic achievement of pupil teachers. A survey was conducted to find out the relationship between problem-solving ability and academic achievement of the pupil teachers of Jabalpur District which is in the state of Madhya Pradesh. The study revealed that the relationship between problem-solving ability and academic achievement is highly positive. There was a significant difference found between science and arts pupil teachers, no significant difference was found between arts-commerce, and science-commerce pupil teachers.

Sreeraj (2015) studied on relationship between multiple intelligences and achievement in mathematics of students at secondary level. It was found that the variables, linguistic intelligence and interpersonal intelligence are not significantly different between male and female students and for all other variables the mean scores of females are

significantly higher than that of male at 1% level of significance. The t- test showed that the mean achievement in mathematics for Govt. school students are not significantly different with the mean scores of private school students (sig. > 0.05). It was indicated that the relation between the selected components of multiple intelligences and achievements in Mathematics are significant. The study showed that the correlation coefficients of achievement in mathematics and linguistic intelligence is 0.432 for rural and 0.395 for urban school students. Both the correlation coefficients are significant at 1% level of significance. It is also shown that the intrapersonal intelligence and the achievement in mathematics are associated significantly at 1% level of significance. There was a significant relationship between components of multiple intelligences that discriminate against students of various achievement levels.

Bala (2014) studied on aptitude for Mathematics as predictor of Mathematical achievement. The present paper comprises the study of aptitude for mathematics as predictor of mathematical achievement, Researcher wanted to know the relationship between mathematical aptitude and achievement in mathematics and established the comparison of the mathematical aptitude in arts and science stream; male and female; urban and rural areas groups. Researcher adopted random sampling technique for the study of present problem. There were two stages to collect the sample. In the first stage 756 students selected from the class of 10+1 which belonged to arts and science stream from different schools which was situated in rural and urban area. Sample were collected from boys and girls of the state of Punjab. Researcher has constructed and standardized the Mathematical aptitude Test and it was used as a research tool. To know the academic achievement of class tenth students. Researcher has been measured the final examination marks which obtained by the students in the subject of mathematics which is conducted by Punjab school education board, Mohali. It was shown that the variable of mathematical aptitude was positively significantly correlated with the dependent variable of mathematical achievement. It was calculated at 0.01 level of significance ($r=0.424$). The study founded that mathematical aptitude and mathematical achievement of students go hand in hand with each other and mathematical aptitude is a major factor

of deciding their mathematical achievement. The significant difference of students in the mean scores was found at 0.01 level ($t=5.50$) due to faculty differences. It was found that mean score and standard deviation of science students ($M=16.66$, $SD=5.18$) is more than mean score and standard deviation of arts students ($M=14.68$, $SD=4.67$) after comparing the mean scores on mathematical aptitude test. It can conclude that science students' group have more mathematical aptitude than arts students' group. So, there was no significant difference in the mean scores of male and female students' groups ($t=0.30$). It can say that mathematical aptitude of boys and girls do not differ much although after comparing the mean scores. It was found that mean score and standard deviation of male students ($M=15.71$, $SD=5.44$) are slightly higher as compared to mean score and standard deviation of female students ($M=15.60$, $SD=4.56$) on the variable of mathematical aptitude. The significant difference was observed on the variable of mathematical aptitude in the mean score of the students who belonged to rural and urban group ($t= 3.53$). It illustrates that urban area students differ significantly from rural area students at 0.01 level on mathematical aptitude test but the mean scores of urban students ($M=16.28$) were higher than rural students ($M=15.00$). It may say that urban students have more mathematical aptitude than rural students. Whereas, the score of standard deviation of rural students ($SD=5.03$) was more than urban students ($SD=4.94$). Finally, it concluded that mathematical aptitude of arts and science group students differ significantly but boys and girls do not differ much in mathematical aptitude. There was significant difference in the mathematical aptitude of rural and urban groups. Thus, Mathematical aptitude plays vital role in the achievement of the students in the subject of mathematics.

Dhyani (2014) studied on a study of mathematical aptitude in relation to intellectual and problem-solving abilities of secondary level students. Study found that Mathematical aptitude is not merely a skill in solving mathematical problems. Rather, it is an aptitude that embraces any characteristics which predisposes to learning, including the intellectual ability, personality, interest and special skill like problem-solving. The study also revealed a significant impact of stream on all the five dimensions of Mathematical aptitude as well as the intellectual ability and PS ability. In case of NR the impact of arts

stream was not found to be significant while the intellectual ability and problem-solving ability were found to be significantly affected by science stream only. The findings indicate that students who opt for science stream generate a systematic perception which enables them to score significantly high on intellectual ability and problem-solving scores.

Feldhaus (2014) studied on how pre-service elementary school teachers' Mathematical dispositions are influenced by school Mathematics. The study looked to examine the mathematical beliefs and attitudes of prospective elementary school teachers as they have progressed in the program. When asked about the experiences the participants thought was most important in their mathematical history, the majority of instances described occurred in elementary school. Thus, it would seem that most of the experiences that form positive (and negative) mathematical dispositions happen before middle school, with experiences that happen after that either confirming their already existing disposition or being outliers to the event. For example, Sammie (who scored second best of the instrument) said that she liked mathematics even after "having a terrible math teacher" in college. Similarly, Megan (who scored the lowest) said that she had "awesome" mathematics teachers in college, yet she still disliked mathematics. Unfortunately, that means that influencing the mathematical dispositions of preservice or prospective elementary school teachers in teacher education programs is difficult. However, it reaffirms the necessity to improve the mathematical dispositions of prospective elementary school teachers so that their students may benefit from teachers with positive dispositions. This was not a fact lost on Megan, who shared her own concerns about negatively influencing the mathematical dispositions of her future students. Positive mathematical disposition can be attributed to the student (teacher candidate) having regular small positive experiences where they could succeed with mathematics during their elementary school career (e.g. receiving regular homework help from a parent) while negative mathematical dispositions are formed from individual traumatic mathematical events in the teachers' elementary school career (e.g. being publicly embarrassed about an assignment). It concluded that A student's mathematical disposition is a key component to his or her success learning mathematics, and an

elementary school teacher's mathematical disposition is integral to informing the mathematical disposition of their students.

Sherafat and Murthy (2014) studied on critical thinking and academic achievement among secondary and senior secondary school students. The study revealed that the students' academic achievement was affected by their critical thinking. The students with higher levels of critical thinking did better on academic achievement as compared to their low counterparts. Further, there was no difference between the secondary and senior secondary students on their critical thinking abilities. Results show that critical thinking is an important factor and a correlate of academic achievement.

Tyagi (2014) studied on the causal relationship between Mathematical creativity, Mathematical aptitude and Mathematical problem-solving performance: A cross-lagged panel analysis. The study found that mathematical creativity was found to be causally predominant over mathematical aptitude (i.e., higher mathematical creativity leads to higher mathematical aptitude). Furthermore, mathematical problem-solving performance was found to be the cause of mathematical aptitude and mathematical creativity both (i.e., higher mathematical problem-solving performance leads to higher mathematical aptitude and mathematical creativity).

Temel (2014) studied on the effects of problem-based learning on pre-service teachers' critical thinking dispositions and perceptions of problem-solving ability. The aim of this study was two-fold. The first aim was to determine the levels of critical thinking disposition and perception of problem-solving ability of pre-service teachers. The second aim was to compare the effects of problem-based learning and traditional teaching methods on the critical thinking dispositions and perceptions of problem-solving ability of pre-service teachers, when implemented in the teaching of the acid-base topic. Participants for the study consisted of 49 pre-service teachers. A pre-test–post-test control group design was used. Data were obtained using the California critical thinking disposition inventory and problem-solving inventory. It was generally

determined that pre-service teachers exhibit low levels of critical thinking disposition and medium levels of perception of problem-solving ability. Also, while problem-based learning and traditional teaching methods did not have different effects on the critical thinking dispositions of pre-service teachers, they had different effects on their perceptions of problem-solving ability. An examination of the percentages concerning the pre-service teachers in the two groups showed that the percentages of the pre-service teachers in the low-scoring group according to the post-test results in both the experimental group and control group decreased whereas the percentage of those in the middle-scoring group increased. Nevertheless, it was found that the percentages of those in the low-scoring group were quite high in both the experimental group and control group in the pre-test and the post-test. According to the results, it can be said that the levels of critical thinking disposition of the preservice teachers in both the experimental group and control group were generally low. The results of this study are not unique. The results showed that there is a decrease in the perceptions of problem-solving ability scores of the pre-service teachers in both the experimental group and control group.

Sonar and Patnakar(2013) conducted a study of relationship between Mathematics aptitude and achievement of secondary school students. Researcher through the present study, construct a standardized mathematical aptitude test for secondary school students. This mathematical aptitude test was developed as per the steps of standardization of psychological testing. The reliability of the mathematical aptitude test was calculated by test-retest reliability. And at 0.91 the mathematical aptitude test was reliable. The predictive validity of mathematical aptitude test was calculated. Validity of the test was calculated by the multiple regression equation. The norms of the mathematical aptitude test were developed by establishing the percentile norms. It is concluded that there is no significant difference between boys and girls of secondary school students in relation to mathematical aptitude. There is significant difference between rural and urban students in relation to mathematical aptitude of secondary school. It concluded that there is impact of mathematical aptitude on achievement test. It is also founded that rural area students are weak in understanding the basic concepts in Mathematics subject.

Kaur (2012) studied on causes of low achievement in mathematics at secondary stage. The present study found that intelligence is an important factor contributing to low achievement of subjects in mathematics. The students achieving less marks in mathematics belong to low intelligence level. It can be concluded therefore, that low achievers in mathematics have a low intelligence level. It was found that low achievers in mathematics have average academic achievement motivation.

Paramasivan (2011) studied on effectiveness of activity-oriented approaches in improving the performance of backward learners in Mathematics at the secondary school level. The study found that activity-oriented approaches implemented in class ix have significantly improved the academic performance of the backward students in mathematics. It Was also found that most of the students were very much interested and enjoyed doing theorems with ease and confidence.

Fetterly (2010) studied on an exploratory study of the use of a problem-posing approach on pre-service elementary teachers' - mathematical creativity, beliefs, and anxiety. To know the effect of a punctuated, intentional experience to mathematical creativity on elementary pre-service teachers for this a two-way within-subject's analysis of variance was conducted. Researcher used mathematical creativity as a dependent variable. The within-subjects' factors were treatment groups. The multivariate criterion of Wilk's lambda (Λ) was used for testing the mathematical creativity main effect and mathematical creativity x treatment groups effect. It was found that the mathematical creativity main effect and treatment group interaction effect, was significant, as well as the mathematical creativity x treatment groups interaction effect, $\Lambda=.60$, $F(2, 6) = 9.06$, $p < .01$. It was concluded that a punctuated, intentional experience to mathematical creativity develops elementary pre-service teacher's mathematical creativity. To evaluate the mathematical creativity as to whether the means of the pre-test was significantly different from the post-test for this A paired-samples t -test was conducted by the investigator. The results showed that the pre-test sample mean for mathematical

creativity ($M = 35.13$, $SD = 10.56$) was significantly different from the post-test sample ($M = 40.24$, $SD = 11.42$), $t(31) = 19.99$, $p < .01$. Based on above data it is concluded that a punctuated, intentional experience to mathematical creativity increases or fosters elementary pre-service teacher's mathematical creativity. A paired-sampled t test was also conducted by the investigator on the mathematical beliefs' scores to evaluate whether the means of the pre-test was significantly different from the post-test. The results support the conclusion that a punctuated, intentional experience to mathematical creativity increases elementary pre-service teacher's beliefs that mathematical is fluid. Correlation coefficients were calculated for the mathematical creativity and mathematical beliefs. Mathematical creativity and mathematical beliefs are variables. However, a medium correlation coefficient appeared in the pre-test correlation between mathematical creativity and mathematical beliefs scales. So, it was not significant. It was suggested that no relationship exist between elementary pre-service teacher's mathematical creativity and their mathematical beliefs. It can say in other words those mathematical beliefs are not a predictor of elementary pre-service teacher's mathematical creativity. Correlation coefficients were calculated between mathematical creativity and mathematics anxiety scales. It is also suggested that if mathematical creativity is higher, then mathematics anxiety is lower, it may vice versa too. However, a paired-sampled t test was conducted by investigator scores to evaluate whether the means of the pre-test was significantly different from the post-test on the mathematical anxiety. Based on above conclusion investigator suggested that a punctuated, intentional experience to mathematical creativity decreases elementary pre-service teacher's mathematical anxiety.

Shilling (2010) studied on an exploration of pre-service elementary teachers' mathematical beliefs. The study found that the linguistic choices made by textbook authors may promote different views about mathematics and, as a result, create different learning opportunities for pre-service teachers. The findings also showed that while beliefs are often highly resistant to change, it is possible to motivate change during a single mathematics course. Specifically, the nature of the curriculum materials and the

role of the teacher educator in the course were found to have an important impact on the mathematical beliefs of the pre-service teachers.

Pitma, Tayruakham and Nuangchalem (2009) studied on factors influencing Mathematics problem-solving ability of sixth grade students. The study found in respect to direct factors and indirect factors. Direct factors influencing mathematics problem-solving ability were described that direct and indirect factors influencing mathematics problem-solving ability were attitude towards mathematics, self-esteem and teachers' teaching behavior. Indirect factors influencing mathematics problem-solving ability were motivation and self-efficacy (2) factor models influencing mathematics problem-solving ability of sixth grade students was associated with visual data (3) The developed model could describe variance of skill in mathematics problem-solving at 63.00 % ($R^2 = 0.63$). Conclusion: Teacher's behaviors took both direct and indirect effects on the students' mathematics problem solving. The teachers are supposed to study the methods to develop this ability deeply and then bring them to manage the activities in class that encourage students to be enthusiastic to learn and have good attitude toward mathematics learning or to get students' concentration.

Kalyan (2007) conducted a study on preservice elementary mathematics teachers' Mathematical problem-solving beliefs. The sample of the present study consisted of 244 senior undergraduate students studying in Elementary Mathematics Teacher Education programs at 5 different universities located in Ankara, Bolu, and Samsun. Data were collected in spring semester of 2005-2006 academic years. Participants completed a survey composed of three parts as demographic information sheet, questionnaire items, and non-routine mathematics problems. The results of the study showed that in general the pre-service elementary mathematics teachers indicated positive beliefs about mathematical problem solving. However, they still had several traditional beliefs related to the importance of computational skills in mathematics education, and following predetermined sequence of steps while solving problems. Moreover, a number of pre-service teachers appeared to highly value problems that are directly related to the mathematics curriculum, and do not require spending too much time. Also, it was found that although the pre-service teachers theoretically appreciated the importance and role of the technology while solving problems, this belief was not apparent in their comments

about non-routine problems. In addition to these, the present study indicated that female and male pre-service teachers did not differ in terms of their beliefs about mathematical problem solving. However, the pre-service teachers' beliefs showed significant difference when the universities attended was concerned

Talati (2006) studied on constructed and standardized numerical ability test for students of std VIII to X of Gujarat State. Investigator first done the test items followed by item analysis. After completing the item analysis, the final version of the test was prepared on the basis of difficulty value and discriminating value. It was founded that boys of std. VIII students' who belongs to urban areas were superior to girls of std. VIII students' who belongs to urban areas. Even boys of std. IX students' who belongs to urban areas and semi urban areas were superior to girls' students' who belongs to urban areas.

Castro (2004) studied on Pre-Service Teachers' Mathematical reasoning as an imperative for codified conceptual pedagogy in Algebra: A case study in teacher education. It was found that converting the repeating decimals to fractions was very difficult while the easiest was on finding the value of x^0 . As a whole, the reasoning ability of the respondents, based on their average reasoning ability on the given tasks, indicate that 73% was low, 27% was moderate and that nobody had a high level of reasoning.

Hartono (2001) studied on Mathematical modelling in problem-solving. The present study on problem solving and mathematical modelling and it is a literature review. The steps of mathematical modelling are compared with the stages of problem solving. it was found that modelling is part of problem solving.

Lee (1999) studied on why Asian students fall behind in Mathematics. It was recognized that Asian students having strong achievements in mathematics. However, not all Asian children to be very good in the subject of mathematics. This study aims to identify that

why low math achievers (LMAs) are poor in mathematics. The present study examines about high-math achievers (HMAs) and low math achievers (LMAs) who are at risk of developing mathematical learning disabilities (MLD) for Chinese second - grade students. Investigator indicated that both groups have average to above-average intelligence, normal sensory functioning and no emotional disorders. The results founded that, LMAs were slower to solve number facts than HMAs in addition, when compared to HMAs, LMAs, showed a wide range of weakness in the areas of short-term memory, working memory and long-term memory. They tended to use less mature and less efficient strategies to solve these problems like “counting all” or “counting on” and their place value concepts were also less mature and complete. It was also found that LMAs had more difficulty solving 3-digit as opposed to 2-digit problems, which may result from their less mature understanding of place value and weakness as compared to HMAs. It is observed that a high frequency of LMAs errors in the multi-digit problems involved trading procedures such as increasing or reducing place value.

Although LMAs made progress on fact retrieval automaticity and place-value tasks in the whole session of school but their achievement remained poorer as compare to HMAs.

Khatoon (1998) studied on Mathematical aptitude among boys’ and girls’ students and its relationship with interest and vocational preference. Investigator studied whether achievement of students in the subject of mathematics at secondary school level has any bearing on their interest and aptitude for mathematics. Investigator provided the questionnaire to boys and girls and get opinion. It was founded that achievement of boys was somewhat superior to that of girls at the secondary school level students.

Sumangala (1995) studied on establishment the relationship between Mathematical aptitude and achievement in Mathematics. Investigator used components of Mathematical aptitude like Numerical ability, Numerical reasoning, ability to use symbols, Abstract reasoning and Spatial ability. It was founded that all the mathematical

aptitude are significantly correlated to achievement in mathematics at secondary level students.

Rangappa (1992) studied on the relationship between the achievement of school going students in relation to reasoning ability. It was observed that those who have high level of reasoning ability they score more in the subject of mathematics. The study was found that a significant difference in the achievement in mathematics of school going students having different levels of reasoning ability.

Roslay (1992) studied on the relationship between the attitude of high school students towards learning mathematics and achievement. It was observed that those who have high level of attitude to learn mathematics their achievement is good in the subject of mathematics. It was founded that the attitude of high school students towards learning mathematics and their achievement in the subject of mathematics were co-related.

Krishnan (1990) studied on identification of problem-solving strategies in Mathematics among high school students in District Devakottai. It was observed that problem-solving strategies plays vital role to improve mathematical skills in respect to high school students. The study revealed that problem-solving strategies had a significant relationship with application of problem-solving in mathematics.

Chitkara (1985) studied on the effectiveness of different strategies of teaching on achievement in Mathematics in relation to intelligence, sex and personality. It was found that the making of different various strategies of teaching like using the lecture discussion method, inductive drill in the classroom and auto instruction group discussion were equally effective in terms of achievement in mathematics and it was disregarding the level of intelligence, sex and personality type. The finding results showed that all the factors have a positive effect on mathematical achievement. Investigator indicated that Man is gifted with reasoning power, but each of them has no equal level of reasoning. The aim of reasoning power of human beings is used to solve the problem which faced in real life situation. Students should train and develop problem-solving skills in schools

to solve the problems in real life. Mathematics is such subject which is directly linked with the Problem Solving. So, problem-solving ability has a good scope in the development of scientific and mathematical aptitude amongst the students.

Patel (1984) studied on an investigation into the Mathematical ability of pupils of classes IX and X in context of some cognitive and affective variables. Investigator collected the data from students of Classes IX and X in relation to cognitive and affective variables. Researcher provided the questionnaire based on mathematical ability and it relate to cognitive and affective variables. It was found that people who have high level reasoning ability they are better in mathematical ability compare to who have low level reasoning ability. It was also found that those who have favorable attitude towards mathematics they are better in mathematical aptitude compare to those who have less favorable attitude.

Vohra (1977) studied on an investigation of relationship among intelligence, aptitude, personality, academic achievement vocational choice of polytechnic students. Researcher collected the data from students of Polytechnic colleges. It was found that there was a low correlation between personality and aptitude for vocational courses in Polytechnic college. It was also found that academic achievement and aptitude were positively correlated.

2.2 Conclusion

All these studies reflect that in some cases, variables like intelligence and problem-solving ability affect the mathematical aptitude of an individual, while in other cases we fail to trace their impact. Reason may be many. It may be due to different socio-economic status, cultural background, geographical diversities, support from parents and teachers or any other cause. A review of literature does not indicate a clear-cut relationship of these variables, viz. intelligence and problem-solving ability with

mathematical aptitude. Though it appears that the variables undertaken are significant determinant, yet they need to be subjected to scientific corroboration.

So far none of the reviews talked about the study of mathematical aptitude of pupil teacher who can lay a strong foundation of mathematics education at primary level of education. Further, no such study was found to be done in the state of Sikkim. Therefore, the present study may be a unique and original piece of study which can accelerate mathematics education in the state of Sikkim

CHAPTER III

METHODOLOGY AND RESEARCH PROCEDURE

Research methodology is the framework which provides direction to carry on the research work in a scientific and valid manner. Research methodology consists of all general and specific activities of research. Understanding of the methodology invariably enhances understanding of the research activities. The method of the research provides

information about the tools and techniques by which the research problem is stroked. It consists of procedures and techniques for conducting a study, therefore researcher must have clarity of idea about proper use of research method. There are various methods of research but selection of method depends upon nature of the problem. The investigator begins with the initial identification of the problem. Research methodology is also very important and vital part of research process where the appropriateness of sampling technique must be known. The appropriate sampling method is adopted using which information is gathered to study a population and thereafter analysis of data takes place accordingly (Kaur,2016 p-76-77).

The present chapter presents an outline of the methodology and procedures of research that have been utilized in the present study titled ‘Mathematical Aptitude of Pre-Service Elementary Teachers of Sikkim in relation to Intelligence and Problem-Solving Abilities’. Keeping in view the nature of the problem, descriptive method is used for data collection which provides a method of investigation to discover, describe and interpret what exists at present and not in past or future. The three variables of the study are Mathematical Aptitude, Intelligence and Problem-Solving Abilities. It is also included independent variables like Gender, Management, Category and Stream. It also contains details on research design, population and sample taken, the tools and techniques used for data collection and the methods of tabulation and analysis of the data hence collected.

The chapter has been organized as follows.

3.1 Research design

3.2 Population and Sample

3.3 Tools and techniques used for data collection

3.4 Mode of data collection

3.5 Tabulation and analysis of data

3.1 Research design

“Research design is a plan, structure and strategy of investigation so conceived as to obtain answers to research questions or problems” - Karlinger

A research design is a planned structure of the study outlines the method and it is a strategy and technique used to find answers to the research questions and to test the hypotheses thereafter. The present study purports to know the current status of mathematical aptitude of pre-service tribal and non-tribal elementary teachers of Sikkim in relation to their intelligence and problem-solving abilities as influenced by gender, management and mathematical and non-mathematical backgrounds. The researcher aimed to find the level of mathematical aptitude of tribal and non-tribal elementary teachers and further investigated its relationship with their intelligence levels and problem-solving abilities, if any. The role of gender orientation, private and government management and mathematical and non-mathematical backgrounds has also been explored to having any kind of influence on mathematical aptitude of these tribal and non-tribal elementary teachers. In order to attain these objectives, descriptive method of research was considered as the most suitable method for conducting the present study.

3.2 Population of the study

Sikkim is situated in the Himalayan mountains, the state of Sikkim is characterized by mountainous terrain. Almost the entire state is hilly, with an elevation ranging from 280 meters (920 ft) in the south at the border with West Bengal to 8,586 meters (28,169 ft.) in northern peaks near Nepal and Tibet. The summit of Kangchenjunga, the world's third-highest peak, is the state's highest point, situated on the border between Sikkim and Nepal. As per census 2011, Sikkim is India's least populous state, with 610,577 inhabitants. There are 4 districts, 9 Taluks, 451 villages and 9 towns in Sikkim.

Out of total population, 74.85% of population lives in urban area and 25.15% lives in rural area. There are 33.8% scheduled tribe (ST) and 66.2 % non-ST of total population in Sikkim.

It is also one of the least densely populated Indian states, with only 86 persons per square kilometer. The sex ratio is 889 females per 1,000 males, the capital Gangtok is the most significant urban area in the mostly rural state. The average per capita income in Sikkim stood at ₹ 81,159. Sikkim's adult literacy rate was 82.2 per cent in which 87.29 per cent for males and 76.43 per cent for females. There are a total of 1,157 schools in the state, including 765 schools run by the state government, seven central government schools and 385 private schools. There is one institute of National importance, one central university¹ and four private universities in Sikkim offering higher education.

Sikkim had divided in 4 districts initially i.e., East Sikkim, West Sikkim, North Sikkim and South Sikkim but at present 6 districts i.e., Gangtok, Pakyong, Gyalshing, Soreng, Mangan and Namchi. There are 3 Government DIETs in East, South and West of Sikkim and one private managed DIETs college, Pakyong in East of Sikkim. In the present study, population refers to all the pre-service teachers of DIETs of East, South and West districts of Sikkim for 400 populations. All pre-service teachers of three DIETs and one privately managed elementary teacher training Institution namely Carmel teachers training Institute, Pakyong, Sikkim have been considered as population.

Table No. 3.1

List of DIETs

Sl. No.	Name of the DIETs
1	District Institute of Education and Training (DIETs) Gangtok East of Sikkim
2	District Institute of Education and Training (DIETs), Namchi, South of Sikkim

3	District Institute of Education and Training (DIETs), Gyalshing, West of Sikkim
4	Carmel teachers training Institute, Pakyong, East of Sikkim.

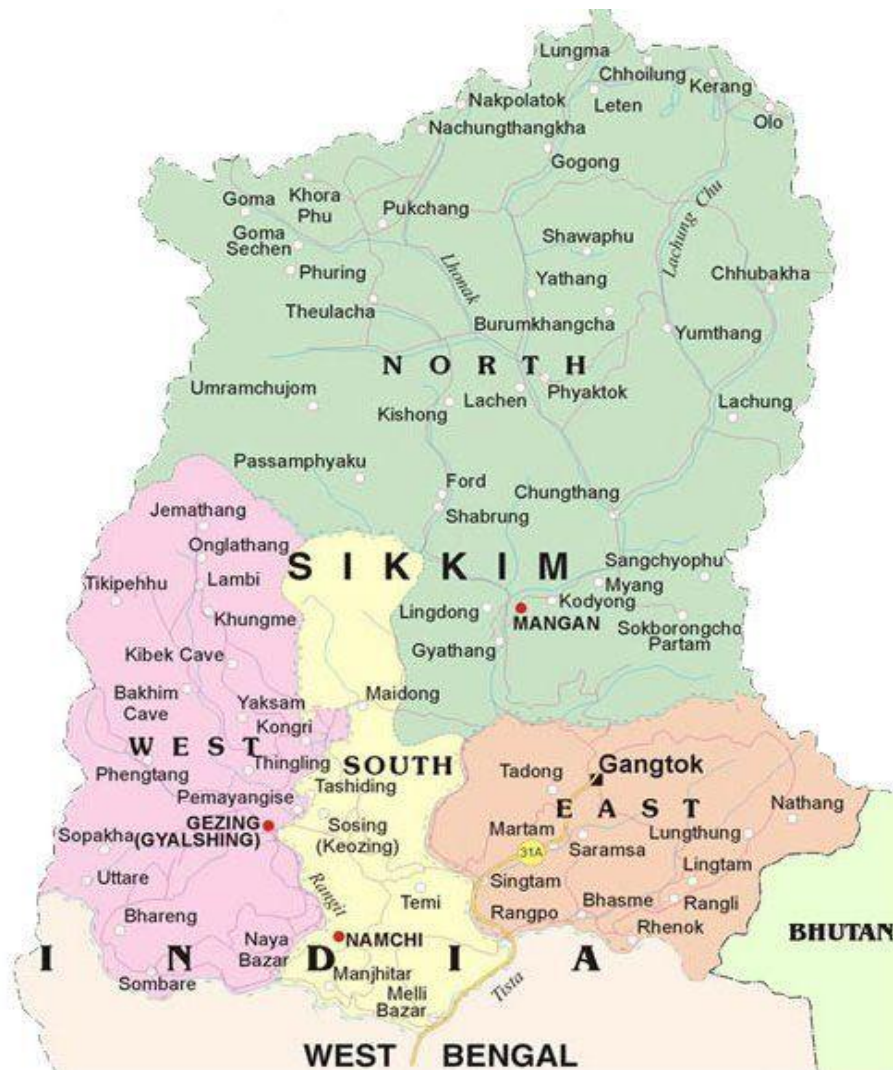


Fig. No. 3.1 Map of Sikkim

3.3 Sample of the study

The sample is the representative group of persons taken from this population in order to study their characteristics/attributes. Simple random sampling technique was used to

collect the data for the present study. Initially the researcher planned to take all the 400 pre service elementary teachers from all the DIETs of Sikkim. After reputed visiting of all the DIETs data has been collected from 346 pre-service teachers of all the elementary teacher training institutions of Sikkim. Out 346 pre-service teachers 53 are Male and 293 Female.

Table No. 3.2

Frequency Table of Samples

Gender	Male	Female	Total
	53	293	346
Management	Government	Private	Total
	249	97	346
Stream	Mathematical Background	Non-Mathematical Background	Total
	106	240	346
Category	ST	NON-ST	Total
	155	191	346

3.4 Tools and Techniques used for data collection

The research tools are very important for any research study. It plays a vital role in collection of data and research process. In the present study, the investigator has used standardized scales for the assessment of intelligence and problem-solving ability.

Investigator has used a self-constructed Mathematical Aptitude Test also for present study.

For the collection of data following tools were used:

1. Problem Solving Ability Scale standardized by L.N. Dubey (2008)
2. Wechsler's Adult Intelligence Scale developed by David Wechsler (2008)
3. Self-constructed Mathematical Aptitude Test: In order to know the Mathematical Aptitude of pre-service elementary teachers.

3.4.1 Problem-solving ability scale

Problem-solving ability is highly correlated with intelligence, reasoning ability and mathematical ability. It is the ability to think and reason on given level of complexity. Problem solving in mathematics is a fruitful exercise for the development of one's mental abilities as the process of problem solving involves the scientific method of thinking and reasoning. It is the framework or pattern in which thinking and creativity has to play vital role to develop learner's skills.

This scale has been standardized by L.N. Dubey (2008) In this scale an effort has been made to assess various dimensions like arithmetic concept, time and work, measure direction, profit and loss, probability etc. to know the level of problem-solving ability. The problem-solving ability has a total of 20 items. These items pertain to problem solving, problem posing and overcoming fixation in mathematical situations. The items are equally divided into the different levels of word problem-based questions. It has been done to overcome the problems of administration. The time limit is mentioned for each separate item. The time provided for each item is two minutes. The items of problem-solving ability questionnaire have been written in English language for ease of administration in various institutions of Sikkim having adopted English as medium of instruction. For scoring of problem-solving ability separate system of scoring procedure

has been devised. The subjects' problem-solving ability gets manifested depending upon the sum of his/ her scores on all the items. The items are scored for different dimensions included in the tool such as arithmetic concept, time and work, measure direction, profit and loss, probability etc. to know the overall level of problem-solving ability of a person.

Standardization: The present study had been standardized over a representative sample of the 525 students selected from different colleges. The selected students both boys and girls. The selected students both boys and girls belong to varied intelligence and all social stratum. This scale was administered twice on 525 boys and girls with 20 items.

Reliability: Reliability coefficient of the problem-solving ability scale was established by the following method:

1. The Split-Half Reliability (spearman brown formula Reliability) for the, $r = 0.78$
2. Rational equivalence method (Kuder Richardson formula) $r = 0.76$

It indicates that the items from a scale that has reasonable internal consistency reliability. Therefore, problem-solving ability scale was considered to be reliable.

Validity: The content validity involves essentially the systematic examination of the problem-solving ability scale to determine whether it covers a representative sample of the concept to be measured. The content validity of the problem-solving ability scale was established by having a discussion with the experts from the field of mathematics education. The coefficient of validity was calculated by correlating the scores with the following tests: Group intelligence Test (R.K. Tondon). It was found for the 20 items which was 0.68 and test of reasoning ability found for the 20 items was 0.85. On the basis of expert's opinion, the problem-solving ability scale was found to be valid.

Administration of the Test: The instruction for the subject has been printed in front page of the test booklet form. The researcher can read loudly the printed instruction. The time limit of the completion of the whole test was 40 minutes.

Scoring: The test contains 20 items of the problem-solving ability scale with 4 multiple options in which only one answer was correct. The students choose the correct answer and he/she should have awarded 2 marks for right answer and zero mark for wrong answer or left question.

3.4.2 Wechsler Adult Intelligence Scale

Intelligence is cognitive potentiality which helps to increase the learning abilities in the students. It is defined as general cognitive problem-solving skills. A mental ability involved in reasoning, perceiving relationships and analogies, calculating, learning quickly etc.

This scale has been standardized and developed by David Wechsler (2008). In this scale an effort has been made to assess various dimensions like forward and backward digit, similarities, general comprehension, arithmetic reasoning, general knowledge, verbal and non- verbal reasoning, etc. to know the level of intelligence ability. The intelligence scale has a total of 30 items. The items of intelligence ability pertain to reasoning skills, problem posing and overcoming fixation in normal life situations. The items are equally divided into the different level of verbal and non-verbal reasoning-based questions. It has been done to overcome the problems of

administration. The time limit is mentioned for each separate item. The time of two minutes has been provided for each item. The items of intelligence questionnaire have been written in English language for ease of administration in various institutions of Sikkim having adopted English as medium of instruction. For scoring of intelligence ability separate system of scoring procedure has been devised. The subjects' intelligence is the sum of his/ her scores on all the items. The items are scored for forward and backward digit, similarities, general comprehension, arithmetic reasoning, general knowledge, verbal and non- verbal reasoning etc. to know the overall level of intelligence ability.

Reliability: The Wechsler Adult Intelligence is a well-established scale and it has fairly high consistency. Over a 2 to 12-week time period, the test-retest reliabilities ranged from 0.70 to 0.90. Inter-scorer coefficients were very high, all being above 0.90. The WAIS correlated highly with the Stanford-Binet IV test 0.88.

Administration of the Test: The instruction for the subject has been printed in front page of the test booklet form. The researcher can read loudly the printed instruction. The time limit of the completion of the whole test was 60 minutes.

Scoring: The test contains 30 items of the intelligence scale with 4 multiple options in which only one answer was correct. The students choose the correct answer and he/she should have awarded 2 marks for right answer and zero mark for wrong answer or left question.

3.4.3 Mathematical Aptitude Test

Mathematical aptitude is an individual's capacity to quickly perform mathematical operations. It is one of several cognitive abilities that a person can have a strong preference to perform well. It is the capacity to acquire proficiency under the

right for a particular situation that is his potentialities at present, as revealed by his performance on selected tests that have anticipating value. Therefore, aptitude is a pattern of traits but it always refers to future potentialities.

Mathematical aptitude test is a self-developed test. This scale has been standardized by researcher himself. In this scale an effort has been made to assess various dimensions like concept of calculation in arithmetic, series-based questions, verbal reasoning, concept of average, concept of percentage etc. to know the level of mathematical aptitude of the subjects. It can be administered to male and female, ST & non-ST background students of government and private college of DIETs. The Test has a total of 25 items. The items are equally divided into the different level of mathematical aptitude-based questions. It has been done to overcome the problems of administration. The time limit is mentioned for each separate item. The time of two minutes has been provided for each item. The items of mathematical aptitude questionnaire have been written in English language for ease of administration in various institutions of Sikkim having adopted English as medium of instruction. For scoring of mathematical aptitude separate system of scoring procedure has been devised. The subjects' mathematical aptitude is the sum of his/ her scores on all the items.

The items are scored for concept of calculation in arithmetic, series-based questions, verbal reasoning, concept of average, concept of percentage etc. to know the overall level of mathematical aptitude of a subject.

Procedure for Test Construction

Planning of the test

As mathematical aptitude is a natural ability that demarcate the individual from the crowd of high achievers in mathematics; highlighting in him a specific tendency to tackle his surroundings with a rigorous analytical and creative approach. This fine line that discriminates the high mathematical aptitude and high mathematical achievement has to be born in mind in order to construct the mathematical aptitude test for the pre-service trainees. Moreover, the pre-service student-teacher are highly aspirant adult who are all the more carrier conscious, seeking their compatibility in various professional

courses. Most of the competitive examinations that they encounter after their schooling have a provision for aptitude testing with mathematics aptitude assessment being prime. Considering this the researcher felt that the mathematical aptitude test for the present study must be constructed under the domain of these requisites.

Rationale

Construction of Mathematical aptitude test was based on the assessment that male/female pre-service trainees belonging to the rural / urban areas and studying in the English medium DIETs may vary in their attitudes, needs and exposure to varying experiences that may foster the development of mathematical aptitude. Therefore, the following steps have been considered in the development of the final tool.

Structural approach:

Analysis of the content and the source material

1. After determining the objectives, several books based on mathematical competence and assessment of mathematical ability of pre-service trainees, and the resource material based on various competitive examinations undertaken by the students just after completing their schooling was analysed by the researcher thoroughly. The researcher went through various mathematical aptitude tests as prescribed in mathematical talent hunt for elementary level student-teacher, as well as the aptitude test prescribed for different professional courses like teaching and administrative services etc.
2. Questions under each dimension were either selected or structured out keeping in mind the pattern as required for assessing the aptitude of an individual under various dimensions.
3. Experts' opinion was also collected during the selection procedure.
4. Elementary level student-teacher were also approached and their views were also collected.
5. Study of various standardized tests helped in the construction of items for the new test. General ideas about outlining, content and form were obtained by studying the best published tests.

Phase I- Preparing the first draft

Collection of effective dimensions

Firstly, the content of Mathematical aptitude was collected from the related literature, books on various competitive examinations, aptitude tests prescribed for various

professional courses related with mathematics, discussions was done with experts, student-teacher of elementary level, senior research scholars and educational administrators.

The researcher while reviewing the related literature found that Sumangla (1995) made an attempt to establish the relationship between mathematical aptitude and achievement in mathematics and traced five dimensions of mathematical aptitude. The researcher made use of all these five dimensions to construct her own Mathematical aptitude test in order to measure the mathematical aptitude of the students of elementary level.

Finally, the five dimensions chosen to develop the “Mathematical Aptitude Test” for elementary level pre-service trainees were as follows: Numerical ability, Numerical reasoning, Ability to use symbols, Abstract reasoning ability and Spatial ability. 100 items in all were constructed related to all possible five dimensions mentioned above.

Arrangement of items dimension wise

The framed items were now to be categorized in five dimensions. A rough plan was prepared while going through the list of assorted items and they were sorted out dimension wise. While doing so the items similar in meaning or based on repeated pattern were taken out by the investigator. Thus ultimately 75 such items were finalized.

Determining relevance of the statements

- 1) Pre-Try- out: - After preparing a preliminary draft of the mathematical aptitude test consisting 75 items, it was given to 15 judges to assess the relevance of these items to the specific dimensions of mathematical aptitude. The necessary modifications in language were made as recommended by the experts in the respective items. Thereafter another format was framed in which there were only 50 items. These items were based on the five dimensions as mentioned above and administered on 40 students. After the Pre- try- out, ten questions were neglected due to language ambiguity. Ultimately 40 items were selected for the actual try-out.
- 2) Actual Try Out: - The second draft of Mathematical Aptitude test containing 40 items was administered to 168 students drawn randomly from various Government and Private DIETs of 3 districts of Sikkim.

Item analysis

Item analysis was carried out to eliminate inconsistency of the items. In order to analyze each item, in usual practice of comparing the proportion of cases that are placed in upper and lower group was followed. After the actual try out the score of 168 students was

obtained on the entire MAT containing 40 items under 5 dimensions. These scores were then arranged in increasing order so as to obtain 27% high and 27% low. On the basis of this information the Difficulty Index (D.I) and Discriminating Power of each and every item was calculated.

Following Kelley (1939), that sharpness of differentiation and reliability of statistics is reached when upper 27 percent of the sample is compared with the lower 27 percent, two criterion groups were formed for item analysis.

(a) Item Selection

(b) Selection of items was made according total indices provided by **Ebel and Frisbie**

Table No. 3.3

Ebel and Frisbie's Index of Discrimination

Index of discrimination	Item Evaluation
0.40 and up	Very good items
0.30 to 0.39	Reasonably good but possibly subject to improvement
0.20 to 0.29	Marginal items, usually needing and being subject to improvement

(c) On the basis of indices provided by Ebel and Frisbie the index of discrimination was observed and consequently it was decided to select only those items whose discrimination power was 0.30 or above.

(d)Final format of mathematical aptitude test

In the final format of mathematical aptitude test, the instruction and necessary background information were printed on the cover page. The 25 items were selected by the above procedure and arranged in an increasing order of difficulty index in their respective dimension, In the final format, the dimension wise distribution of test items is given in the below Table: 3.4.

Table No.3.4
Dimension wise distribution of test items

Sl. No.	Dimension	Items Numbers	Total No, of items
1.	Numerical ability	1, 8,13,14,18,20	6
2.	Numerical reasoning	4,6,7,9,21,25	6
3.	Ability to use symbols	10,16,12	3
4.	Abstract reasoning	2,3,15,19,23	5
5.	Spatial Ability	5,11,17,22,24	5
	Total Items selected		25

Phase II – Determination of reliability and validity of mathematical aptitude test

Reliability

The reliability is one of the important characteristics of any test and measuring instrument. It is the term used to describe one of the most significant properties of a set of tests scores-how consistent or error free the measurements are. The classical definition of score reliability makes use of the idea of correlation equivalent tests.

“The reliability coefficient for a set of scores from a group of examinees is the coefficient of correlation between that set of scores and another set of scores on an equivalent test obtained independently from members of the same group” (Ebel and Frisbie, 2004)

The reliability of the mathematical aptitude test was computed with the help of Split – Half method. The new sequence of odd and even correct responses given by 168 students according to the modified test containing 25 test items was tabulated as shown below:-

Table No. 3.5
Frequency distribution of odd and even correct response

Scores	Correct odd responses (Max. = 14)	Correct even responses (Max. = 11)
36-41	04	03
30-35	13	12
24-29	24	26
18-23	55	57
12-17	46	45
6-11	21	19
0-5	05	06
Total	168	168

Reliability of the Mathematical aptitude test

The test was established with the help of Split-Half Reliability KR-20 method. For establishing the reliability, the mathematical aptitude test was administered twice on 168 pre-service teachers of DIETs from government and private institutions. From the data, correlation coefficient was computed. The Split-Half Reliability KR-20 Reliability coefficient alpha for the 25 items was 0.63, which indicates that the items from a scale that has reasonable internal consistency reliability. Therefore, mathematical aptitude was considered to be reliable.

Validity

(i) **Content validity:** With relevance to the five dimensions considered by the researcher to define the trait called mathematical aptitude, it was decided on the basis of unanimous judgment of the experts that the items constructed in the different dimensions aptly represents the dimensions for which they are constructed, thereby confirming the content validity of the test.

(ii) **Item validity:** The process of selection of items, using discriminating index, adequately confirms the item validity of the test.

(iii) **Intrinsic validity:** It is indicated here in terms of reliability coefficient. The high value of reliability coefficient has also verified the existence of a considerable degree of intrinsic validity of the constructed MAT Test.

(iv) **Constructive validity:** The inter correlation among all the 5 dimensions was calculated. The statistically satisfactory and significant value of p confirms its constructive validity as shown in the correlation matrix in Table: 3.6

Table No. 3.6
Factor loadings of the five dimensions

Variable	Factor Loadings Extraction: Principal components, (Marked loadings are >.600000)
	Factor 1
Numerical ability	-0.805644
Numerical reasoning	-0.721282
Ability to use symbols	-0.823153
Abstract reasoning	-0.851782
Spatial Ability	-0.601433
Expl. Var.	2.934145
Prpl. Total	0.586829

The speculation of table 3.6 reveals that the factor loadings of the five dimensions undertaken in the study are considerably high which is above 0.6. (This fulfils the criteria of minimum level to be valid i.e., 0.4)

Thus, the present test (MAT) is a valid and a reliable tool for measuring the mathematical aptitude of elementary level pre-service trainees. Keeping in view its various psychometric properties, this scale is very useful for the future research.

Scoring of Mathematical Test (MAT)

The test contains 25 items of the mathematical aptitude scale with 4 multiple options in which only one answer was correct. The students choose the correct answer and he/she should have awarded 2 marks for right answer and zero mark for wrong answer or left question.

Administration of MAT

The MAT is constructed in English version only because medium of study in English in DIETs. The instruction for the subject has been printed in front page of the test booklet form. The researcher can read loudly the printed instruction. The time limit of the completion of the whole test was 50 minutes.

3.5 Mode of data collection

In order to collect data, the researcher visited each DIETs and private managed elementary teacher training institution of Sikkim. Prior permission of the principals was taken from these institutions to conduct the study. The process of data collection began with the sharing of the objectives of study with the pre-service teachers. The various queries raised by them were addressed. They were also apprised about the response pattern. The pattern of response was selection of one item out of multiple-choice type items. There was no negative marking for the wrong response. They were well informed about the time-limit. They were requested to respond to the questionnaire without consulting with their batch mates. They were assured of maintaining confidentiality of their responses. After this, data collection was done using different tools.

3.6 Mode of tabulation and analysis of data

The data collected from all the respondents were scrutinized and tabulated. The data collected from questionnaire was analyzed quantitatively. The responses of the pre-service elementary teachers on the questionnaires were tabulated using Excel worksheets. Data was calculated with the help of Excel and SPSS. The tabulated data from questionnaire were analyzed using simple percentages, Descriptive statistics, 't' test, and correlation between independent and dependent variables.

CHAPTER-IV

ANALYSIS AND INTERPRETATION OF DATA

4.0 Introduction

Analysis of the data is an important and crucial step in educational research from which results can be out streamed. The investigator makes analysis after collecting the data. Analysis of data means studying the tabulated material in order to determine inherent facts or meanings. It involves the breaking of complex factors into simpler parts and putting the parts together in a new arrangement for the purpose of interpretation. So, the process of interpretation is essentially one of stating what the result shows, what do they mean? What is their significance? What is the answer to the original problem? In the present chapter, for a systematic and clear presentation of results the data obtained on the variables under study is being analyzed.

The present study focuses on the nature of score distribution of pre-service elementary teachers on intelligence, problem-solving ability and mathematical aptitude variables. It measures the correlation of different independent variables i.e., intelligence and problem-solving ability with dependent variable i.e., mathematical aptitude.

The present study examines the significance differences between mathematical aptitude, intelligence and problem-solving ability with respect to male and female pre-service elementary teachers of DIETs Sikkim, government and private pre-service elementary teachers of DIETs Sikkim, mathematical and non- mathematical background pre-service elementary teachers of DIETs Sikkim and tribal and non-tribal pre-service elementary teachers of DIETs Sikkim. The data were analyzed with the help of SPSS and Excel. The results were discussed on the basis of 0.05 level of significance.

4.1 General profile of Respondence

Table No. 4.1

Numbers and Percentage of Female and Male of Pre-Service Elementary Teachers

Gender	Frequency	Percent
Female	293	84.7 %
Male	53	15.3%
Total	346	100 %

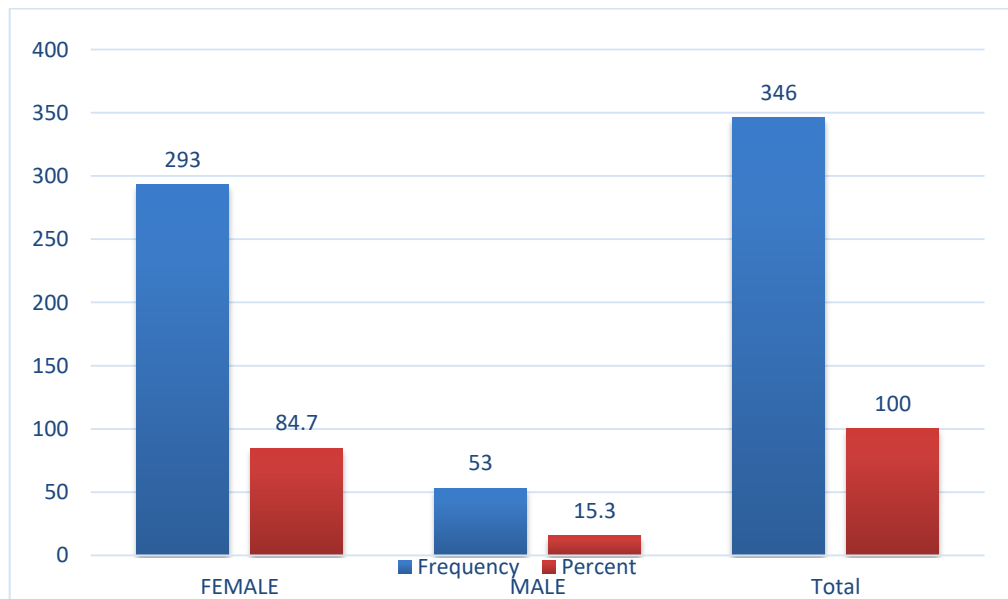


Figure No. 4.1

Numbers and Percentage of Female and Male of Pre-Service Elementary Teachers

Table No. 4.2

Numbers and Percentage of Government and Private of Pre-Service Elementary Teachers

Management	Frequency	Percent
Government	249	72 %
Private	97	28 %
Total	346	100 %

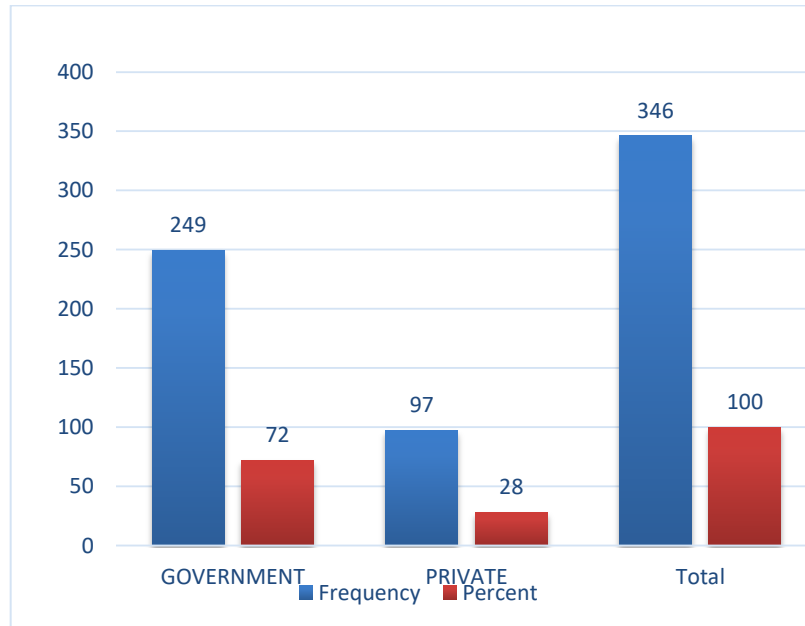


Figure No. 4.2
Numbers and Percentage of Government and Private of Pre-Service Elementary Teachers

Table No. 4.3
Numbers and Percentage of Mathematical background and non- Mathematical background of Pre-Service Elementary Teachers

Stream	Frequency	Percent
Mathematical background	106	30.6%

Non-Mathematical Background	240	69.4%
Total	346	100%

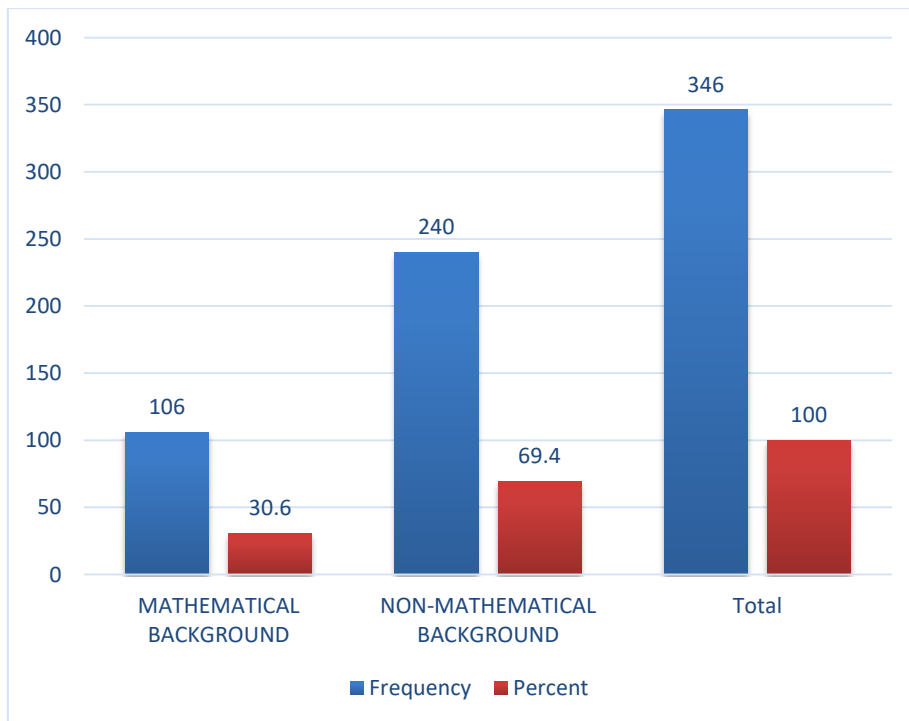


Figure No. 4.3

Numbers and Percentage of Mathematical background and non- Mathematical background of Pre-Service Elementary Teachers

Table No. 4.4

Numbers and Percentage of non-ST and ST of Pre-Service Elementary Teachers

Category	Frequency	Percent
NON-ST	191	55.2%
ST	155	44.8%
Total	346	100%

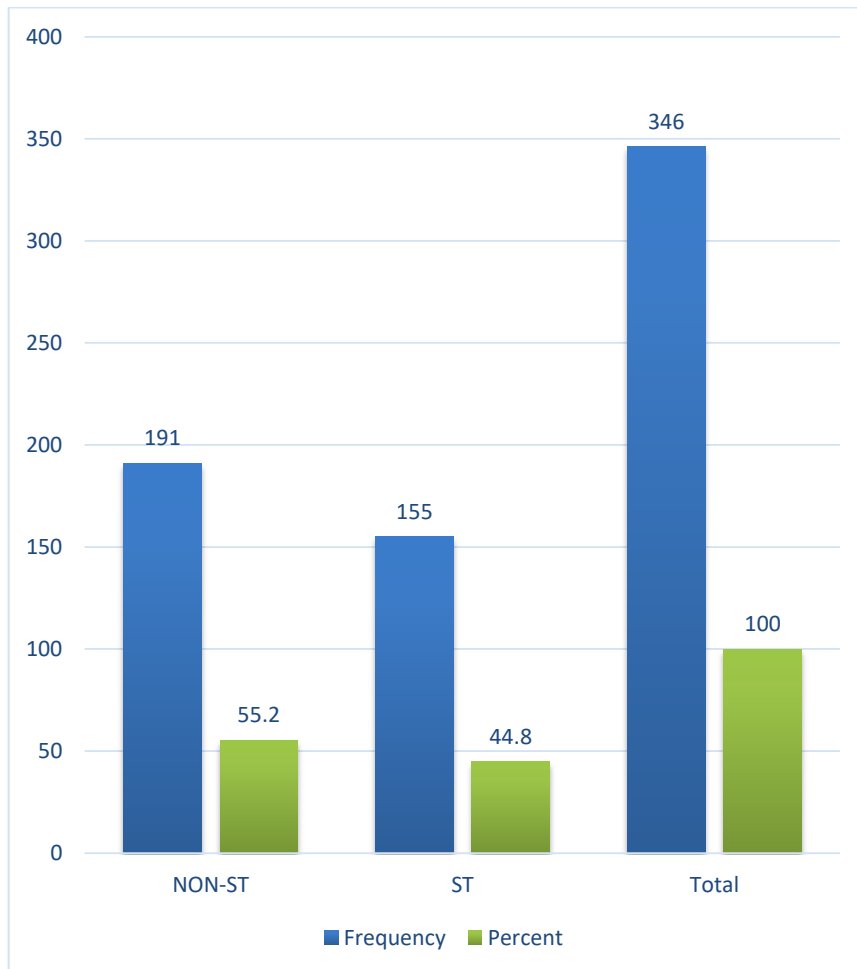


Figure No. 4.4

Number and Percentage of non-ST and ST of Pre-Service Elementary Teachers

4.2 Objective No.1: To construct a mathematical aptitude standardized scale for pre-service elementary teachers of Sikkim

Researcher has constructed tools of mathematical aptitude and standardized scale for pre-service elementary teachers of DIETs Sikkim and effort has been made to assess various dimensions like concept of calculation in arithmetic, series-based questions, verbal reasoning, concept of average, concept of percentage etc. to know the level of mathematical aptitude of the subjects for pre-service elementary teachers of DIETs Sikkim. It has administered to male and female, ST & non-ST background students, government & private college students and, mathematical & non- mathematical background of pre-service elementary teachers of DIETs Sikkim. The test has a total of 25 items. The items are equally divided into the different level of mathematical aptitude-based questions. Reliability of the mathematical aptitude test was established with the help of Split-Half Reliability KR-20 method. For establishing the reliability, the mathematical aptitude test was administered twice on 168 pre-service teachers of DIETs Sikkim from government and private college. From the given data, correlation coefficient was computed. The Split-Half Reliability KR-20 Reliability coefficient alpha for the 25 items was 0.63, which indicates that the items from a scale that has reasonable internal consistency reliability. So, it was considered to be reliable.

Table No. 4.5

Number of male and female in government and private college

Management	Male	Female	Total
Government	20	61	81

Private	12	75	87
Total	32	136	168

Nature of score distribution

The nature of correlation of the different independent variables i.e., intelligence and problem-solving ability with dependent variable i.e., mathematical aptitude. In order to test the normality of distribution of the scores, the values of mean, standard deviation, skewness and kurtosis were worked out relating to the variables of intelligence, problem-solving ability and mathematical aptitude. The value of mean, median, standard deviation, skewness and kurtosis were depicted in tabular form.

4.3 Objective N0.2: To study the mathematical aptitude, intelligence and the problem-solving ability of pre-service elementary teachers of Sikkim.

Table No. 4.6

Mean and SD of Pre-Service Elementary Teacher on Intelligence, Problem-Solving Ability and Mathematical Aptitude.

Variables	Mean	Std. Deviation
Intelligence	25.32	8.280
Problem- Solving Ability	11.73	4.900
Mathematical Aptitude	19.96	6.912

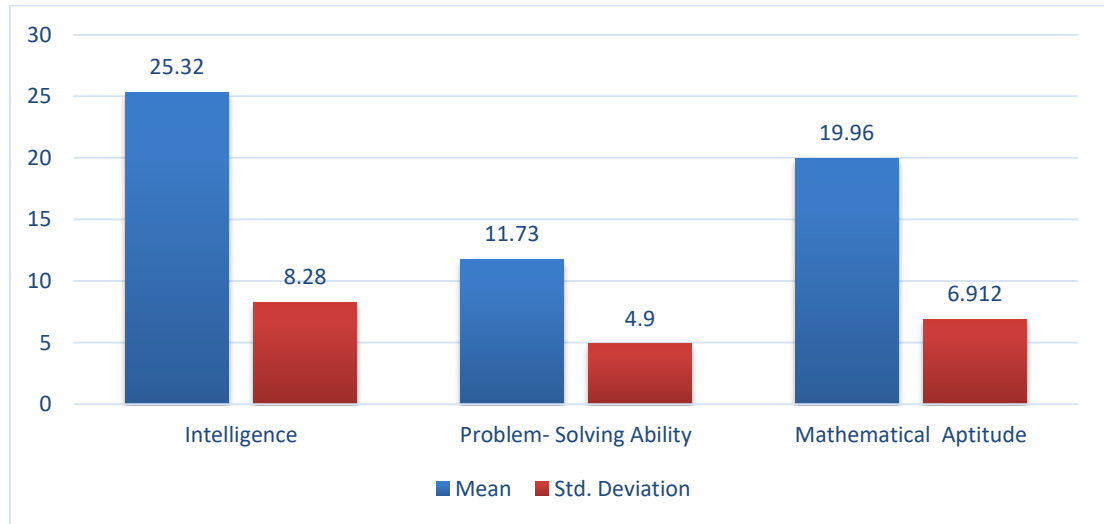


Figure No. 4.5

Mean and SD of Pre-Service Elementary Teacher on Intelligence, Problem-Solving Ability and Mathematical Aptitude.

Table No.4.7

Measures on the scores of pre-service elementary teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude (N=346)

Variables	Range	Mean	Median	Std. Deviation	Skewness	Kurtosis
Intelligence	42	25.32	26	8.28	0.13	-0.54
Problem-Solving Ability	28	11.73	12	4.90	0.35	0.06
Mathematical Aptitude	36	19.96	20	6.91	0.27	-0.29

The above table 4.7 exhibits the descriptive measures of all the variables for the total sample of pre-service elementary teachers of DIETs Sikkim (N=346) which reveals that the value of mean and median on the variable of intelligence of pre-service

elementary teachers is 25.32 and 26 respectively which are quite proximate to each other. The positive value of skewness (0.13) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.54) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that intelligence scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of problem- solving ability of pre-service elementary teachers is 11.73 and 12 respectively which are quite proximate to each other. The positive value of skewness (0.35) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (0.06) is slightly more than zero implies that distribution is slightly leptokurtic. The observation leads to the conclusion that problem- solving ability scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of mathematical aptitude of pre-service elementary teachers is 19.96 and 20 respectively which are quite proximate to each other. The positive value of skewness (0.27) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.29) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that mathematical aptitude scores of pre-service elementary teachers are normally distributed.

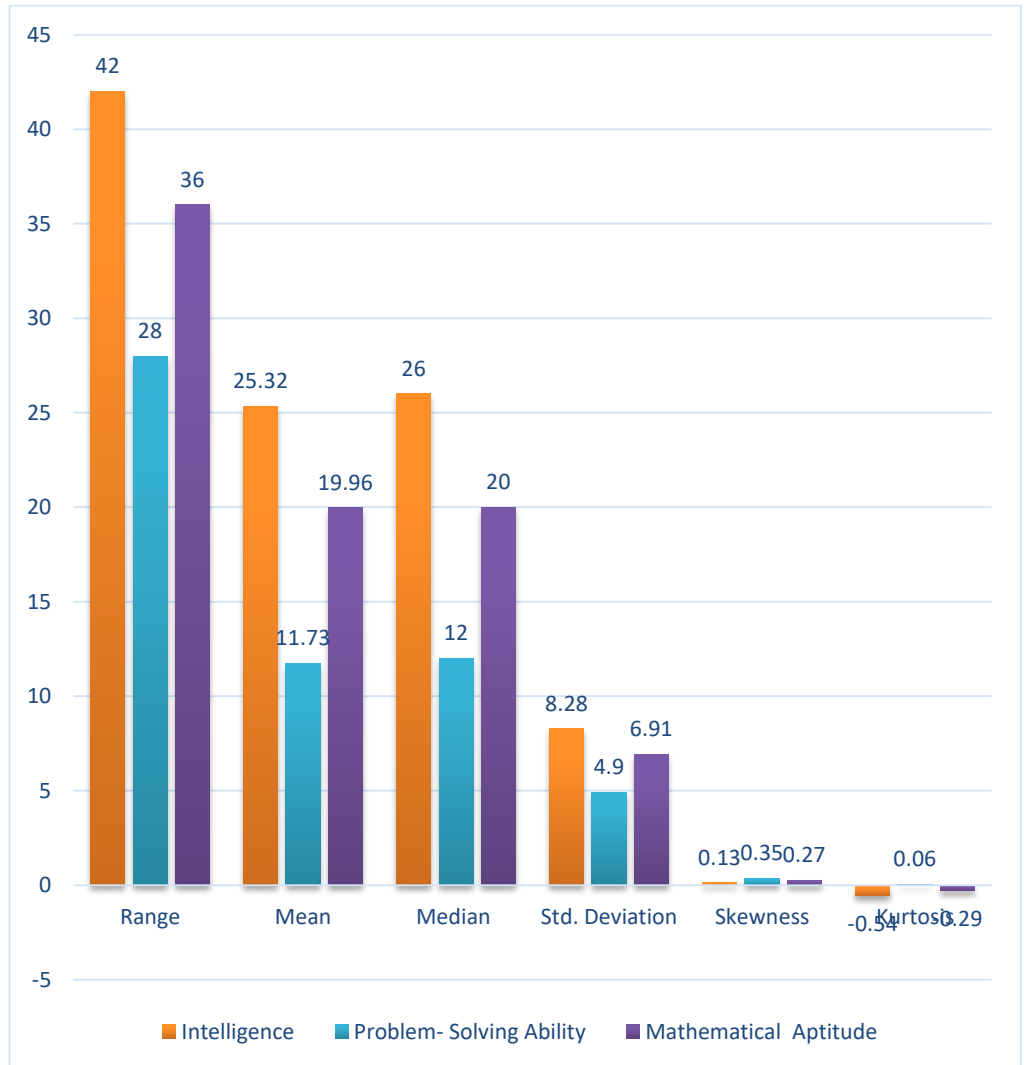


Figure 4.6

Descriptive Measures on the Scores of Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude

Table No. 4.8

Descriptive Measures on the Scores of Male Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude (N=53)

Variables	Range	Mean	Median	Std. Deviation	Skewness	Kurtosis
Intelligence	36	28.50	30	1.00	0.02	0.03
Problem-Solving Ability	20	13.40	14	4.46	-0.26	-0.17
Mathematical Aptitude	28	23.13	24	5.92	-0.19	0.07

The above table 4.8 exhibits the descriptive measures of all the variables for the total sample of male pre-service elementary teachers of DIETs Sikkim (N=53) which reveals that the value of mean and median on the variable of intelligence of male pre-service elementary teachers is 28.50 and 30 respectively which are quite proximate to each other. The positive value of skewness (0.02) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (0.03) is slightly more than zero implies that distribution is slightly leptokurtic. The observation leads to the conclusion that intelligence scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of problem-solving ability of male pre-service elementary teachers is 13.40 and 14 respectively which are quite proximate to each other. The negative value of skewness (-0.26) suggests that data is skewed to the left and the distribution is approximately symmetric. The excess kurtosis (-0.17) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that problem-solving ability scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of mathematical aptitude of male pre-service elementary teachers is 23.13 and 24 respectively which are quite proximate to each other. The negative value of skewness (-0.19) suggests that data is skewed to the left and the distribution is

approximately symmetric. The excess kurtosis (0.07) is slightly more than zero implies that distribution is slightly leptokurtic. The observation leads to the conclusion that mathematical aptitude scores of pre-service elementary teachers are normally distributed.

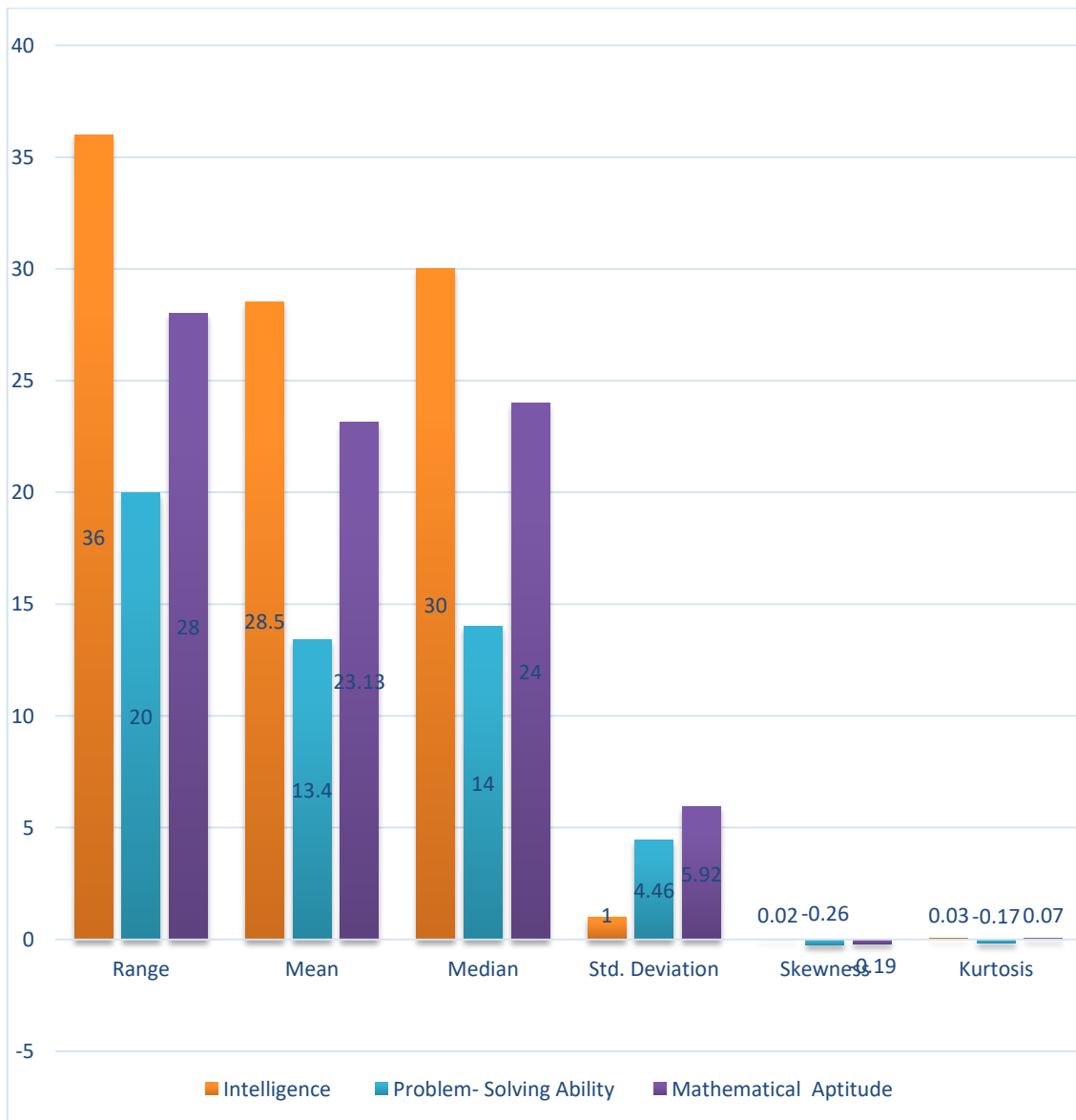


Figure No. 4.7

Descriptive Measures on the Scores of Male Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude

Variables	Range	Mean	Media n	Std. Deviation	Skew- ness	Kurtosis
Intelligence	46	25.06	24	8.39	0.16	-0.49
Problem- Solving Ability	28	11.47	10	4.91	0.55	0.48
Mathematical	34	19.63	20	7.14	0.31	-0.23

Table No.4.9

Descriptive Measures on the Scores of Female Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude (N=293)

Aptitude						
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The above table 4.9 exhibits the descriptive measures of all the variables for the total sample of female pre-service elementary teachers of DIETs Sikkim (N=293) which reveals that the value of mean and median on the variable of intelligence of female pre-service elementary teachers is 25.06 and 24 respectively which are quite proximate to each other. The positive value of skewness (0.16) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.49) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that intelligence scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of problem- solving abilities of female pre-service elementary teachers is 11.47 and 10 respectively which are quite proximate to each other. The positive value of skewness (0.55) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (0.48) is slightly more than zero implies that distribution is slightly leptokurtic.

The observation leads to the conclusion that problem- solving ability scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of mathematical aptitude of female pre-service elementary teachers is 19.63 and 20 respectively which are quite proximate to each other. The positive value of skewness (0.31) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.23) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that mathematical aptitude scores of pre-service elementary teachers are normally distributed.

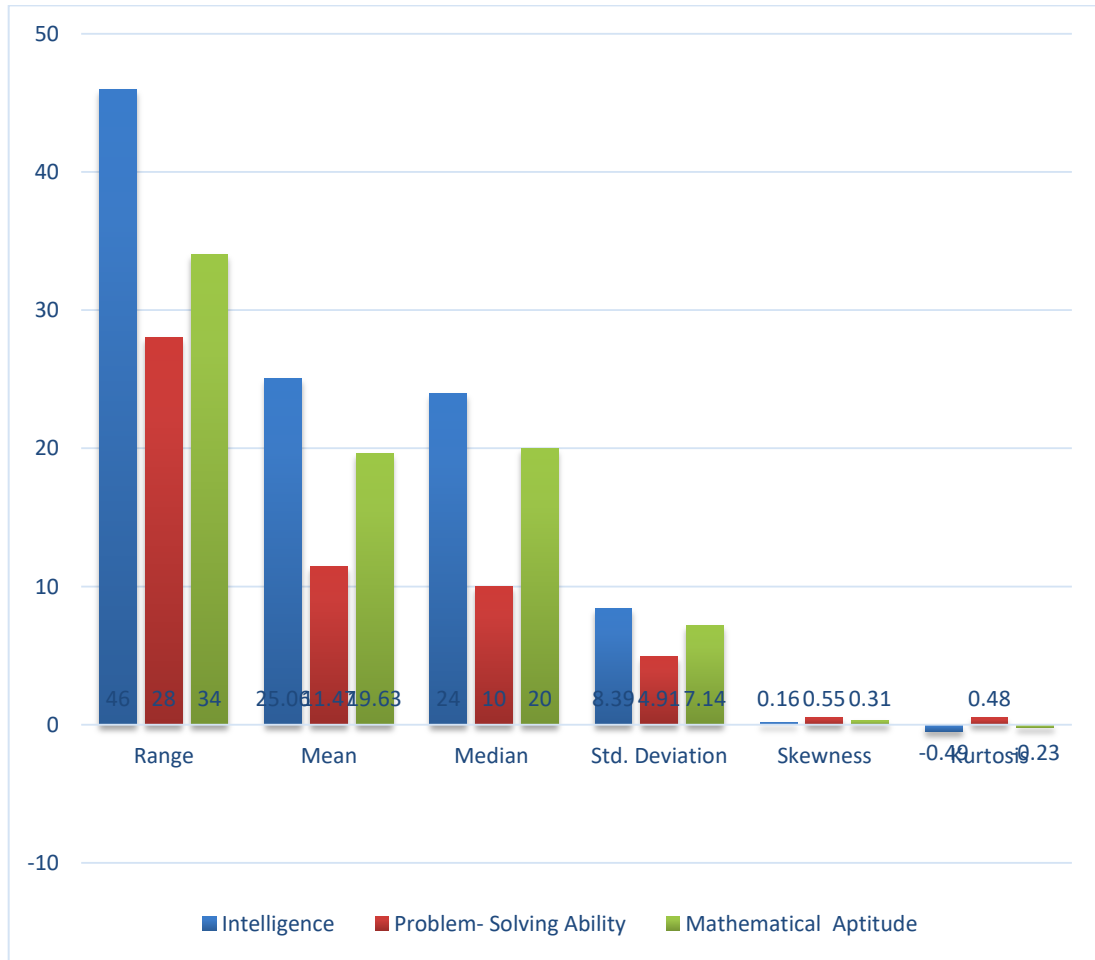


Figure No. 4.8

Descriptive Measures on the Scores of Female Pre-Service Elementary Teachers on Intelligence, Problem-Solving Abilities and Mathematical Aptitude

Table No. 4.10

Descriptive Measures on the Scores of Government Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude (N=249)

Variables	Range	Mean	Median	Std. Devia	Skewness	Kurtosis

				tion		
Intelligence	42	27.67	28	7.81	-0.11	-0.18
Problem- Solving Ability	28	12.48	12	4.76	0.27	0.30
Mathematical Aptitude	34	20.57	20	7.35	0.17	-0.45

The above table 4.10 exhibits the descriptive measures of all the variables for the total sample of government pre-service elementary teachers of DIETs Sikkim (N=249) which reveals that the value of mean and median on the variable of intelligence of government pre-service elementary teachers is 27.67 and 28 respectively which are quite proximate to each other. The negative value of skewness (-0.11) suggests that data is skewed to the left and the distribution is approximately symmetric. The excess kurtosis (-0.18) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that intelligence scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of problem- solving ability of government pre-service elementary teachers is 12.48 and 12 respectively which are quite proximate to each other. The positive value of skewness (0.27) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (0.30) is slightly more than zero implies that distribution is slightly leptokurtic. The observation leads to the conclusion that problem- solving ability scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of mathematical aptitude of government pre-service elementary teachers is 20.57 and 20 respectively which are quite proximate to each other.

The positive value of skewness (0.17) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.45) is slightly less than

zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that mathematical aptitude scores of pre-service elementary teachers are normally distributed.

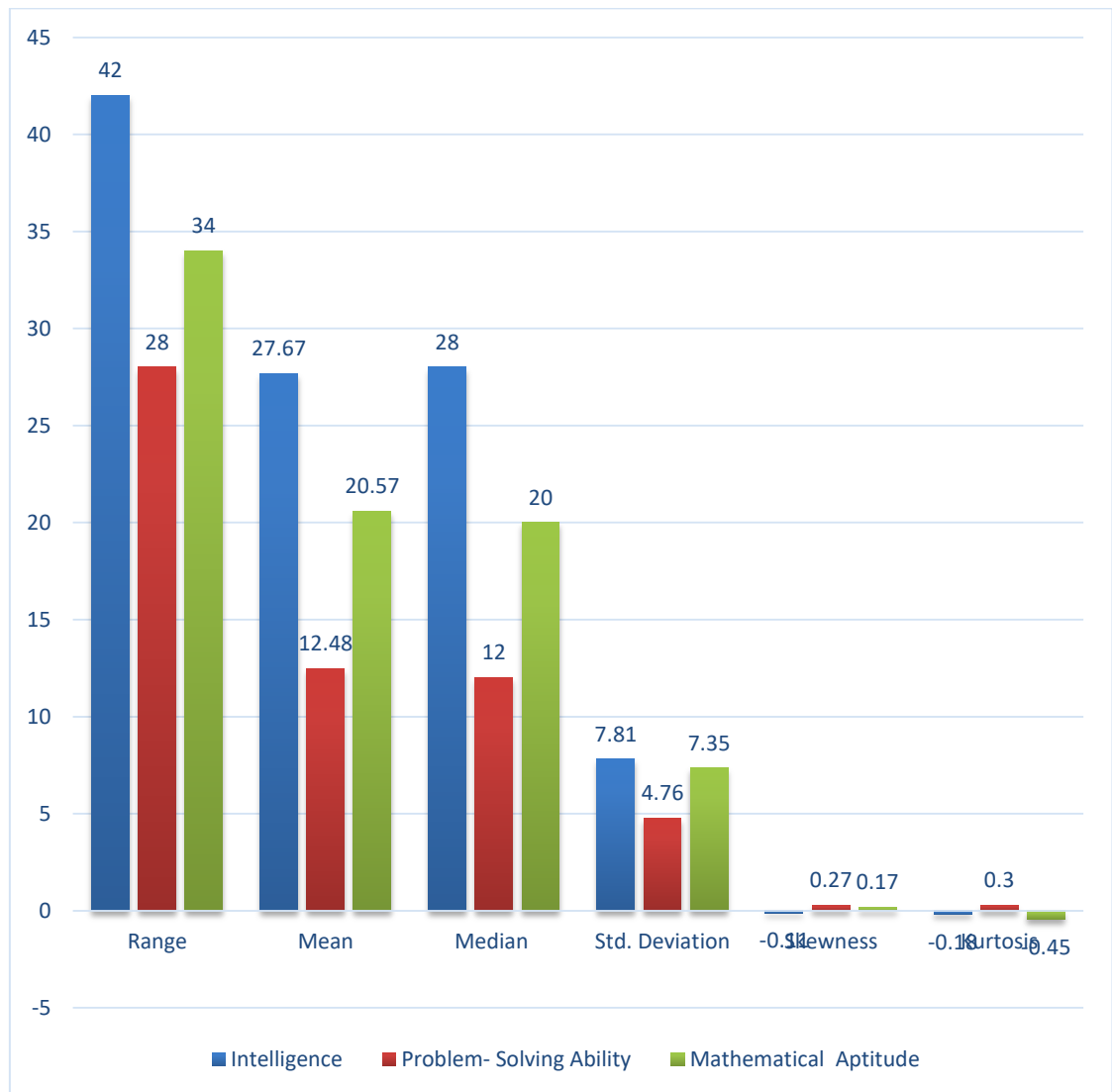


Figure No. 4.9

Descriptive Measures on the Scores of Government Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude

Table No. 4.11

Descriptive Measures on the Scores of Private Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude (N=97)

Variables	Range	Mean	Median	Std. Deviation	Skewness	Kurtosis
Intelligence	30	19.28	18	6.13	0.67	0.30
Problem-Solving Ability	22	9.79	10	4.75	0.74	0.32
Mathematical Aptitude	22	18.35	18	5.33	0.18	-0.52

The above table 4.11 exhibits the descriptive measures of all the variables for the total sample of private pre-service elementary teachers of DIETs Sikkim (N=97) which reveals that the value of mean and median on the variable of intelligence of private pre-service elementary teachers is 19.28 and 18 respectively which are quite proximate to each other. The positive value of skewness (0.67) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (0.30) is slightly more than zero implies that distribution is slightly leptokurtic. The observation leads to the conclusion that intelligence scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of problem-solving ability of private pre-service elementary teachers is 9.79 and 10 respectively which are quite proximate to each other. The positive value of skewness (0.74) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (0.32) is slightly more than zero implies that distribution is slightly leptokurtic. The

observation leads to the conclusion that problem-solving ability scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of mathematical aptitude of private pre-service elementary teachers is 18.35 and 18 respectively which are quite proximate to each other. The positive value of skewness (0.18) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.52) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that mathematical aptitude scores of pre-service elementary teachers are normally distributed.

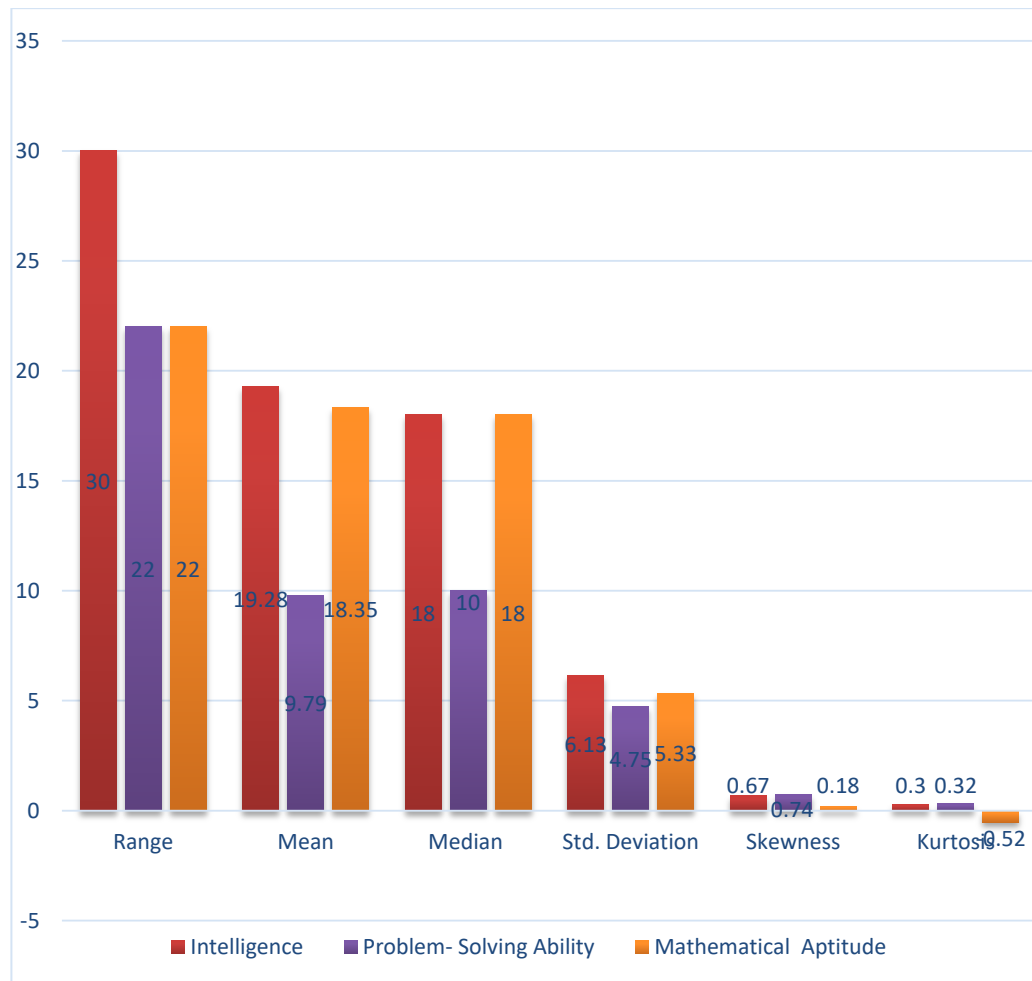


Figure No. 4.10

Descriptive Measures on the Scores of Private Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude

Table No. 4.12

Descriptive Measures on the Scores of Mathematical background Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude (N=106)

Variables	Range	Mean	Median	Std. Deviation	Skew -ness	Kurtosis
Intelligence	42	25.81	26	9.00	0.17	-0.30
Problem-Solving Ability	28	12.11	12	5.11	0.56	0.66
Mathematical Aptitude	32	19.67	20	6.80	0.04	-0.24

The above table 4.12 exhibits the descriptive measures of all the variables for the total sample of mathematical background pre-service elementary teachers of DIETs Sikkim (N=106) which reveals that the value of mean and median on the variable of intelligence of mathematical background pre-service elementary teachers is 25.81 and 26 respectively which are quite proximate to each other. The positive value of skewness (0.17) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.30) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that intelligence scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of problem- solving ability of mathematical background pre-service elementary teachers is 12.11 and 12 respectively which are quite proximate to each

other. The positive value of skewness (0.56) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (0.66) is slightly more than zero implies that distribution is slightly leptokurtic. The observation leads to the conclusion that problem- solving ability scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of mathematical aptitude of mathematical background pre-service elementary teachers is 19.67 and 20 respectively which are quite proximate to each other. The positive value of skewness (0.04) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.24) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that mathematical aptitude scores of pre-service elementary teachers are normally distributed.

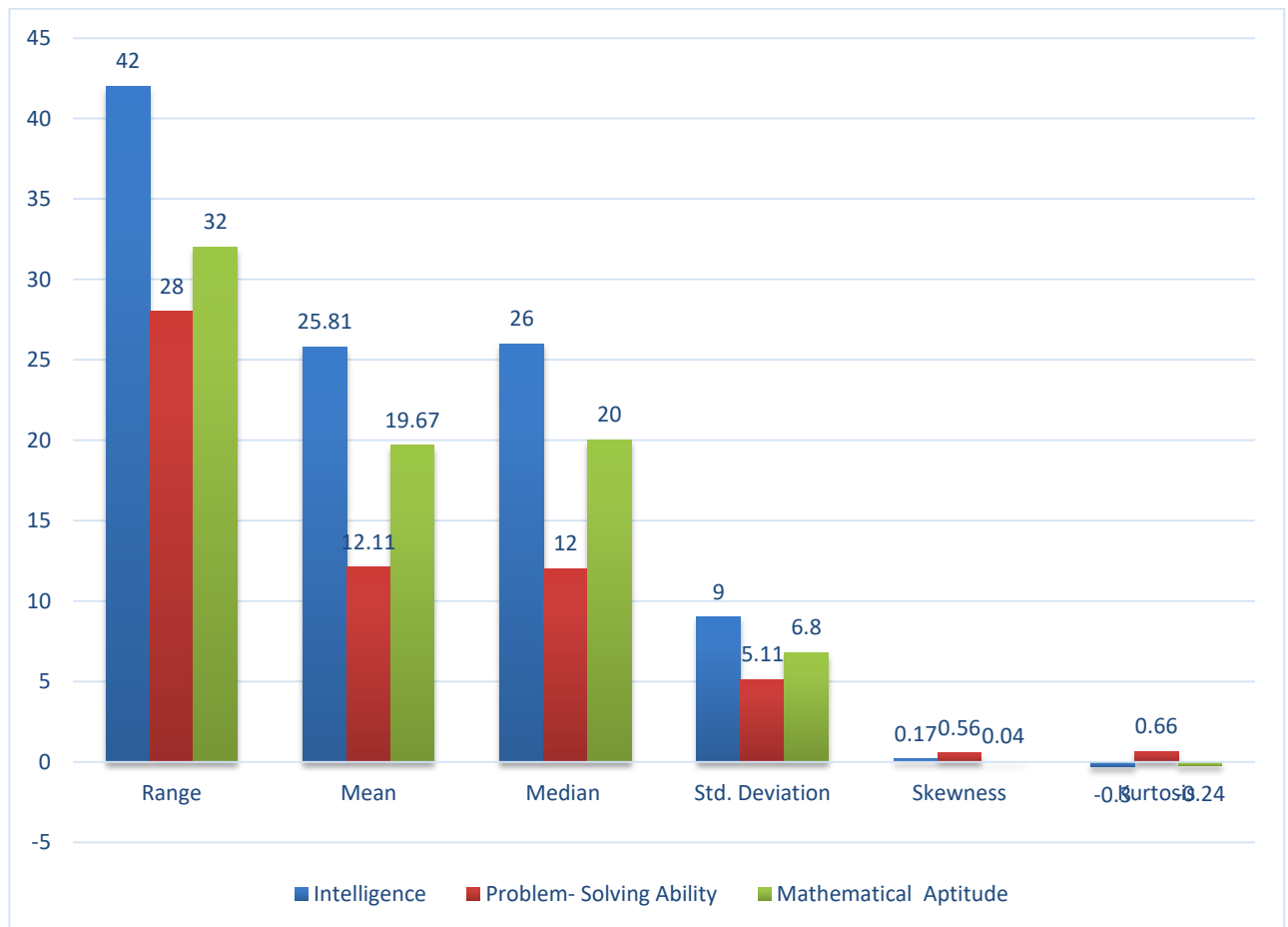


Figure No. 4.11
Descriptive Measures on the Scores of Mathematical background Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude

Table No. 4.13
Descriptive Measures on the Scores of non- Mathematical background Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude. (N=240)

Variables	Range	Mean	Median	Std. Deviation	Skew-ness	Kurtosis
Intelligence	38	25.10	24	7.95	0.08	-0.78
Problem-Solving Ability	24	11.56	12	4.80	0.23	-0.30
Mathematical Aptitude	34	20.09	20	6.97	0.36	-0.32

The above table 4.13 exhibits the descriptive measures of all the variables for the total sample of non-mathematical background pre-Service elementary teachers of DIETs Sikkim (N=240) which reveals that the value of mean and median on the variable of

intelligence of non-mathematical background pre-service elementary teachers is 25.10 and 24 respectively which are quite proximate to each other. The positive value of skewness (0.08) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.78) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that intelligence scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of problem- solving ability of non-mathematical background pre-service elementary teachers is 11.56 and 12 respectively which are quite proximate to each other. The positive value of skewness (0.23) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.30) is slightly less than zero implies that distribution is slightly platykurtic.

The observation leads to the conclusion that problem- solving ability scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of mathematical aptitude of non-mathematical background pre-service elementary teachers is 20.09 and 20 respectively which are quite proximate to each other. The positive value of skewness (0.36) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.32) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that mathematical aptitude scores of pre-service elementary teachers are normally distributed.

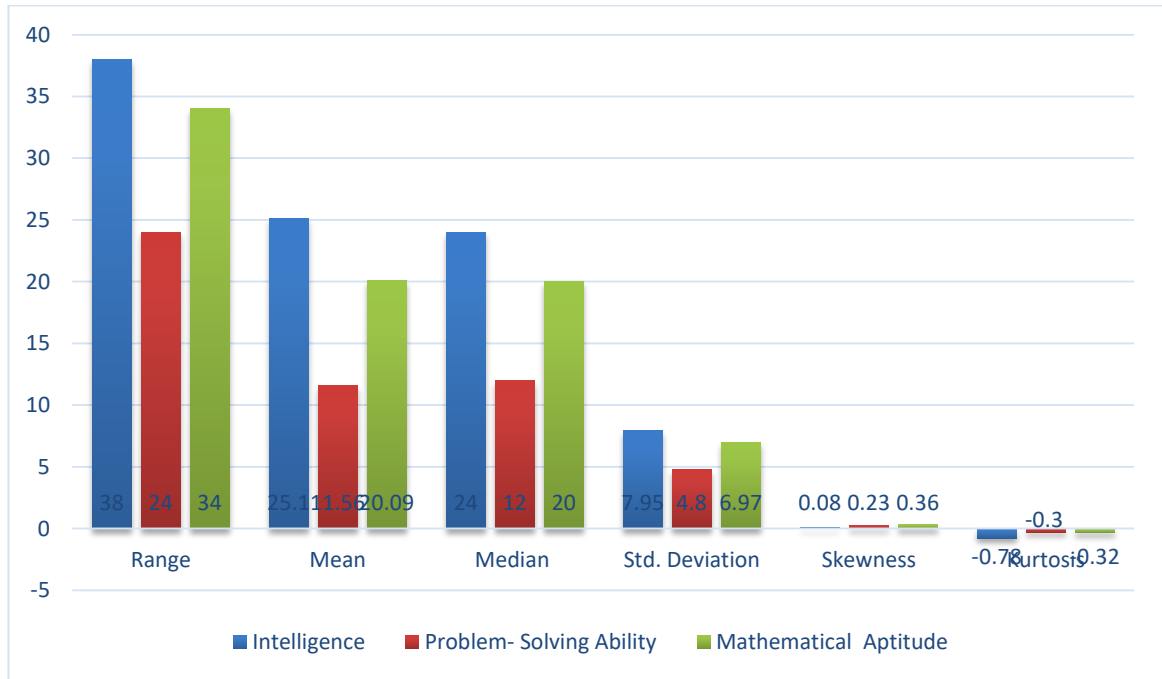
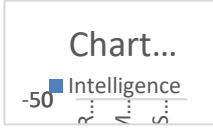


Figure No. 4.12:

Descriptive Measures on the Scores of non- Mathematical background Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude

Table No. 4.14

Descriptive Measures on the Scores of ST Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude (N=155)

Variables	Range	Mea n	Median	Std. Deviation	Skew -ness	Kurtos -is
						
Intelligence	40	25.73	26	8.71	0.21	-0.41
Problem- Solving Ability	28	12.01	12	4.96	0.24	-0.29
Mathematical Aptitude	34	20.48	20	7.04	0.39	-0.10

The above table 4.14 exhibits the descriptive measures of all the variables for the total sample of ST pre-Service elementary teachers of DIETs Sikkim (N=155) which reveals that the value of mean and median on the variable of intelligence of ST pre-service elementary teachers is 25.73 and 26 respectively which are quite proximate to each other. The positive value of skewness (0.21) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.41) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that intelligence scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of problem- solving ability of ST pre-service elementary teachers is 12.01 and 12 respectively which are quite proximate to each other. The positive value of skewness (0.24) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.29) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that problem- solving ability scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of mathematical aptitude of ST pre-service elementary teachers is 20.48 and 20 respectively which are quite proximate to each other. The positive value of skewness (0.39) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.10) is slightly less than zero implies that distribution

is slightly platykurtic. The observation leads to the conclusion that mathematical aptitude scores of pre-service elementary teachers are normally distributed.

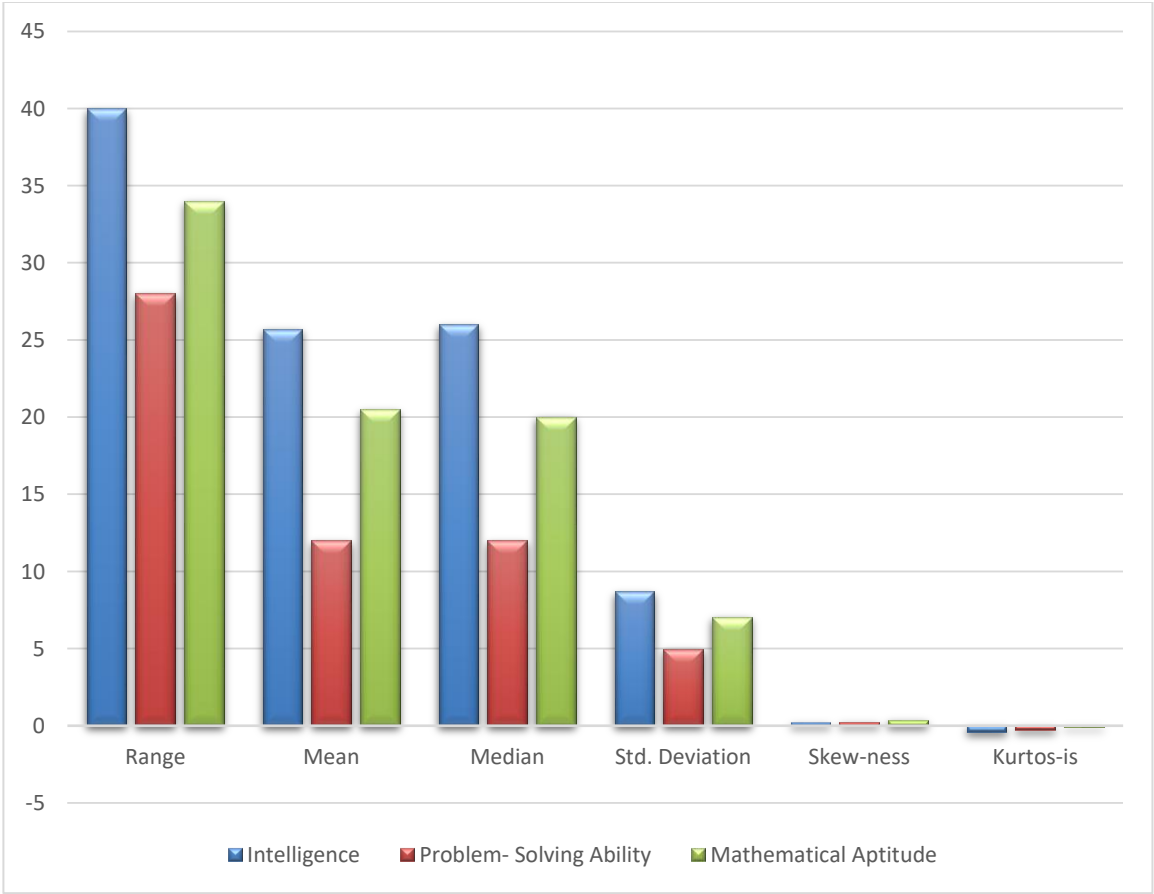


Figure No. 4.13

Descriptive Measures on the Scores of ST Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude

Table No. 4.15

**Descriptive Measures on the Scores of non- ST Pre-Service Elementary Teachers
on Intelligence, Problem-Solving Ability and Mathematical Aptitude.
(N=191)**

Variables	Range	Mean	Median	Std. Deviation	Skewness	Kurtosis
Intelligence	40	24.98	24	7.93	0.02	-0.78
Problem-Solving Ability	24	11.50	12	4.85	0.44	-0.07
Mathematical Aptitude	32	19.54	20	6.80	0.15	-0.52

The above table 4.15 exhibits the descriptive measures of all the variables for the total sample of non-ST pre-Service elementary teachers of DIETs Sikkim (N=191) which reveals that the value of mean and median on the variable of intelligence of non-ST pre-service elementary teachers is 24.98 and 24 respectively which are quite proximate to each other. The positive value of skewness (0.02) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.78) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that intelligence scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of problem- solving ability of non-ST pre-service elementary teachers is 11.50 and 12 respectively which are quite proximate to each other. The positive value of skewness

(0.44) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.07) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that problem-solving ability scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of mathematical aptitude of non-ST pre-service elementary teachers is 19.54 and 20 respectively which are quite proximate to each other. The positive value of skewness (0.15) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.52) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that mathematical aptitude scores of pre-service elementary teachers are normally distributed.

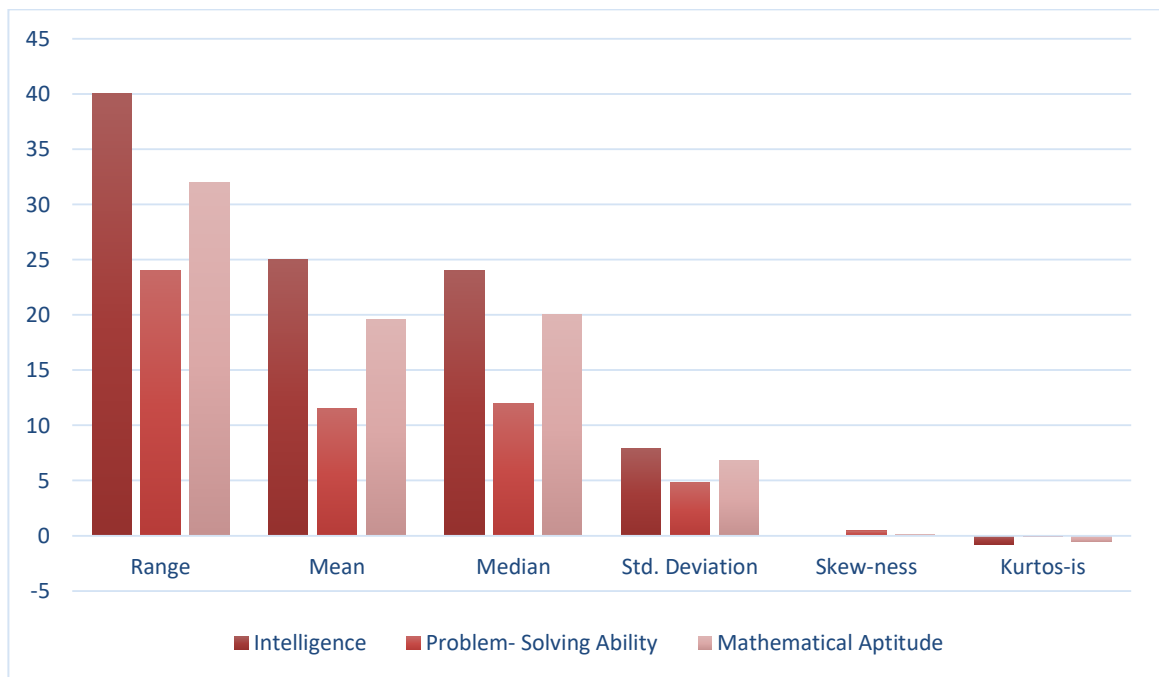


Figure No. 4.14

Descriptive Measures on the Scores of ST Pre-Service Elementary Teachers on Intelligence, Problem-Solving Ability and Mathematical Aptitude

4.4 Objective N0. 3: To compare the mathematical aptitude of tribal and non-tribal pre-service elementary teachers of Sikkim.

Table No. 4.16

Descriptive Measures on the Scores of Pre-Service Elementary Teachers on ST and non-ST (N=346)

Mathematical Aptitude	Range	Mean	Median	Std. Deviation	Skewness	Kurtosis
ST	34	20.48	20	7.04	0.39	-0.10
NON-ST	32	19.54	20	6.80	0.15	-0.52

The above table 4.16 exhibits the descriptive measures of all the variables for the total sample of ST and Non- ST pre-Service elementary teachers of DIETs Sikkim (N=346) which reveals that the value of mean and median on the variable of mathematical aptitude of ST pre-service elementary teachers is 20.48 and 20 respectively which are quite proximate to each other. The positive value of skewness (0.39) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.10) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that mathematical aptitude scores of ST pre-service elementary teachers are normally distributed. The value of mean and median on the variable of mathematical aptitude of non-ST pre-service elementary teachers is 19.54 and 20 respectively which are quite proximate to

each other. The positive value of skewness (0.15) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.52) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that mathematical aptitude scores of non-ST pre-service elementary teachers are normally distributed. The value of mean and median on the variable of mathematical aptitude of ST pre-service elementary teachers is 20.48 and the value of mean and median on the variable of mathematical aptitude of non - ST pre-service elementary teachers is 19.54.

It shows that mathematical aptitude of ST pre-service elementary teachers is slightly more than non-ST pre-service elementary teachers.

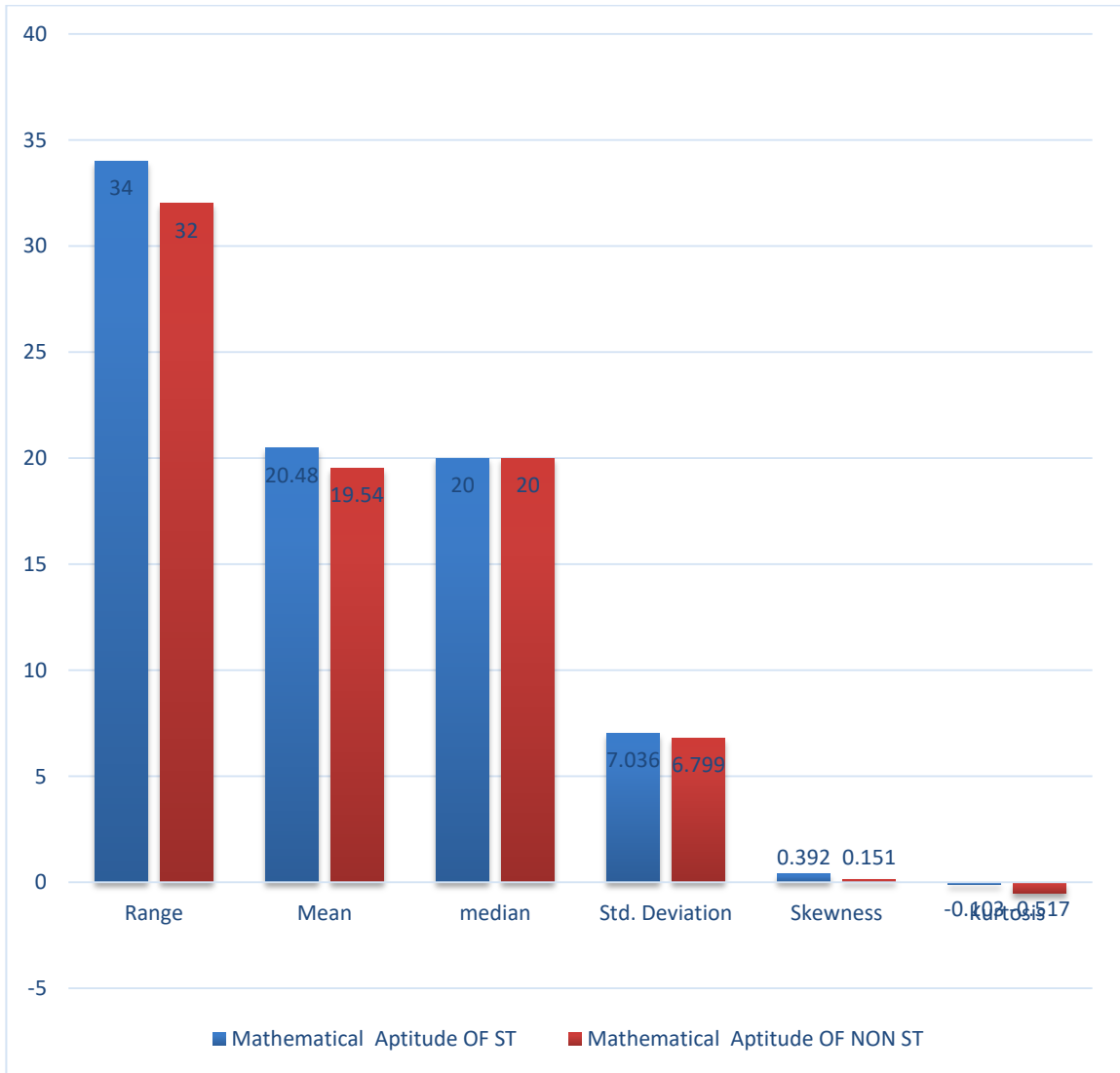


Figure No. 4.15
Descriptive Measures on the Scores of Pre-Service Elementary Teachers on ST and non-ST

4.1 Objective N0. 4: To examine the correlation between intelligence and mathematical aptitude of pre-service elementary teachers of Sikkim.

Table No. 4.17
Correlation between Intelligence and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with of Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
Intelligence	0.463**

** . Correlation is significant at the 0.05 level (2-tailed).

The above Table 4.17 reveals the coefficient of correlation between intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation is more than the tabulated value at the level of significance 0.05 level ($r=0.463$ respectively). Hence there exists positive and significant relationship between intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In the other words, the results of present study clearly found that intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are closely associated and intelligence is a powerful determinant of deciding the mathematical aptitude of pre-service elementary teachers. The reasons for the significant positive correlation may be explained on the basis that nature of intelligence test and mathematical aptitude are somewhat similar. Intelligence influences to improve mathematical aptitude in pre-service elementary teachers. The obtained result may be supported from the study of **Pyari, Mishra & Dua (2016)** who came out with the finding that there is significant effect of aptitude in the stream selection process of students, due to their ability for mathematical reasoning which forms an integral part of intelligence and plays a significant role for choosing

mathematics as careers option at higher secondary level. Intelligence and mathematical aptitude were found to be highly correlated in this study.

4.6 Objective N0. 5: To examine the correlation between mathematical aptitude and problem-solving ability of pre-service elementary teachers of Sikkim.

Table No. 4.18

Correlation between Problem-Solving Ability and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with of Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
Problem-Solving Ability	0.352**

** . Correlation is significant at the 0.05 level (2-tailed).

The above table 4.18 reveals the coefficient of correlation between problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation is more than the tabulated value at the level of significance 0.05 level ($r=0.352$ respectively). Hence there exist positive and significant relationship between problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the results of present study clearly found that problem solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are closely associated. Problem-solving ability is a powerful determinant of deciding the mathematical aptitude of pre-service elementary teachers. The reasons for the significant positive correlation may be explained on the basis that nature of problem-solving ability test and mathematical aptitude are somewhat similar.

The finding of the present study may be corroborated with the study of **Tyagi (2014)** who found that mathematical creativity was found to be causally predominant over mathematical aptitude (i.e., higher mathematical creativity leads to higher mathematical aptitude). Furthermore, mathematical problem-solving performance was found to be the cause of mathematical aptitude and mathematical creativity both (i.e., higher mathematical problem-solving performance leads to higher mathematical aptitude and mathematical creativity). The present study too evidenced to this fact that problem solving ability does get influenced by the mathematical aptitude of pre-service teachers.

4.7 Objective N0. 6: To examine the correlation between intelligence and problem-solving ability of pre-service elementary teachers of Sikkim.

Table No. 4.19

Correlation between Intelligence and Problem-Solving Ability of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with of Problem-Solving Ability of pre-service elementary teachers of DIETs Sikkim
Intelligence	0.415**

** . Correlation is significant at the 0.05 level (2-tailed).

The above table 4.19 reveals that the coefficient of correlation between intelligence and problem-solving ability of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation is more than the tabulated value at the level of significance 0.05 level ($r=0.415$). Hence there exist positive and significant relationship between intelligence and problem-solving ability of pre-service elementary teachers of DIETs Sikkim. In the other words, the results of present study clearly state that intelligence and problem-solving ability of pre-service elementary teachers of

DIETs Sikkim are integrally related. Intelligence does play a dominant role in impacting the problem-solving ability of pre- service elementary teachers. Higher the intelligence level, more the problem-solving ability of the pre-service teachers.

The reasons for the significant positive correlation may be explained on the basis that nature of intelligence test and problem-solving ability are same what similar.

4.8 Objective N0. 7: To examine the test of significance relationship between mathematical aptitude, intelligence and problem-solving abilities of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.

Table No. 4.20

Correlation between ST with Intelligence and Problem -Solving Ability of Pre-Service Elementary Teachers of DIETs Sikkim.

Independent Variable	The value of Coefficient of Correlation with Intelligence and Problem-Solving Ability of pre-service elementary teachers of DIETs Sikkim
ST	0.392 ^{**}

****.** Correlation is significant at the 0.05 level (2-tailed).

The above table No.4.20 reveals that coefficient of correlation between ST, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r= 0.392$) is more than the tabulated value 0.159 at the level of significance 0.05 level. Hence there exist positive and significant relationship between ST, variable intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that ST, intelligence and problem-solving ability of pre-service elementary

teachers of DIETs Sikkim are integrally related. ST pre-service elementary teachers have good intelligence and problem –solving ability.

Table No. 4.21
Correlation between ST with Problem-Solving Ability and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with Problem-Solving Ability and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
ST	0.309 ^{**}

** . Correlation is significant at the 0.05 level (2-tailed).

The above table No.4.21 reveals that coefficient of correlation between ST, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r= 0.309$) is more than the tabulated value 0.159 (N= 155) at the level of significance 0.05 level. Hence there exist positive and significant relationship between ST, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that ST and problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are integrally related. ST pre-service elementary teachers have good problem-solving ability and mathematical aptitude.

Table No. 4.22

Correlation between ST with Intelligence and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim.

Independent Variable	The value of Coefficient of Correlation with Intelligence and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
ST	0.416**

** . Correlation is significant at the 0.05 level (2-tailed).

Independent Variable	The above table No.4.22 reveals that coefficient of correlation between ST, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation (r = 0.416) is more than the tabulated value 0.159 (N= 155) at the level of significance 0.05 level .Hence
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there exist positive and significant relationship between ST, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that ST, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are integrally related. ST pre-service elementary teachers have good intelligence and mathematical aptitude.

Table No. 4.23

Correlation between non-ST with Intelligence and Problem-Solving Ability of Pre-Service Elementary Teachers of DIETs Sikkim.

Independent Variable	The value of Coefficient of Correlation with Intelligence and Problem-Solving Ability of pre-service elementary teachers of DIETs Sikkim
Non-ST	0.433**

** . Correlation is significant at the 0.05 level (2-tailed).

The above table No.4.23 reveals that coefficient of correlation between intelligence & problem-solving ability of pre-service elementary teachers of Sikkim. The calculated value of correlation is more than the tabulated value 0.191) at the level of significance 0.05 level (r= 0.433). Hence there exist positive significant relationship between non-ST, intelligence & problem solving- ability service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that non-ST, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim are integrally related. Non-ST Pre-service elementary teachers have good intelligence & problem-solving ability.

Table No. 4.24

Correlation between non- ST with Problem-Solving Ability and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with Problem-Solving Ability and Mathematical Aptitude of pre-
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Male	0.367**
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Table No. 4.24
Correlation between non- ST with Problem-Solving Ability and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with Problem-Solving Ability and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
Non-ST	0.385**

** Correlation is significant at the 0.05 level (2-tailed).

The above table No.4.24 reveals that coefficient of correlation between non-ST, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r = 0.385$) is more than the tabulated value 0.138 (N=191) at the level of significance 0.05 level. Hence there exist positive and significant relationship between non-ST, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that non-ST, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are integrally related. Non-ST pre-service elementary teachers have good problem-solving ability and mathematical aptitude.

Table No. 4.25
Correlation between Male with Intelligence and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim.

Independent Variable	The value of Coefficient of Correlation with Intelligence and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
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Non-ST	0.503**
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** . Correlation is significant at the 0.05 level (2-tailed)

The above table No.4.25 reveals that coefficient of correlation between non-ST, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r = 0.503$) is more than the tabulated value 0.138 (N=191) at the level of significance 0.05 level. Hence there exist positive and significant relationship between non-ST, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that non-ST, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are integrally related. Non-ST pre-service elementary teachers have good intelligence and mathematical aptitude.

Table No. 4.26

Correlation between Male with Intelligence and Problem –Solving Ability of Pre-Service Elementary Teachers of DIETs Sikkim.

Independent Variable	The value of Coefficient of Correlation with Intelligence and Problem-Solving Ability of pre-service elementary teachers of DIETs Sikkim
Male	0.367**

** Correlation is significant at the 0.05 level (2-tailed).

The above table No.4.26 reveals that coefficient of correlation between male, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r= 0.367$) is more than the tabulated value

0.273 (N=53) at the level of significance 0.05 level. Hence there exist positive and significant relationship between male, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that male intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim are integrally related. Male, pre-service elementary teachers have good intelligence & problem-solving ability.

Table No. 4.27

Correlation between Male with Problem-Solving Ability and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with Problem-Solving Ability and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
Male	0.337 ^{**}

^{**} Correlation is significant at the 0.05 level (2-tailed).

The above table No.4.27 reveals that coefficient of correlation between male, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r = 0.337$) is more than the tabulated value 0.273 (N=53) at the level of significance 0.05 level. Hence there exist positive and significant relationship between male, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that male, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are integrally related. male pre-service elementary teachers have good problem-solving ability and mathematical aptitude.

Table No. 4.28

Correlation between Male with Intelligence and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with Intelligence and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim	**
Male	0.380**	Correlation

is significant at the 0.05 level (2-tailed).

The above table No.4.28 reveals that coefficient of correlation between male, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r = 0.380$). is more than the tabulated value 0.273 ($N=53$) at the level of significance 0.05 level. Hence there exist positive and significant relationship between male, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that male, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are integrally related. Male pre-service elementary teachers have good intelligence and mathematical aptitude.

Table No. 4.29

Correlation between Female with Intelligence and Problem-Solving Ability of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with Intelligence and Problem-Solving Ability of pre-service elementary teachers of DIETs Sikkim
Female	0.406**

** Correlation is significant at the 0.05 level (2-tailed).

The above table No.4.29 reveals that coefficient of correlation between female, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r= 0.406$) is more than the tabulated value 0.112 (N=293) at the level of significance 0.05 level. Hence there exist positive and significant relationship between female, intelligence & problem –solving ability of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that female intelligence & problem-solving abilities of pre-service elementary teachers of DIETs Sikkim are integrally related. Female pre-service elementary teachers have good intelligence & problem-solving ability.

Table No. 4.30
Correlation between Female with Problem-Solving Ability and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with Problem-Solving Ability and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
Female	0.333**

** Correlation is significant at the 0.05 level (2-tailed).

Table No.4.30 reveals that coefficient of correlation between female, problem-solving abilities and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r= 0.333$) is more than the tabulated value 0.112 (N=293) at the level of significance 0.05 level. Hence there exist positive and significant relationship between female, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that female, problem-solving ability and mathematical

aptitude of pre-service elementary teachers of DIETs Sikkim are integrally related. Female pre-service elementary teachers have good problem-solving ability and mathematical aptitude.

Table No. 4.31

Correlation between Female with Intelligence and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with Intelligence and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
Female	0.454**

** Correlation is significant at the 0.05 level (2-tailed).

TableNo.4.31 reveals that coefficient of correlation between female intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r = 0.454$) is more than the tabulated value 0.112 ($N=293$) at the level of significance 0.05 level. Hence there exist positive and significant relationship between female, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that female, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are integrally related. Female pre-service elementary teachers have good intelligence and mathematical aptitude

Table No. 4.32

Correlation between Mathematical background with Intelligence and Problem – Solving Ability of Pre-Service Elementary Teachers of DIETs Sikkim.

Independent	The value of Coefficient of Correlation with Intelligence and
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Variable	Problem-Solving Ability of pre-service elementary teachers of DIETs Sikkim
Mathematical Background	0.476**

** Correlation is significant at the 0.05 level (2-tailed).

Table No.4.32 reveals that coefficient of correlation between mathematical background, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r= 0.476$) is more than the tabulated value 0.195 ($N=106$) at the level of significance 0.05 level. Hence there exist positive and significant relationship between mathematical background, intelligence & problem –solving ability of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that mathematical background, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim are integrally related. Mathematical background pre-service elementary teachers have good intelligence & problem –solving ability.

Table No. 4.33

Correlation between Mathematical background with Problem-Solving Ability and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim.

Independent Variable	The value of Coefficient of Correlation with Problem-Solving Ability and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
Mathematical Background	0.534**

** Correlation is significant at the 0.05 level (2-tailed).

Table No.4.33 reveals that coefficient of correlation between mathematical background, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r= 0.534$) is more than the tabulated value 0.195 (N=106) at the level of significance 0.05 level. Hence there exist positive and significant relationship between mathematical background, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that mathematical background, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are integrally related. mathematical background pre-service elementary teachers have good problem-solving ability and mathematical aptitude.

Table No. 4.34

Correlation between Mathematical background with Intelligence and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim.

Independent Variable	The value of Coefficient of Correlation with Intelligence and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
Mathematical Background	0.428**

** Correlation is significant at the 0.05 level (2-tailed).

Table No.4.34 reveals that coefficient of correlation between mathematical background, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r = 0.428$) is more than the tabulated value 0.195 (N=106) at the level of significance 0.05 level .Hence there exist positive and significant relationship between mathematical background, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that mathematical background, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs

Sikkim are integrally related. Mathematical background pre-service elementary teachers have good intelligence and mathematical aptitude.

Table No. 4.35

Correlation between non- Mathematical background with Intelligence and Problem –Solving Ability of Pre-Service Elementary Teachers of DIETs Sikkim.

Independent Variable	The value of Coefficient of Correlation with Intelligence and Problem-Solving Ability of pre-service elementary teachers of DIETs Sikkim
Non-Mathematical Background	0.381**

** Correlation is significant at the 0.05 level (2-tailed).

Table No.4.35 reveals that coefficient of correlation between non-mathematical background, intelligence and problem-solving ability of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r= 0.381$) is more than the tabulated value 0.124 ($N= 240$) at the level of significance 0.05 level. Hence there exist positive and significant relationship between non-mathematical background, intelligence and problem-solving ability of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that non-mathematical background, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim are integrally related. Non- mathematical background pre-service elementary teachers have good intelligence & problem-solving ability.

Table No. 4.36

Correlation between non- Mathematical background with Problem-Solving Ability and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with Problem-Solving Ability and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
Non- Mathematical Background	0.273**

** Correlation is significant at the 0.05 level (2-tailed).

Table No.4.36 reveals that coefficient of correlation between non-mathematical background and problem-solving ability, mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r = 0.273$) is more than the tabulated value 0.124 ($N = 240$) at the level of significance 0.05 level. Hence there exist positive and significant relationship between non-mathematical background, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that non-mathematical background, problem-solving ability and mathematical

aptitude of pre-service elementary teachers of DIETs Sikkim are integrally related. Non- mathematical background pre-service elementary teachers have good problem – solving ability and mathematical aptitude.

Table No. 4.37

Correlation between non- Mathematical background with Intelligence and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with Intelligence and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
Non-Mathematical Background	0.483 ^{**}

^{**}Correlation is significant at the 0.05 level (2-tailed).

Table No.4.37 reveals that coefficient of correlation between non-mathematical background, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r = 0.483$) is more than the tabulated value 0.124 (N= 240) at the level of significance 0.05 level. Hence there exist positive and significant relationship between non-mathematical background, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that non-mathematical background, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are integrally related. Non-mathematical background pre-service elementary teachers have good intelligence and mathematical aptitude.

Table No. 4.38

Correlation between Government with Intelligence and Problem –Solving Ability of Pre-Service Elementary Teachers of DIETs Sikkim.

Independent Variable	The value of Coefficient of Correlation with Intelligence and Problem-Solving Ability of pre-service elementary teachers of DIETs Sikkim
Government	0.487**

** Correlation is significant at the 0.05 level (2-tailed).

Table No.4.38 reveals that coefficient of correlation between government, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r = 0.487$) is more than the tabulated value 0.232 ($N=76$) at the level of significance 0.05 level .Hence there exist positive and significant relationship between government, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that government, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim are integrally related. government pre-service elementary teachers have good intelligence and problem-solving ability.

Table No. 4.39

Correlation between Government with Problem-Solving Ability and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim.

Independent Variable	The value of Coefficient of Correlation with Problem-Solving Ability and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
Government	0.610**

** Correlation is significant at the 0.05 level (2-tailed).

Table No.4.39 reveals that coefficient of correlation between government, problem-solving ability and mathematical aptitude of pre-service elementary teachers

of DIETs Sikkim. The calculated value of correlation ($r = 0.610$) is more than the tabulated value 0.232 ($N=76$) at the level of significance 0.05 level .Hence there exist positive and significant relationship between government, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that government, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are integrally related. Government pre-service elementary teachers have good problem-solving ability and mathematical aptitude.

Table No. 4.40
Correlation between Government with Intelligence and Mathematical Aptitude of
Pre-Service Elementary Teachers of DIETs Sikkim.

Independent Variable	The value of Coefficient of Correlation with Intelligence and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
Government	0.464 ^{**}

^{**} Correlation is significant at the 0.05 level (2-tailed).

Table No.4.40 reveals that coefficient of correlation between government, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r = 0.464$) is more than the tabulated value 0.232 ($N=76$) at the level of significance 0.05 level .Hence there exist positive and significant relationship between government, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that government, intelligence and mathematical aptitude of pre-service elementary

teachers of DIETs Sikkim are integrally related. Government pre-service elementary teachers have good intelligence and mathematical aptitude.

Table No. 4.41

Correlation between Private with Intelligence and Problem-Solving Ability of Pre-Service Elementary Teachers of DIETs Sikkim.

Independent Variable	The value of Coefficient of Correlation with Intelligence and Problem-Solving Ability of pre-service elementary teachers of DIETs Sikkim
Private	0.441**

** Correlation is significant at the 0.05 level (2-tailed).

Table No.4.41 reveals that coefficient of correlation between private, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r = 0.441$) is more than the tabulated value 0.361 (N=30) at the level of significance 0.05 level .Hence there exist positive and significant relationship between private, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that private, intelligence and problem-solving ability of pre-service elementary teachers of DIETs Sikkim are integrally related. private pre-service elementary teachers have good intelligence & problem-solving ability.

Table No. 4.42

Correlation between Private with Problem-Solving Ability and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with Problem-Solving Ability and Mathematical Aptitude of pre-service
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	elementary teachers of DIETs Sikkim
Private	0.288**

** Correlation is significant at the 0.05 level (2-tailed).

Table No.4.42 reveals that coefficient of correlation between private, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r= 0.288$) is more than the tabulated value 0.361 (N=30) at the level of significance 0.05 level .Hence there exist positive and significant relationship between private, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that private, problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are integrally related. Private pre-service elementary teachers have good problem –solving ability and mathematical aptitude.

Table No. 4.43

Correlation between Private with Intelligence and Mathematical Aptitude of Pre-Service Elementary Teachers of DIETs Sikkim

Independent Variable	The value of Coefficient of Correlation with Intelligence and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim
Private	0.370**

** Correlation is significant at the 0.05 level (2-tailed).

Table No.4.43 reveals that coefficient of correlation between private, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation ($r = 0.370$) is more than the tabulated value 0.361 ($N=30$) at the level of significance 0.05 level. Hence there exist positive and significant relationship between private, intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the result of present study clearly states that private, an intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are integrally related. Private pre-service elementary teachers have good intelligence and mathematical aptitude.

4.8.1 Analysis of test of significant difference between means of Intelligence, Problem solving ability and Mathematical aptitude variables.

One of the objectives of the present study was to find the differences between intelligence, problem-solving ability and mathematical aptitude of male and female pre-service elementary teachers of DIETs Sikkim, government and private pre-service elementary teachers of DIETs Sikkim, mathematical and non- mathematical background pre-service elementary teachers of DIETs Sikkim and tribal and non-tribal pre-service elementary teachers of DIETs Sikkim. In order to attain these objectives, 't' test was computed and consequently differential analysis for the same are presented here below.

Table No. 4.44

Test of significant difference between means of Male and Female of Pre-Service Elementary Teachers on Mathematical Aptitude

Gender	N	Mean	Std. Deviation	S_{ED}	t	Remark
Male	53	23.13	5.929	0.910	4.119	Significant at 0.05 level
Female	293	19.39	6.931			

Table Value = 1.97 at 0.05 level of significance

The above table brings out the value of ‘t’ for mathematical aptitude of male and female pre-service elementary teachers as 4.119 which is more than the table value 1.97 at 0.05 level of significance. Therefore, the hypothesis that ‘there exists no significant difference between male and female pre-service elementary teachers for mathematical aptitude was rejected. It means that null hypothesis is not accepted. It shows that mathematical aptitude of male and female pre-service elementary teachers differs significantly. In other words, gender affects the mathematical aptitude of pre-service elementary teachers.

Table No. 4.45

Test of significant difference between means of Male and Female of Pre-Service Elementary Teachers on Intelligence

Gender	N	Mean	Std. Deviation	S_{ED}	t	Remark
Male	53	28.49	7.327	1.118	3.352	

Female	293	24.74	8.324			Significant at 0.05 level
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Table Value = 1.97 at 0.05 level of significance

It is found from the t-value as depicted in the above table for intelligence of male and female pre-service elementary teachers is 3.352 which is more than the table value 1.97 at 0.05 level of significance. Therefore, the hypothesis that there exists no significant difference between male and female pre-service elementary teachers for intelligence was rejected. It means that null hypothesis is not accepted. It shows that intelligence of male and female pre-service elementary teachers differs significantly. In other words, the intelligence level of pre-service elementary teachers gets influenced by the gender variation.

Table No. 4.46

Test of significant difference between means of Male and Female of Pre-Service Elementary Teachers on Problem-Solving Ability

Gender	N	Mean	Std. Deviation	S _{ED}	t	Remark
Male	53	13.40	4.465	.677	2.908	Significant at 0.05 level
Female	293	11.43	4.921			

Table Value = 1.97 at 0.05 level of significance

The obtained t-value as shown in the above table evidenced that problem-solving ability of male and female pre-service elementary teachers is 2.908 which is more than the table value 1.97 at 0.05 level of significance. Therefore, the hypothesis that there exists no significant difference between male and female pre-service elementary teachers for problem-solving ability was rejected. It means that null hypothesis is not

accepted. It shows that problem- solving ability of male and female pre-service elementary teachers differs significantly. Thus, gender is found to affect the problem-solving ability of pre-service elementary teachers.

Table No. 4.47

Test of significant difference between means of Government and Private of Pre-Service Elementary Teachers on Mathematical Aptitude

Management	N	Mean	Std. Deviation	S_{ED}	t	Remark
Government	249	20.59	7.352	0.714	3.131	Significant at 0.05 level
Private	97	18.35	5.331			

Table Value = 1.97 at 0.05 level of significance

From the above table, it is found that the t-value for mathematical aptitude of government and private pre-service elementary teachers is 3.131 which is more than the table value 1.97 at 0.05 level of significance. Therefore, the hypothesis that ‘there exist no significant difference between government and private pre-service elementary teachers for mathematical aptitude was rejected. It means that null hypothesis is not accepted. It shows that mathematical aptitude of government and private pre-service elementary teachers differs significantly, and thus it can be concluded that management variable does affect the mathematical aptitude of pre-service elementary teachers.

Table No. 4.48

Test of significant difference between means of Government and Private of Pre-Service Elementary Teachers on Intelligence

Management	N	Mean	Std. Deviation	S _{ED}	t	Remark
Government	249	27.67	7.811	0.795	10.551	Significant at 0.05 level
Private	97	19.28	6.132			

Table Value = 1.97 at 0.05 level of significance

The above table illustrates that 't' value for intelligence of government and private pre-service elementary teachers is 10.551 which is more than the table value 1.97 at 0.05 level of significance. Therefore, the hypothesis that there exists no significant difference between government and private pre-service elementary teachers for intelligence was rejected. It means that null hypothesis is not accepted. It shows that intelligence of government and private pre-service elementary teachers differs significantly and thus it can be concluded that management does affect the intelligence of pre-service elementary teachers.

Table No. 4.49

Test of significant difference between means of Government and Private of Pre-Service Elementary Teachers on Problem-Solving Ability

Management	N	Mean	Std. Deviation	S _{ED}	t	Remark
Government	249	12.48	4.758	0.569	4.728	Significant at 0.05 level
Private	97	9.79	4.748			

Table Value = 1.97 at 0.05 level of significance

The t-value from above table depicts that for problem-solving ability of government and private pre-service elementary teachers, it is 4.728 which is more than

the table value 1.97 at 0.05 level of significance. Therefore, the hypothesis that ‘there exists no significant difference between government and private pre-service elementary teachers for problem- solving ability was rejected. It means that null hypothesis is not accepted. It shows that problem- solving ability of government and private pre-service elementary teachers differs significantly. It can thus be stated that the management variable influences the problem- solving ability of pre-service elementary teachers.

Table No. 4.50

Test of significant difference between means of Mathematical and non-Mathematical of Pre-Service Elementary Teachers on Mathematical Aptitude

Stream	N	Mean	Std. Deviation	SED	t	Remark
Mathematical	106	19.66	6.803	0.799	0.540	No-Significant at 0.05 level
Non-Mathematical	240	20.09	6.970			

Table Value = 1.97 at 0.05 level of significance

The obtained t-value in the above table for mathematical aptitude of mathematical and non- mathematical background pre-service elementary teachers is found to be 0.540 which is less than the tabular value 1.97 at 0.05 level of significance. Therefore, the hypothesis that ‘there exist no significant difference between mathematical and non-mathematical background pre-service elementary teachers for mathematical aptitude was not rejected. It means that null hypothesis is accepted. It shows that mathematical aptitude of mathematical and non-mathematical background pre-service elementary teachers does not differ significantly. Thus, stream does not affect the mathematical aptitude of pre-service elementary teachers.

Table No. 4.51

Test of significant difference between means of Mathematical and non-Mathematical of Pre-Service Elementary Teachers on Intelligence

Stream	N	Mean	Std. Deviation	SED	't'	Remark
Mathematical	106	25.81	9.002	1.014	0.702	No-Significant at 0.05 level
Non-Mathematical	240	25.10	7.951			

Table Value = 1.97 at 0.05 level of significance

It is found that the t-value from the above table for intelligence of mathematical and non-mathematical background pre-service elementary teachers is 0.702 which is less than the table value 1.97 at 0.05 level of significance. Therefore, the hypothesis that there exists no significant difference between mathematical and non-mathematical background pre-service elementary teachers for intelligence was not rejected. It means that null hypothesis is accepted. It shows that intelligence of mathematical and non-mathematical background pre-service elementary teachers does not differ significantly. In other words, stream does not affect the intelligence of pre-service elementary teachers.

Table No. 4.52

Test of significant difference between means of Mathematical and non-Mathematical of Pre-Service Elementary Teachers on Problem-Solving Ability

Stream	N	Mean	Std. Deviation	S_{ED}	t	Remark
Mathematical	106	12.11	5.11	0.59	0.95	No-Significant at
Non-Mathematical	240	11.56	4.81			

						0.05 level
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Table Value = 1.97 at 0.05 level of significance

It is found that the t-value from Table No. 5.9 for problem- solving ability of mathematical and non- mathematical background pre-service elementary teachers is 0.948 which is less than the table value 1.97 at 0.05 level of significance. Therefore, the hypothesis that there exists no significant difference between mathematical and non-mathematical background pre-service elementary teachers for problem- solving ability was not rejected. It means that null hypothesis is accepted. It shows that problem-solving ability of mathematical and non-mathematical background pre-service elementary teachers does not differ significantly. Therefore, it can be concluded that stream does not have much effect on the problem- solving ability of pre-service elementary teachers.

Table No. 4.53

Test of significant difference between means of ST and non-ST of Pre-Service Elementary Teachers on Mathematical Aptitude

Category	N	Mean	Std. Deviation	S_{ED}	t	Remark
ST	155	20.48	7.036	0.749	1.252	No- Significant at 0.05 level
Non- ST	191	19.54	6.799			

Table Value = 1.97 at 0.05 level of significance

It is found that the t-value from Table No. 5.10 for mathematical aptitude of st and non- st pre-service elementary teachers is 1.252 which is less than the table value 1.97 at 0.05 level of significance. Therefore, the hypothesis that there exists no significant difference between ST and non- ST Pre-Service elementary teachers for

mathematical aptitude was not rejected. It means that null hypothesis is accepted. It shows that mathematical aptitude of ST and non- ST pre-service elementary teachers do not differs significantly. Thus, the scheduled and non-scheduled tribe status of the pre-service teachers does not affect the mathematical aptitude of pre-service elementary teachers.

Table No. 4.54

Test of significant difference between means of ST and non-ST of Pre-Service Elementary Teachers on Intelligence

Category	N	Mean	Std. Deviation	S_{ED}	t	Remark
ST	155	25.73	8.706	0.904	0.823	No-Significant at 0.05 level
Non- ST	191	24.98	7.926			

Table Value = 1.97 at 0.05 level of significance

It is found from the t-value from the above table for intelligence of ST and non-ST pre-service elementary teachers is 0.823 which is less than the table value 1.97 at 0.05 level of significance. Therefore, the hypothesis that there exists no significant difference between ST and non- ST pre-service elementary teachers for intelligence was not rejected. It means that null hypothesis is accepted. It shows that intelligence of ST and non- ST pre-service elementary teachers does not differ significantly. thus, the intelligence of pre-service elementary teachers is not influenced by the scheduled and non-scheduled tribe status of the pre-service teachers.

Table No. 4.55

Test of significant difference between means of ST and non-ST of Pre-Service Elementary Teachers on Problem-Solving Ability

Category	N	Mean	Std. Deviation	S_{ED}	t	Remark
ST	155	12.01	4.960	0.531	0.971	No-Significant at 0.05 level
Non- ST	191	11.50	4.851			

Table Value = 1.97 at 0.05 level of significance

The above table illustrates that ‘t’ value for problem- solving ability of ST and non- ST pre-service elementary teachers was found to be 0.971 which is less than the table value 1.97 at 0.05 level of significance. Therefore, the hypothesis that there exists no significant difference between ST and non- ST pre-service elementary teachers for problem- solving ability was not rejected. It means that null hypothesis is accepted. It shows that problem- solving ability of ST and non- ST pre-service elementary teachers does not differ significantly. It can thus be stated confidently that the scheduled and non-scheduled tribe status of the pre-service teachers does not affect the problem-solving ability of pre-service elementary teachers.

4.9 Mathematical Model based on making theory and formula

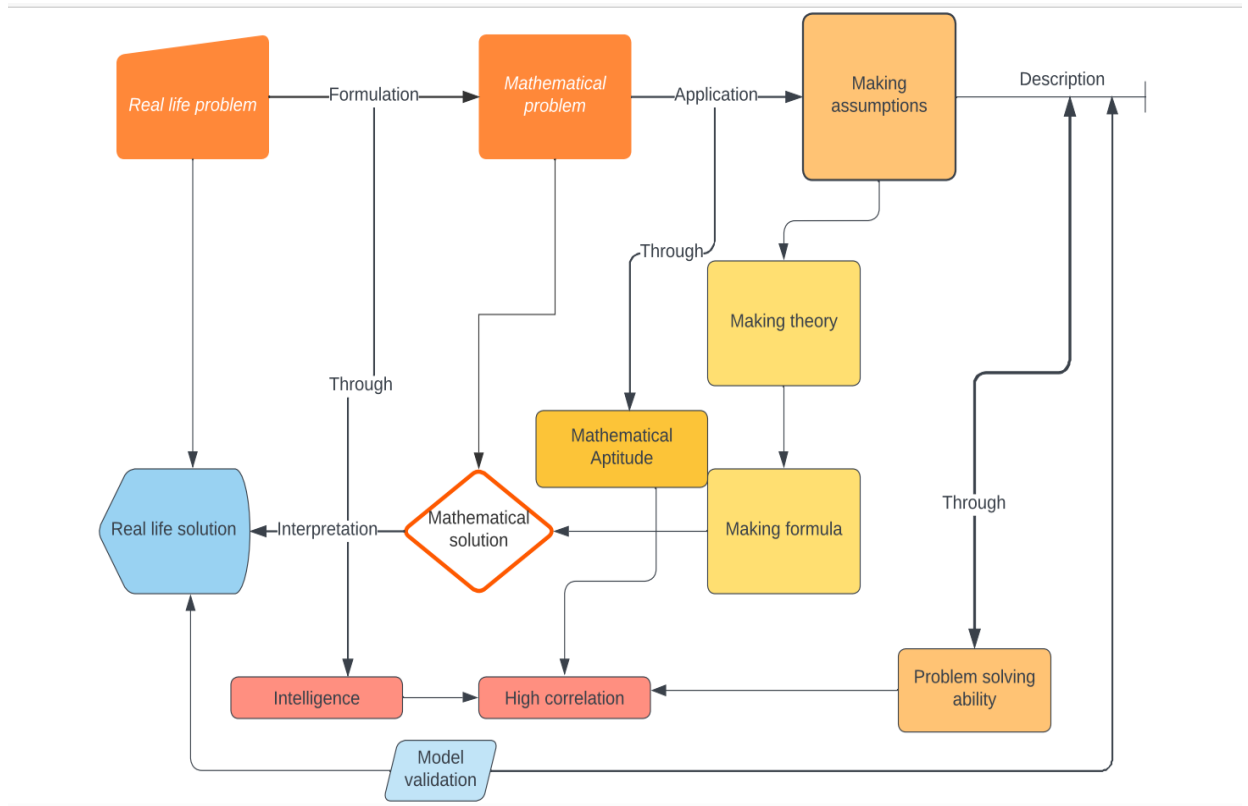


Figure No. 4.16 Mathematical Model

Real world problems cannot be solved with mathematical understanding before the problem is translated into mathematical language in the form of mathematical models. Therefore, the process of turning real world problems into mathematical problems is called mathematical modelling. This is a process of mathematizing real-world problems and hence is also called a mathematical process.

Researcher has made this model from inductive method where we find the solution from example to formula and observation to theory. Researcher has introduced the example based on real life problem find the solution logically and based on understanding of concept. Applying problem solving ability it is easy to solve the real-life problem. It may convert in mathematical problem and using theory and formula solve it. These examples are included in test which has administrated in the data collection. Making the theory and formula based on understanding can solve the problem of real and it comes as a solution.

To understand the problem through using intelligence, applying a special ability by using the numerical value through Mathematical aptitude and use an ability to solve the problem through problem solving ability.

The success of mathematical modelling depends on the ability of the learner to choose right variables and build relationships between variables through a good understanding of the problem to be solved. Because the model is a mathematical representation of the problem, an error in setting the model will produce the wrong solution for the problem. Errors in formulating equations occur due to misunderstanding of the problem. Therefore, understanding the problem is an important step in mathematical modelling. Thus, the model selection can be equalized by setting up the plan for solving the problem. Producing a model is certainly equivalent to carrying out a plan while the interpretation and validation of the model is a looking back activity. Since the equality between the modelling process and problem-solving process exists, it can be concluded that modelling is part of the problem-solving process.

Mathematical modelling provides a new perspective for problem solving, that is a process of interpreting a situation mathematically which often involves an iterative cycle of expressing, testing, and revising mathematical interpretations and activities of choosing, sorting, integrating, revising, and refining the grouping of mathematical concepts for topics inside and outside mathematics (**Lesh and Zawojewski**).

4.9.1 Real life-based questions

Example 1: A 10-meter-long ladder rests on a wall. If the foot of the stairs is 6 meters from the bottom of the wall with the assumption that the wall is perpendicular to the ground. Determine the height of the stairs on the wall.

Solution: By using perpendicular assumptions, the Pythagorean formula $p^2 + b^2 = h^2$ can be directly used to solve this problem; $p^2 + 6^2 = 10^2$, $p = 8$ meters so, height of the stairs on the wall is 8 meters It does not require further analysis to solve it, this problem is not a problem for students who have studied or are studying the Pythagorean Theorem. Mathematical problems will become problems if there are no ready-made methods, techniques, or procedures that can be directly used to solve them, but it requires

additional effort from the person who wants to solve them. Sometimes people have to change their perspective before seeing how to solve a problem.

Example 2: Laxman went 15km to the west from my house, then turned left and walked 16 km. He then turned East and walked 27km. How far was he from his house?

Solution: The Pythagorean formula cannot be directly used to solve this problem even though someone has thought of using it. Therefore, this problem requires further analysis to solve it. Understanding of direction and application of Pythagorean formula are required to solve this problem.

Here, $P = 27 - 15 = 12$, $b = 16$

Now Using Pythagorean formula $p^2 + b^2 = h^2$ to solve this problem;

$$12^2 + 16^2 = h^2, \quad 144 + 256 = h^2, \quad 400 = h^2 \quad h = 20$$

Laxman is 20 km from his house.

Example 3: A few men were ploughing in the field with a few bulls. Taking the men and bulls together, there were altogether 22 legs and 7 heads. Determine the number of men and bulls?

Solution: Suppose that heads of Man represented by a and heads of bulls b . The next step is to look for a relationship between a and b .

$$a + b = 7$$

$$2a + 4b = 22. \text{ Solving this equation, } a = 3 \text{ and } b = 4$$

Example 4 : Every person shook hands with each other after the end of the party, how many people were there in the party if 28 times in all hands were shaken?

Solution: Suppose that number of persons is n

$$\text{Total number of hands shaken} = n(n-1) \div 2. \quad ; \quad 28 = n(n-1) \div 2. \quad \text{So, } n = 8$$

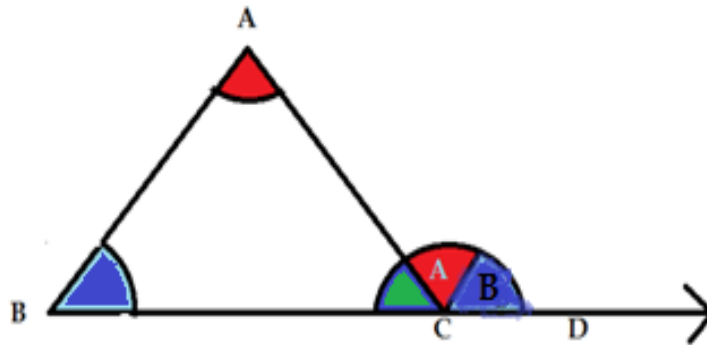
Example 5: One person is 4 years elder than her wife. His wife is 10 times older than her daughter. Her daughter will be of 6 years old after 2 years, then what is the present age of the person?

Solution: Using Simple analysis, we may find the age of person.

Present age of her daughter is $6 - 2 = 4$ years

Age of person = $10 \times 4 + 4 = 44$ years

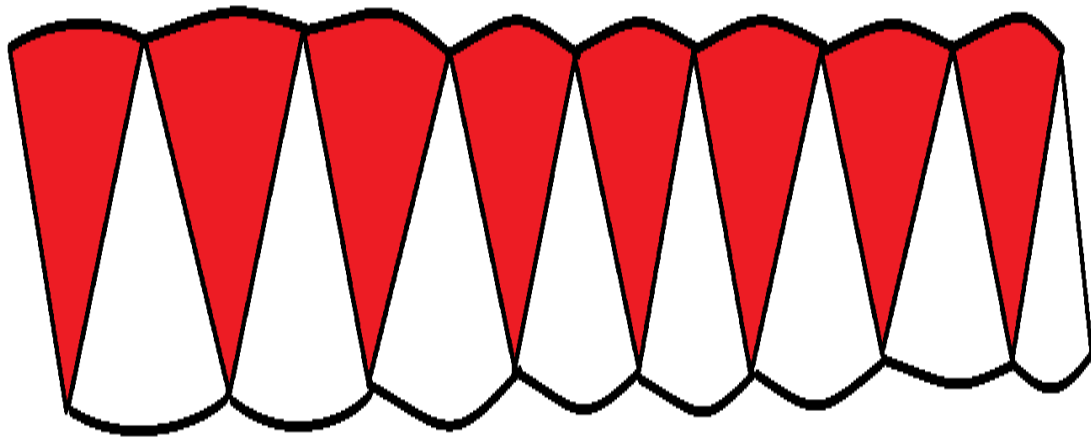
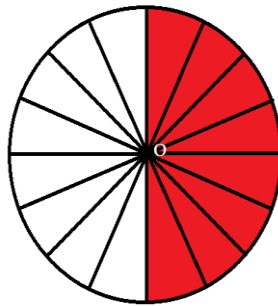
Example 6 : Finding the Sum of angles of a triangle is 180° and Prove that an exterior angle of a triangle is equal to the sum of its interior opposite angles.



Solution:

- Sum of the three angles i.e. $\angle A$, $\angle B$, & $\angle C$, represented by red, blue & green colours respectively 180° as they are contained on a straight line BD.
- Sum of the interior angles $\angle A$ & $\angle B$ represented by red & blue colours respectively coincides with the exterior angle $\angle ACD$, as the non-adjacent arms of $\angle A$ & $\angle B$ coincides with that of $\angle ACD$.

Example 7: To prove that area of a circle of radius r is πr^2 by paper cutting and pasting.



Solution:

- We observe that the shape in looks like a parallelogram. On increasing the number of sectors in which the circle is divided the shape will come closer to the rectangle.
- Now, length of rectangle = length of half of circumference of radius $r = \frac{1}{2} (2\pi r) = \pi r$
- Breadth of rectangle = radius of the circle = r
- So, Area of the circle = area of rectangle thus formed = length of rectangle \times breadth of rectangle = $\pi r \times r = \pi r^2$

SUMMARY AND CONCLUSION

5.0 Summary of the Study

5.1.1 Introduction

Despite the fact that mathematics is important for our cultural growth as well as our personal development, it is not a favorite subject among many pupils. Mathematics is taught as if it were a mechanical topic, with no creativity or practical methods. Students are rarely taught how to build mathematical calculating skills. They are not encouraged to improve their problem-solving skills or increase their mathematical thinking aptitude. The All-India survey regarding achievement of Mathematics (1970) indicates that children's mathematical cognition at the basic level is below the expected level. So, role of mathematics teacher is the most important to transect knowledge amongst the learner. The best teacher is the one who teaches less but inspires more and more. Teachers should teach based on their experience not only through books and abstraction.

If the answer books from the secondary school examination are inspected, it may be noticed that a large proportion of students failed mathematics. Who is to blame for such an ugly situation: the pupils, the parents, or the teachers? Is a fear of science and mathematics an inherited or acquired trait? The answer is debatable. In our society, there is a widespread belief that the more intellectual a person is, the better his math skills will be. However, despite having a similar I.Q., two persons may have different perceptions, judgments, reasoning, word fluency, vocabulary, spatial orientation, and so on. On the one hand, intelligence is concerned with general mental capacity, whereas aptitude is focused with sensory motor, mechanical, creative, or professional skill. We can tell the likelihood of the branch of profession more fit for the individual by understanding their intellectual level based on an Intelligence test or School Progress.

Mathematical aptitude is a person's capacity to solve logical, intellectual, abstract, or any other practical challenge that arises in everyday life. Essentially, aptitude is a combination of natural attributes that point to a person's ability in a particular profession.

Intelligence, on the other hand, is an innate talent that helps an individual in making adjustments, abstract thinking, and acquiring knowledge. As a result, intellect may have a role in the development of a person's mathematical aptitude. Several researches have been conducted to assess the effect of intelligence on the development of mathematical aptitude.

5.1.2 Rationale of the Study

The primary education of Sikkim is entirely depending upon the teachers trained in different DIETs of Sikkim. The mathematical aptitude of pre-service teachers of DIETs can determine the course of mathematics education at the primary level. A considerable number of pre-service teachers belong to the tribal society of Sikkim and their performance in teaching mathematics can lead the mathematics education in the state.

Therefore, it is important to study the aptitude level of the pre-service teachers of DIETs and make a comparison of the aptitude in mathematics between tribal and non-tribal Pre-service teachers. Such study can help the state govt. to design better training module to equip Pre-service teacher in mathematics education so that they can impart proper mathematical skill on the learners at primary level which can further improve mathematics education at secondary and tertiary level.

Individuals' perspectives are changing today, and they are becoming more motivated to acquire a passion for mathematics. Mathematics has been acknowledged as a symbol of human progress by all great educators, like Herbert, Pestalozzi, and others. Given the enormous importance of mathematics in everyday life, we can say that understanding of mathematics is essential and will continue to grow as requirements grow. The question is what are the variables that are most likely to lead to the development of Mathematical Aptitude? As soon we locate them, we will be able to begin orienting our children in order to help them in conquering their fear of mathematics and build an enthusiasm in it

Research Questions

1. What is the Mathematical aptitude level, Intelligence and Problem-solving ability of tribal and non -tribal pre-service elementary teachers of Sikkim?

2. What is the relationship among of Mathematical aptitude with the variables like Intelligence and Problem-solving ability of tribal and non -tribal pre-service elementary teachers of Sikkim in relation to their gender, management and stream of study?

5.1.3 **Statement of the problem:** Therefore, the problem is stated as “**Mathematical Aptitude of Pre-service Elementary Teachers of Sikkim in relation to Intelligence and Problem-Solving Ability**”

5.1.4 **Objectives of the study**

1.To construct a mathematical aptitude standardized scale for pre-service elementary teachers of Sikkim.

2.To study the mathematical aptitude, intelligence and problem-solving ability of pre-service elementary teachers of Sikkim.

3.To compare the mathematical aptitude of tribal and non-tribal pre-service elementary teachers of Sikkim.

4.To examine the correlation between mathematical aptitude and intelligence of pre-service elementary teachers of Sikkim.

5.To examine the correlation between mathematical aptitude and problem-solving ability of pre-service elementary teachers of Sikkim.

6.To examine the correlation between intelligence and problem-solving ability of pre-service elementary teachers of Sikkim.

7.To examine the test of significance relationship between mathematical aptitude, intelligence and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.

5.1.5 Hypothesis of the study

1. There is no significant difference between the mathematical aptitude and intelligence of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.
2. There is no significant difference between mathematical aptitude and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.
3. There is no significant difference intelligence and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.
4. There is no significant difference between mathematical aptitude, intelligence and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.

5.1.6 Method of the Study

Descriptive method was adopted for the study.

5.1.7 Population of study

All pre-service teachers of three DIETs from Gangtok (East), Namchi (South) and Gyalshing (West) districts of Sikkim and one privately managed elementary teacher training Institution namely Carmel teachers training Institute from Pakyong (East) district in Sikkim have been considered as population

5.1.8 Sample of study

The sample of the study included 346 pre-service elementary teachers in which there are 53 Male and 293 Female selected randomly from DIETs of Sikkim

5.1.9 Tools used for data collection

For the collection of data following tools were used for the present study:

1. Problem solving ability scale standardized by L.N. Dubey (2008)
2. Wechsler's Adult Intelligence Scale developed by David Wechsler (2008)

3. Self-constructed Mathematical Aptitude Test: In order to know the mathematical aptitude of pre-service elementary teachers.

5.1.10 Mode of data collection

In order to collect data, the researcher visited each DIETs and private managed elementary teacher training Institution of Sikkim. Prior permission of the principals was taken from these institutions to conduct the study. The process of data collection began with the sharing of the objectives of study with the pre-service teachers. The pattern of answer was selection of one item out of. Multiple choice type items were provided to trainees. There was no negative marking for the wrong answer. They were well informed about the time-limit. They were requested to respond to the test without consulting with their batch mates. They were assured of maintaining confidentiality of their results.

After this, data collection was done using different tools.

5.1.11 Mode of tabulation and analysis of data

The data collected from all the respondents were scrutinized and tabulated. The data collected from questionnaire was analyzed quantitatively. The responses of the pre-service elementary teachers on the questionnaires were tabulated using Excel worksheets. Data was calculated with the help of Excel and SPSS. The tabulated data from questionnaire were analyzed using simple percentages, Descriptive statistics, 't' test, and correlation between independent and dependent variables.

5.2. Finding of study

The findings of study have been presented as follows: -

5.2.1 Related to objective one: To get the findings of objective one, i.e., To construct a mathematical aptitude standardized scale for pre-service elementary teachers of Sikkim.

Researcher constructed and tested self-made tool of 25 items. The items have taken from different level of mathematical aptitude-based questions. Reliability of the mathematical aptitude test was calculated 0.63, which indicates that the items from a scale that has reasonable internal consistency reliability. It was found that mathematical aptitude was considered to be reliable. Factor loadings of the five dimensions undertaken

in the study are considerably high which is above 0.6. This fulfils the criteria of minimum level to be valid i.e., 0.4. Thus, the present test (MAT) is a valid and a reliable tool for measuring the mathematical aptitude of elementary level pre-service trainees.

5.2.2 Related to objective Two: To get the findings of objective two, i.e., To study the mathematical aptitude, intelligence and the problem-solving ability of pre-service elementary teachers of Sikkim.

Researcher has done the content analysis of the questionnaire on the level of mathematical aptitude of pre- service teacher trainees through physical mode. Researcher also found the value of mean and median on the variable of intelligence of pre-service elementary teachers is 25.32 and 26 respectively which are quite proximate to each other. The positive value of skewness (0.13) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.54) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that intelligence scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of problem- solving ability of pre-service elementary teachers is 11.73 and 12 respectively which are quite proximate to each other. The positive value of skewness (0.35) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (0.06) is slightly more than zero implies that distribution is slightly leptokurtic. The observation leads to the conclusion that problem- solving ability scores of pre-service elementary teachers are normally distributed. The value of mean and median on the variable of mathematical aptitude of pre-service elementary teachers is 19.96 and 20 respectively which are quite proximate to each other. The positive value of skewness (0.27) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.29) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that mathematical aptitude scores of pre-service elementary teachers are normally distributed.

5.2.3 Related to objective three: To get the findings of objective three, i.e., To compare the mathematical aptitude of tribal and non-tribal pre-service elementary teachers of Sikkim.

Researcher has done the content analysis of the questionnaire on the level of mathematical aptitude of pre- service teacher trainees through physical mode. Researcher also found the value of mean and median on the variable of mathematical aptitude of ST pre-service elementary teachers is 20.48 and 20 respectively which are quite proximate to each other. The positive value of skewness (0.39) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.10) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that mathematical aptitude scores of ST pre-service elementary teachers are normally distributed. The value of mean and median on the variable of mathematical aptitude of non - ST pre-service elementary teachers is 19.54 and 20 respectively which are quite proximate to each other. The positive value of skewness (0.15) suggests that data is skewed to the right and the distribution is approximately symmetric. The excess kurtosis (-0.52) is slightly less than zero implies that distribution is slightly platykurtic. The observation leads to the conclusion that mathematical aptitude scores of non-ST pre-service elementary teachers are normally distributed.

The value of mean on the variable of mathematical aptitude of ST pre-service elementary teachers is 20.48 and the value of mean on the variable of mathematical aptitude of non-ST pre-service elementary teachers is 19.54. It shows that mathematical aptitude of ST pre-service elementary teachers is slightly more than non- ST pre-service elementary teachers.

5.2.4 Related to objective four: To get the findings of objective four, i.e., To examine the correlation between mathematical aptitude and intelligence of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.

Researcher done the test of correlation between intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation is more than the tabulated value at the level 0.05 of significance ($r=0.463$ respectively). Hence there exist positive and significant relationship between intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In the other words, the results of present study clearly found that intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim are closely associated and intelligence is a powerful determinant of deciding the mathematical aptitude of pre-service elementary teachers. The reasons for the significant positive correlation may be explained on the basis that nature of intelligence test and mathematical aptitude are somewhat similar. Intelligence influences to improve mathematical aptitude in pre-service elementary teachers.

The obtained result may be supported from the study of Pyari, **Mishra & Dua (2016)** who came out with the finding that there is significant effect of aptitude in the stream selection process of students, due to their ability for mathematical reasoning which forms an integral part of intelligence and plays a significant role for choosing mathematics as careers option at higher secondary level. It was found that intelligence and mathematical aptitude were highly correlated in this study.

5.2.5 Related to objective five: To get the findings of objective five, i.e., To examine the correlation between mathematical aptitude and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category. Researcher done the test of correlation between problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation is more than the tabulated value at the 0.05 level of significance ($r=0.352$ respectively). Hence there exist positive and significant relationship between problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. In other words, the results of present study clearly found that problem solving ability and mathematical aptitude of pre-service elementary

teachers of DIETs Sikkim closely associated. Problem-solving ability is a powerful determinant of deciding the mathematical aptitude of pre-service elementary teachers. The reasons for the significant positive correlation may be explained on the basis that nature of problem-solving ability test and Mathematical Aptitude are somewhat similar. The finding of the present study may be corroborated with the study of **Tyagi (2014)** who found that mathematical creativity was found to be causally predominant over mathematical aptitude (i.e., higher mathematical creativity leads to higher mathematical aptitude). Furthermore, mathematical problem-solving performance was found to be the cause of mathematical aptitude and mathematical creativity both (i.e., higher mathematical problem-solving performance leads to higher mathematical aptitude and mathematical creativity). It was found that problem solving ability does get influenced by the mathematical aptitude of pre-service teachers.

5.2.6 Related to objective six: To get the findings of objective six, i.e., To examine the correlation between intelligence and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category. Researcher done the test of correlation between intelligence and problem-solving ability of pre-service elementary teachers of DIETs Sikkim. The calculated value of correlation is more than the tabulated value at the both levels of significance i.e., 0.05 and 0.01 level ($r=0.415$ respectively). Hence there exist positive and significant relationship between intelligence and problem-solving ability of pre-service elementary teachers of DIETs Sikkim. In the other words, the results of present study clearly state that intelligence and problem-solving ability of pre-service elementary teachers of DIETs Sikkim are integrally related. It was found that intelligence does play a dominant role in impacting the problem-solving ability of pre-service elementary teachers. It was also found that Higher the intelligence level, more the problem-solving ability of the pre-service teachers. The reasons for the significant positive correlation may be explained on the basis that nature of intelligence test and problem-solving ability are same what similar.

5.2.7 Related to objective seven: To get the findings of objective seven, i.e., To examine the test of significance relationship between mathematical aptitude, intelligence and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.

5.2.7.1 Finding of study in relation to Mathematical Aptitude

Researcher done the test of significant difference between means of male and female of pre- service teacher trainees on mathematical aptitude and calculated the value of t which is 4.119. and it is significant. Test of significant difference between means of government and private of pre- service teacher trainees on mathematical aptitude calculated the value of t which is 3.131 and it is significant. Test of significant difference between means of mathematical background and non-mathematical background of pre-service teacher trainees on mathematical aptitude calculated the value of t which is 0.540 and it is not significant. Test of significant difference between means of ST and non-ST of pre- service teacher trainees on mathematical aptitude calculated the value of t which is 1.252 and it is not significant.

5.2.7.2 Finding of study in relation to Intelligence

Researcher done the test of significant difference between means of male and female of pre- service teacher trainees on intelligence and calculated the value of t which is 3.352. and it is significant. Test of significant difference between means of government and private of pre- service teacher trainees on intelligence calculated the value of t which is 10.551 and it is significant. Test of significant difference between means of mathematical background and non-mathematical background of pre- service teacher trainees on intelligence calculated the value of t which is 0.702 and it is not significant. Test of significant difference between means of ST and Non-ST of pre-service teacher trainees on intelligence calculated the value of t which is 0.823 and it is not significant.

5.2.7.3 Finding of study in relation to Problem- Solving Ability

Researcher done the test of significant difference between means of male and female of pre- service teacher trainees on Problem- Solving Ability and calculated the

value of t which is 2.908. and it is significant. Test of significant difference between means of government and private of pre- service teacher trainees on problem- solving ability calculated the value of t which is 4.728 and it is significant. Test of significant difference between means of mathematical background and non-mathematical background of pre- service teacher trainees on problem- solving ability calculated the value of t which is 0.948 and it is not significant. Test of significant difference between means of ST and non-ST of pre- service teacher trainees on problem- solving ability calculated the value of t which is 0.971 and it is not significant.

5.2.8 Major Findings of the Study

1. The study found that reliability of the self-constructed tool of mathematical aptitude was considered to be reliable. Factor loadings of the five dimensions undertaken in the study are considerably high which shows test is valid. Thus, the present test (MAT) is a valid and a reliable tool for measuring the mathematical aptitude of elementary level pre-service trainees.
2. The study found that level of intelligence of pre-service elementary teachers of Sikkim is high in respect to developing the thinking skills, building the capability, developing the innovative ideas creativity and developing the better understanding.
3. The study found that level of mathematical aptitude of pre-service elementary teachers of Sikkim is moderate in respect to developing the thinking skills, building the capability, developing the innovative ideas creativity and developing the better understanding.
4. The study found that level of problem-solving ability of pre-service elementary teachers of Sikkim is low in respect to developing the thinking skills, building the capability, developing the innovative ideas creativity and developing the better understanding.
5. The study found that level of mathematical aptitude of male pre-service elementary teachers is slightly better than female pre-service elementary teachers.

6. The study found that mathematical aptitude scores of ST and non-ST pre-service elementary teachers are normally distributed. The value of mean of ST pre-service elementary teachers is slightly more than non-ST. It shows that level of mathematical aptitude of ST pre-service elementary teachers is slightly high than non-ST pre-service elementary teachers.
7. The study found that positive and significant relationship between intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim It shows that intelligence and mathematical aptitude were highly correlated in this study.
8. The study found that positive and significant relationship between problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. It shows that problem solving ability does get influenced by the mathematical aptitude of pre-service teachers.
9. The study found that positive and significant relationship between intelligence and problem-solving ability of pre-service elementary teachers of DIETs Sikkim. It shows that intelligence does play a dominant role in impacting the problem-solving ability of pre- service elementary teachers
10. The study found that positive and significant relationship between mathematical aptitude, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim in relation to gender, management, stream and category.
11. The study found that mathematical aptitude, intelligence & problem –solving ability level of pre-service elementary teachers of Sikkim is not influenced by category (ST and non-ST)
12. The study found that mathematical aptitude, intelligence & problem –solving ability level of pre-service elementary teachers of Sikkim is not influenced by the Stream (Mathematical and non- Mathematical background)
13. The study found that mathematical aptitude, intelligence & problem –solving ability level of pre-service elementary teachers of Sikkim gets influenced by the gender (Male and Female)

14. The study found that mathematical aptitude, intelligence & problem –solving ability level of pre-service elementary teachers of Sikkim gets influenced by the Management (Government and Private institution)
15. The study found that mathematical aptitude, intelligence and the problem-solving ability of pre-service elementary teachers differs significantly.

5.2.9 Educational implications of the study

The main objective of any research, directly or indirectly has a high chance of finding some practical applications and proper implementation. In the light of above findings of the present investigation the educational implications may be suggested.

The following educational implications can be followed: -

1. The present study presents the mathematical aptitude of pre-service elementary teachers of Sikkim in relation to intelligence and problem-solving ability that can be utilized by management, teachers, educators, administrators, planners and guidance personals for exceptionally enhancing the academic achievement of students, especially for those who are taking training in educational and professional Institute.
2. The present study was found that level of intelligence of pre-service elementary teachers of Sikkim is high. This may be due to the fact that from the beginning of teaching mathematics and its application in DIETs is well done and pre-service elementary teachers of Sikkim had developed good attitude towards this subject in their everyday lives.
3. The study showed that the mathematical aptitude level of tribal and non-tribal pre-service elementary teachers of Sikkim is not influenced by category and stream. It shows that their mathematical aptitude, intelligence and problem-solving ability are equally good and no significant difference between tribal and non-tribal pre-service elementary teachers is present.
4. The study also showed that the mathematical aptitude level of pre-service elementary teachers of Sikkim gets influenced by the gender and management. It shows that their mathematical aptitude, intelligence and problem-solving ability are equally not good and

notable difference is present between male – female and government- private institution of pre-service elementary teachers. This is a data that educationists and educational planners should be concerned about. Lecturer may think and find the solution so that no such difference further exists in the development of mathematical aptitude, intelligence and problem-solving ability between male-female and government-private institution of pre-service elementary teachers.

5. The teacher of DIETs can help to spark aptitude, intelligence and problem-solving ability among pre-service elementary teachers; as one of the major responsibilities of teaching community is the promotion of mathematical aptitude among pre-service elementary teachers for this purpose full freedom should be provided to pre-service elementary teachers to experiment with new ideas. The lecturer should not emphasize the confirmatory behaviour but new ideas, novel plans should be accepted and develop the problem-solving ability and encourage to pre-service elementary teachers.
6. The present study can help the state government of Sikkim to design better training module to equip pre-service elementary teachers in mathematics education so that they can impart proper mathematical skill on the learners at elementary level which can further improve mathematics education at secondary and higher secondary level.
7. The counselling of pre-service elementary teachers for aptitude testing and group interaction can be more effective than personal characteristics of trainees in improving aptitude capabilities. In groups, pre-service elementary teachers with special aptitude can involve themselves productively and learn new intellectual skills and aptitude, intelligence and problem-solving ability skills in that particular area.
8. This study will help the lecturer to focus pre-service elementary teacher's attention on their teaching of mathematical concepts and also to know about the ability of pre-service elementary teachers in applying the mathematical knowledge in problem solving skills.
9. Mathematical aptitude performance is the potential of a person to learn effectively in future endeavours, it is therefore important that educational institute should develop curricula that are effective in developing skills of pre-service elementary teachers in

numerical and verbal domains as a means of improving performance of students in general aptitude tests, intelligence and problem-solving ability.

10. Findings of this study may help in understanding the mathematical aptitude of the pre-service elementary teachers. Lecturer can guide the trainees and tell them how important of mathematical aptitude for better career. Mathematical achievement of a learners largely depends upon his/her mathematical aptitude and problem-solving ability.

5.2.10 Recommendations for improving mathematical aptitude, intelligence and problem-solving ability of pre-service elementary teachers

Mathematical skills training should be given at elementary level in Sikkim. It is very importance to develop mathematical ability and problem-solving ability in pre- service elementary teacher trainees so that the basic objectives are attained and new patterns of skills of individuals, group and society as a whole towards mathematical aptitude, intelligence and the problem-solving ability is created. Furthermore, based on the knowledge gained through this study, the following measures are suggested as improvement to the study of mathematics education at the elementary level.

1. The findings of the present study revealed that mathematical aptitude of ST pre-service elementary teachers is slightly more than non-ST pre-service elementary teachers. It is general perception that mathematical aptitude of non-ST candidates is more than ST. We should omit this myth from our mind and teach and treat all pre-service elementary teachers equally.
2. The results of present study clearly found that intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim closely associated and intelligence is a powerful determinant of deciding the mathematical aptitude of pre-service elementary teachers. Intelligence influences to improve mathematical aptitude in pre-service elementary teachers so, teachers of educational institute should keep in mind that motivate to students to apply their intelligence and improve the mathematical aptitude. It

is general perception that Mathematics is very tough and boring subject. It is very necessary to encourage our learners to know more mathematics and apply it in daily life.

3. The results of present study clearly found that problem-solving ability and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim closely associated. Problem-solving ability is a powerful determinant of deciding the mathematical aptitude of pre-service elementary teachers. It was found that problem solving ability does get influenced by the mathematical aptitude of pre-service teachers. So, teachers can share the importance of mathematical aptitude to learners for their problem-solving ability.
4. The results of present study clearly state that intelligence and problem-solving ability of pre-service elementary teachers of DIETs Sikkim are integrally related. It was found that intelligence does play a vital role in impacting the problem-solving ability of pre-service elementary teachers. It was also found that the higher the intelligence level, more the problem-solving ability of the pre-service teachers. So, teachers of educational institute should keep in mind that motivate to students to apply their intelligence and improve the problem-solving ability. Problem-solving ability is correlated with day-to-day situation and good intelligence mind may solve the problem quickly.
5. The study showed that the mathematical aptitude level of tribal and non-tribal pre-service elementary teachers of Sikkim is not influenced by category and stream but gets influenced by the gender and management. Mean (20.49) of government Pre-service elementary teachers are more than mean (18.35) of private pre-service elementary teachers. It is recommended that private institute should focus more to provide good quality education rather than focusing on earning more money. Mean (23.13) of male pre-service elementary teachers are more than mean (19.39) of female pre-service elementary teachers. It is recommended that educational institute should more focus on female candidates by their faculty. Government can also provide better education to female candidates through more facilities.
6. The role of teachers of DIETs is very vital to provide more guidance to pre-service elementary teachers to solve their problems so that they are motivated to learn in a better way. Private institute is also providing more facilities and remuneration to faculties for

their satisfaction so they may work honestly and encourage learners for better performance. Mathematics education is not a small thing, its development would lead to the development of the whole state and the people of Sikkim. Therefore, there is no effort too big for the development of this subject.

5.2.11 Suggestions for Further Research

The researcher would like that further research be done on the following objectives:

1. The present study was carried out for DIETs teacher's trainees of Sikkim. A similar study can be carried out upon the teachers' trainees of different educational institutes for B.Ed. and M.Ed. trainees and for general degree and post-graduate college and university with different age groups and different educational streams.
2. The study may be conducted for the lecturer of DIETs and another professional institute to know their level of mathematical aptitudes.
3. The present study was limited to the state of Sikkim only. It can be extended to other states in order to have a broader and comprehensive perspective study.
4. An analysis of actions taken for policies and for the upgradation of mathematical aptitude for teachers training institute by the state government.
5. The present study was used self-made tools of mathematical aptitude. A similar tool can be developing for intelligence and problem-solving ability.
6. A critical study of expert works for the development of mathematical aptitude for trainees in relation to intelligence and problem-solving ability.

7. The present study was compared between ST and non-ST teachers' trainees. A similar study can be conducted among General, OBC, SC & ST.
8. A comparative study should be undertaken with similar variables and it can be comparison between mathematical aptitude and academic achievement.
9. A comparative study of Sikkim and other states of North- East India can be done.
10. The study needs to know the role of parental education, socio-economic status and their intelligence which is going to impact the development of mathematical aptitude in relation to intelligence and problem-solving ability.

5.2.12 Conclusion

Study reveals the mathematical aptitude of pre-service elementary teachers of Sikkim in relation to intelligence and problem-solving ability. There is no end point or a complete solution to each problem, so some important measures can always be taken in order to make positive steps towards betterment of learners. Keeping this in mind for the purpose of study to know mathematical aptitude of pre-service elementary teachers in relation to intelligence and problem-solving ability is one of the most important determinants of success in their career because, learners who achieve well academically have some advantages in their future.

Mathematical aptitude is a person's capacity to solve logical, intellectual, abstract, or any other practical challenge that arises in everyday life. Essentially, aptitude is a combination of natural attributes that point to a person's ability in a particular profession. Intelligence, on the other hand, is an innate talent that helps an individual in making adjustments, abstract thinking, and acquiring knowledge. As a result, intellect may have a role in the development of a person's mathematical aptitude.

Individuals' perspectives are changing today, and they are becoming more motivated to acquire a passion for mathematics. Mathematics has been acknowledged as a symbol of human progress by all great educators. Given the enormous importance of mathematics in everyday life, we can say that understanding of mathematics is essential and will continue to grow as requirements grow.

The present study found that mathematical aptitude level of tribal and non-tribal pre-service elementary teachers of Sikkim is not influenced by category and stream but gets influenced by the gender and management. It is general perception that those who have mathematical background they score more in mathematical aptitude test and their aptitude skills are good. It is a subject which can solve the problem based on their intelligence and day to day life experiences. It is also general perception that those have non-ST background like General OBC, SC they have more mathematical aptitude skills. It has also rejected in the present study. It means that acquiring the knowledge and develop the mathematical aptitude, intelligence and problem-solving ability is not based on category and stream it is based on individuals and guidance by teachers and educational environment of institute. Mean of government pre-service elementary teachers are slightly more than mean of private pre-service elementary teachers. So private institute should focus more to provide good quality education. Mean of male pre-service elementary teachers are slightly more than mean of female Pre-Service Elementary Teachers. So, educational institute should more focus on female candidates by their faculty. Government can also provide better education to female candidates through more facilities. Therefore, Sikkim should improve mathematics education provided by good skills teachers in such a manner so each and every learner develops the mathematical aptitude. We need to give proper attention to the recommendations that have been made based on the findings of research and make effort for the development of mathematics education. Also, the state government needs to pay more attention for the advancement of mathematics education. It is clear that something is needed to be done in order to improve learner's attitude towards learning the concept of mathematics.

However, for true change to be established, teachers, government, parents and the society itself need to co-operate and do whatever they can in order to improve this vital part of education. If each and everyone plays role there is hope that in the near future, this state will establish itself as one of the most well performing states in India in relation to mathematics education.

APPENDIX 1
Basic Information

Instructions:

1. The information will be kept confidential and will be used only for research Purpose
2. Tick (√) appropriate options/code of response.

Name of the Student:

Name of the Institution:

Mob. No. Email:

Age in years: Date:

Stream: Science/ Commerce/ Humanities/ Others

Gender: Male/ Female

Category: Gen./OBC/SC/ST/Others

Semester: 1st/ 3rd Types of Institution: Government/ Private

Section: A ; Questionnaire: Intelligence

Directions: Answer the following questions by selecting the most appropriate option.

1. How many Union territories are there in India?
(1) 9 (2) 8 (3) 7 (4) 10
2. Study of insects is known as?
(1) Ecology (2) Ornithology (3) Entomology (4) Zoology
3. Who won IPL 2021?
(1) Sunrisers Hyderabad (2) Mumbai Indians (3) Chennai Super Kings
(4) Kolkata Knight Riders
4. Initially, How many articles were present there in Indian Constitution?
(1) 470 Articles (2) 395 Articles (3) 360 Articles (4) 365 Articles
5. Who was the 10th Prime Minister of India?
(1) Atal Bihari Vajpayee (2) Manmohan Singh (3) P.V. Narashimha Rao
(4) Morarji Desai
6. Find the Volume of cube if side(edge) is 5cm.
(1) 125cm^3 (2) 25cm^3 (3) 215cm^3 (4) 50cm^3
7. Find the average of the given set of numbers- 5, 10,15, 20, 25 and 30
(1) 15 (2) 17 (3) 17.5 (4) 25
8. If $5a + 8 = 17$ then find the value of “a”
(1) 1.8 (2) 2.8 (3) 3.8 (4) 8.1
9. In a row of trees one tree is the 7th from either end or beginning of the row. How many trees are there in the row?
(1) 11 (2) 13 (3) 15 (4) 14
10. Which of the following is a prime number? 15, 21, 39, 43, 55
(1) 21 (2) 39 (3) 43 (4) 55
11. How many total squares are there on a standard chess board?
(1) 32 (2) 62 (3) 64 (4) 128
12. If $4 + 5 = 10$ and $5 + 5 = 12$, what is 5 equal to?

- (1) 6 (2) 5 (3) 10 (4) 12
13. What will be Backward number of 3861589?
 (1) 9851683 (2) 153 6889 (3) 9886531 (4) 1356889
14. If Bullock cart is related to Tanga then auto-rickshaws is related to?
 (1) Polarish Slingshot (2) Motorcycle (3) Car (4) Bus
15. If train is called bus, bus is called tractor, tractor is called car, car is called scooter, scooter is called bicycle, bicycle is called moped, which is used to plough a field?
 (1) Moped (2) Train (3) car (4) Tractor
16. Choose a pair similar to; Optimistic: Pessimistic
 (1) Difficult: Impossible (2) Export: Import (3) Study: Play
 (4) Tolerating: disgusting
17. Find the missing term- 5:124::7:?
 (1) 125 (2) 248 (3) 342 (4) 343
18. Choose the colour which is different from others in the group.
 Violet, Yellow, Red, Black and Green
 (1) violet (2) yellow (3) Green (4) Black
19. Select the one which is different from the other given responses.
 (1) Biography (2) Photography (3) Lithography (4) Xerography
20. 'MP' is related to 'OR' and 'DG' in the same way is to 'FI', in the same way 'RU' is related to
 (1) UW (2) TX (3) TV (4) TW
21. Find the missing number

4	7	4
7	8	5
8	9	?

60 79 39

(1) 5 (2) 6 (3) 7 (4) 8

22. Choose the word in which all vowels are there?

(1) Education (2) Envelope (3) Cinema Hall (4) Saving Money

23. In which of the following word if first letter shifts from left to right it will be not the same word

(1) Grammar (2) Banana (3) Malayalam (4) Dresser

24. Some boys were playing. Two boys were in front of one boy; One boy behind another boy; One boy in the middle. How many boys participated in the game?

(1) 6 (2) 3 (3) 4 (4) 5

25. How many meaningful English words can be made with the letters EOPR?

(1) 4 (2) 3 (3) 2 (4) 1

26. From the following alternatives select the word which cannot be formed using a letter of the given word: DEPARTMENT?

(1) PART (2) TREAT (3) MATURE (4) TAME

27. If it is possible to make only one meaningful word with the second, fourth, six and seven “CONFIRMATION”, which would be the second letter of that word from the left? If more than one such word can be formed given ‘X’ as the answer. If no such word can be formed, give ‘Z’ as your answer.

(1) N (2) X (3) T (4) Z

28. The position of how many alphabets will remain the same if each of the alphabets in word FRIENDS is rearranged in the alphabetical order from left to right?

(1) None (2) One (3) Two (4) Three

Direction: (29- 30) : Each of the following questions consists of two sets of figures. Figures A, B, C and D constitute the Problem Set while figures 1, 2, 3, 4 and 5 constitute the Answer Set. There is a definite relationship between figures A and B. Establish a similar relationship between figures C and D by selecting a suitable figure from the Answer Set that would replace the question mark (?) in fig. (D).

29.

Problem Figures:



(A) (B) (C) (D)

(1) 3 (2) 4 (3) 5 (4) 1

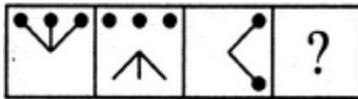
Answer Figures:



(1) (2) (3) (4) (5)

30.

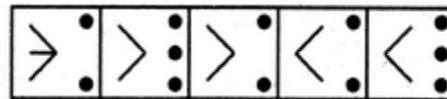
Problem Figures:



(A) (B) (C) (D)

(1) 5 (2) 4 (3) 2 (4) 3

Answer Figures:



(1) (2) (3) (4) (5)

Instructions:

1. The information will be kept confidential and will be used only for research purpose.
2. Tick (\checkmark) appropriate options/code of response.

Name of the Student:

Name of the Institution:

Mob. No. ----- Email: -----

Age in years: Date:

Stream: Science/ Commerce/ Humanities/ Others

Gender: Male/ Female

Category: Gen./OBC/SC/ST/Others

Semester: 1st/ 3rd Types of Institution: Government/ Private

Section: B; Questionnaire: PSAT

1. Rajiv has 35 notes of 100 rupees' denomination in serial. If 12965 is the number of first note, what will be number of last notes?
(1) 13999 (2) 13000 (3) 12999 (4) 13001
2. There are four married sons of a husband and wife in a family. Each son has 4 children. Then how many members are there in the family.
(1) 16 (2) 20 (3) 24 (4) 26
3. Write two such numbers which are having their total as 30 and difference is 20.
(1)15; 15 (2) 28;5 (3) 25; 5 (4) 28;2
4. One person is 4 years elder than her wife. His wife is 10 times older than her daughter. Her daughter will be of 6 years old after 2 years, then what is the present age of the person?
(1)40 years (2) 44 years (3) 48 years (4) 42 years
5. There are two taps in a tank. One tap fill that in 10 hours and the other tap empties it in 8 hours. If both the taps are opened simultaneously, then in how many hours the tank will be filled completely?
(1) 10 hours (2) 13 hours (3) 18 hours (4) Will never fill

6. A soldier from his camp goes 6km straight in the north. Then he goes 5 km in east then he goes again 5 km in south then finally he turned right and goes 5km. Now how many km away he is from his camp?
(1) 21 Km (2) 16 Km (3) 1 Km (4) 11Km
7. There is a difference of 40 between 6 times and 8 times of a number then what is that number?
(1) 240 (2) 320 (3) 40 (4) 20
8. Smt. Shakuntia said to her daughter Sudha that I was of your age when you were born. If the present age of Smt. Shakuntia is 40 years what would have been the age of Sudha 4 years before?
(1) 14 years (2) 16 years (3) 20 years (4) 24 years
9. Adding twice of any number in that number and subtracting half of that number comes 50 then what will be that number?
(1) 50 (2) 40 (3) 30 (4) 20
10. A fish is 20 inches long Its length of head is equal to that of tail. The length of the tail would have been equal to its body if the length of the head had been twice of the tail. What will be the length of the body of fish?
(1) 5 inches (2) 8 inches (3) 30 inches (4) 12 inches
11. Age of Madhu is 18 years. She was twice the age of Sharad before 6 years when she was of the age of marriage then what was the age of Sharad at that time?
(1) 6 years (2) 10 years (3) 12 years (4) 14 years
12. The cost of white washing of four walls of the room comes to Rs. 10. What will be the cost of white washing a room of exactly twice the length, breadth and height of this room?
(1) Rs. 20 (2) Rs. 40 (3) Rs. 80 (4) Rs. 120
13. A number with itself is added same number is subtracted from the total, then the remainder is multiplied with the same number. If the product is 100 what will be that number?

- (1)100 (2) 50 (3) 20 (4) 10
14. A gain 10 % more profit than B what percentage of loss occurs to B than A?
(1)10 % (2) Neither profit nor loss (3) $9\frac{1}{11}$ % (4) cannot be determined
15. A six-digit number is formed by repeating three-digit number for example 538538 or 235235. By which number this so formed number can be divided completely?
(1)8 (2) 11 (3) 14 (4) 18
16. A student of psychology had to obtain 20% marks for passing. He got 20 marks and he failed by 20 marks then what is the maximum marks in that paper?
(1)50 (2) 100 (3) 200 (4) 400
17. Think of a number, after dividing it by 4 add 9 in the quotient. If answer comes 15 that number will be?
(1)20 (2) 24 (3) 36 (4) 48
18. A milk seller has one liter water in different bottles. He exchanged half of the quantity among two of the bottles. He did so three times. Then tell what is the ratio of milk and water?
(1) 3: 1 (2) 1: 1 (3) 1: 2 (4) None of these
19. Kalpana, Sadhana, Rahul and Ashish have to deliver speech in the class. In how many ways teacher can arrange their turn?
(1) 4 (2) 12 (3) 24 (4) 16
20. Every person shook hands with each other after the end of the party, how many people were there in the party if 28 times in all hands were shaken?
(1)14 (2) 18 (3) 8 (4) 1

APPENDIX 3
Basic Information

Instructions:

1. The information will be kept confidential and will be used only for research purpose.
2. Tick (\surd) appropriate options/code of response.

Name of the Student:

Name of the Institution:

Mob. No. ----- Email: -----

Age in years: Date:

Stream: Science/ Commerce/ Humanities/ Others

Gender: Male/ Female

Category: Gen./OBC/SC/ST/Others

Semester: 1st/ 3rd Types of Institution: Government/ Private

Section: C; Questionnaire: Mathematical Aptitude

Directions: Answer the following questions by selecting the most appropriate option.

1. If you may complete one-fourth work in 5 days. How many days will you take to complete the whole work?
(1) 10 days (2) 15 days (3) 20 days (4) 25 days
2. There are four pieces of chart paper. If first paper has 9 small holes in it, second paper has 20 small holes in it, third has 31 small holes in it. How many holes are there in the fourth paper?

(1) 41 (2) 42 (3) 43 (4) 44

3. A class trip is planned for 45 students. There must be at least one teacher for every 9 students. What is the minimum number of people on the trip?

(1) 50 (2) 51 (3) 52 (4) 54

4. If Ram knows that y is an integer greater than 2 and less than 7 and Hari knows that y is an integer greater than 5 and less than 10, then they may correctly conclude that

(1) y can be exactly determined (2) y may be either of the values

(3) y may be any of three values (4) There is no value of y satisfying these conditions

5. A party was held in which a grandmother, father, mother, four sons, their wives and one son and two daughters to each of the sons were present. The number of males present in the party is?

(1) 09 (2) 14 (3) 18 (4) 24

6. Some equations are solved on the basis of certain system. On the same basis, find out the correct answer for the unsolved equation.

$$4 \times 6 \times 9 = 694, 7 \times 3 \times 2 = 327, 5 \times 3 \times 4 = ?$$

(1) 453 (2) 543 (3) 345 (4) 354

7. The next term in the series: B2, D4, F8, H16, ?

(1) J56 (2) I62 (3) Q32 (4) J32

8. The average of 5 consecutive numbers is 25. What is the largest number?

(1) 23 (2) 24 (3) 26 (4) 27

9. The next term in the series 2, 3, 5, 7, 11, 13, ?

(1) 19 (2) 17 (3) 23 (4) 29

10. If $A=2$, $B=3$, $CAT=27$, Then $JOB =?$

- (1)30 (2)27 (3)57 (4)32

11. In a certain code '415' means 'milk is hot'; '18' means 'hot soup'; and '895' means 'soup is tasty'. What number will indicate the word 'tasty'?

- (1) 9 (2) 8 (3) 5 (4) 4

12. Laxman went 15km to the west from my house, then turned left and walked 20kms. He then turned East and walked 25km and finally turning left covered 20 km. How far was he from his house?

- (1)5 km (2) 10 km (3) 40 km (4) 80 km

13. Two railway tickets from city A to B and three tickets from city A to C cost ` Rs 177. Three tickets from city A to B and two tickets from city A to C cost Rs ` 173. The fare for city B from city A will be `

- (1) Rs 25 (2) Rs 27 (3) Rs 30 (4) Rs 33

14. What is the sum of all natural numbers up to 10 ?

- (1) 66 (2) 60 (3) 56 (4) 55

15. Raman ranks sixth from the top and fifth from the bottom in the class. How many students are there in the class?

- (1) 10 (2) 11 (3) 6 (4) 5

16. Let "a" means (-), "b" means (\times), "c" means (+) and "d" means (\div)

The value of $90 \text{ d } 9 \text{ a } 29 \text{ c } 10 \text{ b } 2$ is?

- (1) 8 (2) 1 (3) 12 (4) 0

17. A few men were ploughing in the field with a few bulls. Taking the men and bulls together, there were altogether 22 legs and 7 heads. Say which one is true the number of men and bulls were

- (1) 1 and 6 (2) 2 and 5 (3) 3 and 4 (4) 4 and 3

18. A boy was asked to multiply a certain number by 50. He multiplied it by 30 and got his answer less than the correct one by 400. The number to be multiplied was
(1) 10 (2) 20 (3) 30 (4) 40
19. Ali buys a glass, a pencil box and a cup and pays Rs ` 21 to the shopkeeper. Rakesh buys a cup, two pencil boxes and a glass and pays ` Rs 28 to the shopkeeper. Preeti buys two glasses; a cup and two pencil boxes and pays ` Rs 35 to the shopkeeper. The cost of 10 cups will be ?
(1) Rs 40 (2) Rs 60 (3) Rs 80 (4) Rs 70
20. Anil played 8 cricket matches. The Mean (Average) of the runs was found to be 80. After playing four more matches, the mean of the runs of all the matches was found to be 70. The total runs made in the last four matches is?
(1) 400 (2) 300 (3) 200 (4) 80
21. The sum of the two numbers is 119 and their difference is 11. Which is the largest number?
(1) 65 (2) 55 (3) 54 (4) 45
22. 60 % of employees in a company are female. If the number of male employees is 400, then the total number of employees is ?
(1) 100 (2) 600 (3) 1000 (4) 1200
23. The sum of the age of 5 children born at the intervals of 3 years each is 50 years. What is the age of the youngest child?
(1) 4 yrs (2) 8 yrs (3) 10 yrs (4) 12 yrs
24. In a town, 55% people watched the news on television, 30% read a newspaper and 45% read a newspaper and watched the news on television also. What percentage of the people neither watched the news on television nor read a newspaper?
(1) 50 % (2) 10 % (3) 15 % (4) 60 %
25. Which number is wrong in this series? 6, 15, 35, 77, 165, 337
(1) 35 (2) 77 (3) 165 (4) 337

References

Aher. R.R (2017). Co-operative learning strategies academic achievement interest and problem-solving ability of students. *Adarsha Comprehensive College of Education and Research, Pune.* <http://hdl.handle.net/10603/308456>

Alibraheim, E & Al-hussary, K.D (2021). Investigating Pre-service Elementary Teachers' Mathematical Power. *Psychology and Education* (2021) 58(2):98049812ISSN:003333077

[https://www.researchgate.net/publication/350089927_Investigating_Pre-service_Elementary_Teachers_Mathematical_Power.](https://www.researchgate.net/publication/350089927_Investigating_Pre-service_Elementary_Teachers_Mathematical_Power)

Bala.R(2014). Aptitude for Mathematics as Predictor of Mathematical Achievement. *GHG Journal of Sixth Thought* Vol.1 No.2, December – 2014, ISSN 2348-9936

Bindu. N.H (2021). *Problem solving ability among 9th standard students in relation to their emotional intelligence and achievement in Mathematics.* Department of education, Annamalai University.[http://hdl.handle.net/10603/392178.](http://hdl.handle.net/10603/392178)

Borja, M.J.B; & Ompoc , A. B; Temblor,K.A.S & Torello, N.C (2019). The Challenges among Pre-Service Elementary Teachers. *SMCC Teacher Education Journal* ISSN Print: 2008- 0598, ISSN Online: 2008-0601 Volume 1 , June 2019

Castro. B (2004). *Pre-Service Teachers' Mathematical Reasoning as an Imperative for Codified Conceptual Pedagogy in Algebra: A case Study in Teacher Education.* Asia Pacific Education Review 2004, Vol. 5, No. 2, 157-166.

Chitkara, M. (1985). To study the effectiveness of different strategies of teaching on Achievement in Mathematics in relation to Intelligence, Sex and personality. *Fourth Survey of Research in Education* 1983-88 Vol. (1), 697, New Delhi, N.C.E.R.T.

Dandagal, S.N. & Yarriswami M.C. (2017). A Study of Intelligence in Relation to Academic Achievement of Secondary School Students. *International Journal of Advanced Research in Education & Technology (IJARET)* Vol. 4, Issue 3 (July - Sept. 2017) ISSN: 2394-6814.

Dhoundiyal.V & Rawat.S (2021). A study of Mathematical aptitude in relation to intellectual abilities of secondary level students. *Scholarly Research Journal for Humanity Science & English Language, peer reviewed & refereed journal*, 1 VOL-9/44, 2021 Online ISSN 2348-3083, SJ Impact Factor 2019: 6.251, www.srjis.com

Dhyani. V(2014). *A study of mathematical aptitude in relation to intellectual and problem-solving abilities of secondary level students.* Department of Teacher Education S.S.J. Campus, Almora, Kumaun University Nainital, (Uttarakhand) July- 2014 <http://hdl.handle.net/10603/75634>

Feldhaus. C. A (2014). How Pre-Service Elementary School Teachers' Mathematical Dispositions are Influenced by School Mathematics. *American International Journal of Contemporary Research* Vol. 4, No. 6; June 2014

Fetterly .J.M (2010). *An Exploratory Study of the Use of a Problem-Posing Approach on Pre-service Elementary Education Teachers' Mathematical Creativity, Beliefs, and Anxiety.* Electronic Theses, Treatises and Dissertations, The Graduate School Florida State University Libraries, June 2010 www.lib-ir@fsu.edu

Ghatak. A & Mittal.K(2019). *Problem-Solving Ability of School Students in Relation to their Academic Achievement.* IJSRST | Volume 6 | Issue 2 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X Themed Section: Science and Technology, 2019 DOI: <https://doi.org/10.32628/IJSRST119623>

Gupta.M, Pasrija.P & Kavita (2015). Effect of problem -solving ability on academic achievement of high school students: a comparative study. Volume 4, Issue II, March 2015, ISSN:2277-1255 *Bhartiyam International Journal of Education & Research*

Hartono,Y(2001). Mathematical Modelling in Problem –solving. IOP Conf. Series: Journal of Physics: Conf. Series 1480 (2020)012001 IOP Publishing doi:10.1088/1742-6596/1480/1/012001

Hudda. M & Devi. R (2018). Effect of problem-solving ability on mathematics achievement among secondary school students Volume-03 ISSN: 2455-3085 (Online) Issue-08 Research Review *International Journal of Multidisciplinary* August-2018

Kalyan .F (2007). *A study on preservice elementary mathematics teachers' mathematical problem-solving beliefs.* The graduate school of social sciences of middle east technical university January 2007

Karademir. C. A (2019).Pre-Service Teachers' Problem-Solving Skills and Curiosity Levels, *International Journal of Educational Methodology* Volume 5, Issue 1, 151 - 164.

Kaur.H(2012). *Causes of low achievement in mathematics at secondary stage.* <http://hdl.handle.net/10603/13751> Punjabi University

Khatoon, F. (1988). A Study of Mathematical Aptitude among Boys and Girls students and its relationship with interest and vocational preference at the secondary school level *Fifth Survey of Educational Research*, 1988- 92, Vol. (2), 1283, New Delhi: N.C.E.R.T.

Krishnan N.J. (1990). Identification of Problem-solving strategies in Mathematics among high school students in District Devakottai. *Fifth Survey of Educational Research*, 1988- 92, Vol. (2), 1283, New Delhi: N.C.E.R.T.

Kumar. K & Kumari. M (2019). A study of Mathematical aptitude of students in relation to achievement motivation at secondary level Vol-22- Issue-14-December-2019 , *Think India Journal*, ISSN:0971-1260.

Lee (1999): *Why Asian students fall behind in math.* Asian book, 1991

Lizzie (2017). Problem solving Ability in relation to their Academic achievement among higher secondary students. *Journal of educational and Psychological Research* (Vol 7, No.1) ISSN: 2230-9586

Lubis.R.H.W, Syahputra.E , Siagian.P(2018). Improving students' ability in mathematical problem solving through problem-based learning model in tenth grades state senior high school 7 of Medan. *Advances in Social Science, Education and Humanities Research*, volume 200, 3rd Annual International Seminar on Transformative Education and Educational Leadership (AISTEEL 2018).

Mallart.A , Font. V & Diez. J (2017). Case Study on Mathematics Pre-service Teachers' Difficulties in Problem Posing. *EURASIA Journal of Mathematics, Science and Technology Education* ISSN: 1305-8223 (online) 1305-8215 (print).

Milan.L (2021). *A study of problem-solving ability aptitude and interest in the achievement of mathematics among secondary school students.* Department of education, University of Mysore. <http://hdl.handle.net/10603/392206>.

Mishra. S (2017). Scientific Aptitude and Achievement in Mathematics of Students in Sikkim. *Journal of educational and Psychological Research* (Vol 7, No.1) ISSN: 2230-9586.

Nagajothi, P(2020). *Effect of self-regulatory training module to enhance the mathematical problem-Solving ability of pre service teachers.* Department of education, Alagappa University. <http://hdl.handle.net/10603/383326>

Nahil M. Aljaberi & Eman Gheith (2016). Pre-Service Class Teacher' Ability in Solving Mathematical Problems and Skills in Solving Daily Problems. *Higher Education Studies*; Vol. 6, No. 3; 2016 ISSN 1925-4741 E-ISSN 1925-475X Published by Canadian Centre of Science and Education

Paramasivan. S (2011). *The studied-on Effectiveness of activity-oriented approaches in improving the performance of backward learners in Mathematics at the secondary school level.* <http://hdl.handle.net/10603/196444>

Pathak.N (2015). A study of problem-solving ability in relation to academic achievement of pupil teachers. *Voice of Research* Volume 4 Issue 2 September 2015 ISSN No. 2277-7733

Patel, N.R. (1984). An Investigation into the Mathematical Ability of Pupils of Classes IX and X in context of some cognitive and Affective variables, Buch, M.B. (1991), *Fourth Survey of Research in Education*, 1983-88. Vol. 1, 704- 705. New Delhi, N.C.E.R.T.

Pitma. S, Tayruakham. S & Nuangchalem.P (2009). Factors influencing Mathematics Problem –solving ability of Sixth grade students. *Journal of Social Sciences* 5 (4): 381-385, 2009 ISSN 1549-3652.

Pyari. P, Mishra.K & Dua. B (2016). A Study of Impact of Aptitude in Mathematics as Stream Selection at Higher Secondary Level. Published online: September 05, 2016. The Author(s) 2016. open access at www.chitkara.edu.in/publications DOI: 10.15415/iie.2016.32011

Rangappa, K.T. (1992). The relationship between the achievement of school going students in relation to reasoning ability. *Fifth Survey of Educational Research* 1988- 92, 1904- 1905, New Delhi, N.C.E.R.T.

Roslay, A. (1992). The relationship between the attitude of high school students towards learning mathematics and achievement. *Fifth Survey of Educational Research* 1988- 92, 1904- 1905, New Delhi, N.C.E.R.T.

Roy. S.S (2016). Cooperative learning strategy for effective teaching to pre service teachers. *Adarsha Comprehensive College of Education and Research, Pune.* <http://hdl.handle.net/10603/203953>

Sarkar. S (2021). Impact of problem-solving skills to achieve in Mathematical Ability of the female students of secondary level of education. Vol. 8, Issue 8, August 2021

International Advanced Research Journal in Science, Engineering and Technology
ISSN (O) 2393-8021, ISSN (P) 2394-1588, DOI: 10.17148/IARJSET.2021.8828.

Sherafat.R, Murthy. C.G.V (2014).Critical Thinking and Academic Achievement among Secondary and Senior Secondary School Students. *Indian Educational Review*, Vol. 54, No.2, July 2016

Shilling, L.N (2010). An exploration of pre-service elementary teachers' mathematical beliefs.https://www.researchgate.net/publication/282259241_An_exploration_of_pre-service_elementary_teachers%27_mathematical_beliefs

Sonar. Y.V & Patnakar. P.S(2013). A Study of Relationship Between Mathematics Aptitude and Achievement of Secondary School Students. *Indian Streams Research Journal*, Volume 3, Issue. 5, June. 2013 ISSN:-2230-7850 Available online at www.isrj.net

Sreeraj. K G (2015).Relationship between multiple intelligences and achievement in Mathematics of Students at Secondary Level. <http://hdl.handle.net/10603/184540>

Sumangala (1995). Establishment the relationship between Mathematical Aptitude and Achievement in Mathematics.*Sixth Survey of Educational Research*, 1993-2000, Vol 2, 365

Talati, J. K. (2006). *Constructed and standardized numerical ability test for students of std VIII to X of Gujarat State.* Department of Education, Gujarat University, 2006 <http://hdl.handle.net/10603/46940>

Temel.S (2014).The effects of problem-based learning on pre-service teachers' critical thinking dispositions and perceptions of problem-solving ability. *South African Journal of Education*; 2014; 34(1) 1 Art. # 769, 20 pages, <http://www.sajournalofeducation.co.za>

Tyagi.T.K(2014).The Causal Relationship between Mathematical Creativity, Mathematical Aptitude and Mathematical Problem-Solving Performance. A *Cross-Lagged Panel Analysis Indian Educational Review*, Vol. 54, No.2, July 2016.

Vohra,H.B.L. (1977). An Investigation of Relationship among Intelligence, Aptitude, Personality, Academic Achievement Vocational choice of Polytechnic Students. *Third Survey of Research in Education*, Vol. (2), 466, New Delhi, N.C.E.R.T

Voskoglou. M.G (2021). Problem-solving and Mathematical Modelling. Vol. 9, No. 2, 85-90. *American Journal of Educational Research*, 2021, Science and Education Publishing DOI:10.12691/education-9-2-6 <http://pubs.sciepub.com/education/9/2/6>

Wassem. A(2019). *A Study of the ways Children Solve Mathematical Problems* Jamia Milia Islamia University, New Delhi. <http://hdl.handle.net/10603/332042>

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Gender: : Male
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Language Known : English, Hindi Maithili,
Interest : Quiz & Debate

Academic record & distinction

M.Sc. in Mathematics (L.N.M.U. Darbhanga, Bihar).

B.Ed. (L.N.M.U. Darbhanga, Bihar).

MA in Education (IGNOU).

M.Ed. (Sikkim University).

SLET and NET in Education.

Areas of Specialization

Educational Management & Administration, Higher Education, Research Methodology & Statistics in Education and Mathematics Education.

Achievements /Awards

- Quiz Contest Conducted by Competition Success Review
- Inter College Debate Competition Award by D.M (Madhubani), Bihar
- Organised Quiz contest at Dr. Hedgewar Library Awarded by B.D.O Rahika, Madhubani Bihar
- Honored by Akhil bhartiya Gayitree family at Rajnagar, Madhubani for Social Activity through library as a founder, Dr. Hedgewar Library since 1991

- Social workers Award by S.P Mr. Sushil Kumar Madhubani and Padam Shree Awardee Mrs. Dulari Devi for the field of Education through KYC Foundation Madhubani Bihar.
- Participate and Presentation of the New Concept in Conference on Mathematics Education & Technology Organized by D.P.S R.K. Puram, Delhi & Mathematical Science Foundation.
- Attended the combined NCC Training camp organized by NCC office Madhubani Bihar.
- Participated in the orientation programme for Mathematics teacher by Arya Publication
- Participated in the Panel discussion organized by IGNOU Regional Centre Gangtok.
- Participated in the Conference & presented Action Research organized by MGNCRE, Department of Higher Education MHRDD, New Delhi at Hyderabad
- Blood donation organized by State Blood Transfusion council, West Bengal in 2013
- Blood donation organized by Central Referral Hospital, Tadong Gngtok Sikkim in 2014
- Attended many Workshops organized by different Schools/ colleges/ Publications.
- Attended many Seminars organized by different Colleges / Universities.
- Organized Quiz Contest every year on 31st December since 1995 at Dr. Hedgewar Library, Laxmi Nagar Bhachhi, Madhubani, Bihar

Experiences

- Coordinator of the International Mathematics/ Science Olympiad in D.P.S Siliguri
- Guest Lecture in Teachers' Training Program 2011 to 2015, Organized by Vidya Bharati Sikkim (A unit of Vidya Bharati Akhil Bharatiya Siksha Sansthan, New Delhi)
- IGNOU Academic Counsellor of Study Centre B.Ed College siliguri for B.Ed course in year 2014-17
- IGNOU Academic Counsellor of Regional Centre Gangtok 5th mile for AMT Course (MATHS) & MA(Education)
- Resource person for the celebration of "International Yoga Day" at IGNOU Regional Centre Gangtok Sikkim in the year 2022
- Trainer of State Bank of India pre-exam training Siliguri & Gangtok.
- Trainer of NABARD pre-exam training, Gangtok.
- Resource person to conduct the various competitive Exams in West Bengal State.
- Resource Person for the various professional development program organized by CBSE.
- Resource Person for in-service teacher training Program 10th may to 20th may 2021 for S.E Railway School teachers Adara West Bengal.
- Coordinator of MGNCRE, Ministry of Higher Education Govt. of India for Gangtok District.
- Panel member for Methodology held at SSTRB, Syari, Gangtok in year 2021 and 2022.
- Evaluator for B.Ed course held at Examination department, Sikkim University
- Organizing Secretary for the celebration of "International Yoga Day" at Harkamaya College of Education Gangtok Sikkim in the year 2022.
- Member of STET, SCERT Sikkim for question paper preparation for the pedagogy of Mathematics.

Publications

- Human Rights and Equal Opportunity: “Sarva Siksha Abiyan as an Icon for Human Rights to Equal Opportunity and Role of Private Institution in it.”; Siliguri B.Ed college ISBN :978-81-908751-2-7; June 2015, page no. 111-116
- *Himalayan Journal of Social Sciences*: “Perception of Teacher Trainees about In-Service Training Under SSA Scheme” ; Harkamaya college of Education, Gangtok ISSN : 2231-6639 ; Vol. 6 April 2016 page no. 85-92
- Approaches to teaching and learning: “Problem Solving Approach in Teaching Mathematics for Cognitive Development” ; APH Publishing corporation New Delhi; ISBN 978-93-85876-80-6 ; 2016 page no.235-242
- Teaching in 21st Century: “Challenges, Techniques & Opportunity” ; Awareness in Mathematics & Science ; ABS Publishing corporation New Delhi; ISBN 978-93-86088-92-5; 2018 page no. 179-186
- Quality Enhancement of Teacher Education Institutions: Innovative Practice in Mathematics for 21st century in learner centered teaching methods.; University Prakashan Unideast Education Pvt. Ltd Agara U.P ISBN: 978-93-88974-06-6 2019 page no. 149-152
- Relevance of peace and value education in the modern world: Importance of peace and value Awareness campaign and constructivist Approach N.B Publications Ghaziabad UP ISBN 978-93-89234-84-8 Page no, 358-364 2020
- Impact of Activity Based Approaches on Mathematics Learning in Secondary Schools *International Journal of Special Education* Vol.37, No.3, 2022-page No. 5616-5627 ISSN 08273383, Scopus
- Impact of experiential learning approaches on mathematical aptitude in Pre-Service Teacher Trainees; *Journal of Pharmaceutical Negative Result* Vol.3 Issue 4 2022 Page No. 1876-1882; No ISSN Print -0976-9234 online 2229-7723, Scopus

- Youth and Wellbeing: Impact of Intelligence on Life Skill Education of Young Pre-Service Elementary Teachers” Kunal Publication New Delhi ISBN 978-93-95651-24-0 Page no. 145-153, 2023

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ABSTRACT

**MATHEMATICAL APTITUDE OF PRE-SERVICE ELEMENTARY
TEACHERS OF SIKKIM IN RELATION TO INTELLIGENCE AND
PROBLEM-SOLVING ABILITY**

**AN ABSTRACT SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY**

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DEPARTMENT OF EDUCATION

SCHOOL OF EDUCATION

OCTOBER 2023

**MATHEMATICAL APTITUDE OF PRE-SERVICE ELEMENTARY
TEACHERS OF SIKKIM IN RELATION TO INTELLIGENCE AND
PROBLEM-SOLVING ABILITY**

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Introduction

Despite the fact that mathematics is an important for our cultural growth as well as our personal development, it is not a favorite subject among many pupils. Mathematics is taught as if it were a mechanical topic, with no creativity or practical methods. Students are rarely taught how to build mathematical calculating skills. They are not encouraged to improve their problem-solving skills or increase their mathematical thinking aptitude. The All-India Survey regarding Achievement of Mathematics (1970) indicates that children's mathematical cognition at the basic level is below the expected level. So, Role of Mathematics teacher is the most important to transect knowledge amongst the learner. The best teacher is the one who teaches less but inspires more and more. Teachers should teach based on their experience not only through books and abstraction.

If the answer books from the Secondary School Examination are inspected, it may be noticed that a large proportion of students failed mathematics. Who is to blame for such an ugly situation: the pupils, the parents, or the teachers? Is a fear of science and mathematics an inherited or acquired trait? The answer is debatable. In our society, there is a widespread belief that the more intellectual a person is, the better his math skills will be. However, despite having a similar I.Q. two persons may have different perceptions, judgments, reasoning, word fluency, vocabulary, spatial orientation, and so on. On the one hand, intelligence is concerned with general mental capacity, whereas aptitude is focused with sensory motor, mechanical, creative, or professional skill. We can tell the likelihood of the branch of profession more fit for the individual by understanding their intellectual level based on an Intelligence test or School Progress.

Mathematical aptitude is a person's capacity to solve logical, intellectual, abstract, or any other practical challenge that arises in everyday life. Essentially, aptitude is a combination of natural attributes that point to a person's ability in a particular profession. Intelligence, on the other hand, is an innate talent that helps an individual in making adjustments, abstract thinking, and acquiring knowledge. As a result, intellect may have a role in the development of a person's mathematical aptitude. Several researches have been conducted to assess the effect of intelligence on the development of mathematical aptitude.

Rationale of the Study

We know that all scientific education is based on the subject of Mathematics and their application. Its neglect means to remain ignorant about all other sciences. We should not forget that right from morning till evening, all our activities and engagements are controlled and fashioned by mathematics. Mathematics is an exact science and involves high cognitive abilities and powers. Mathematics is a form of reasoning and consists of thinking in a logical manner, formulating and testing conjectures, making sense of concepts, formulating inferences, conclusions and judgments as well as justifying them. Mathematics is more than calculation and memorization of basic facts and manipulation of symbols. Students who truly understand or make sense of mathematical concepts are not just manipulating symbols or following rules invented by others to solve problems. They are applying rules and inventing solutions by using logical thinking and reasonableness of solutions. National Policy on Education (1986):- has considered the importance of mathematics in general education and suggested that, “Mathematics should be visualised as the vehicle to train a child to think, reason, analyse and to articulate logically.” Mathematics helps us to develop our intellectual powers like power of imagination, memorization, logical thinking and reasoning. Student’s flexibility, interest, curiosity and creativity also affect the acquisition of mathematical power. Study of mathematics is helpful in learning most of school subjects. Also, prosperity of a nation and human resource development largely depends upon the development of the creativity of an individual. The school climate provides the framework within which students, teachers, administrators and parents function co-operatively and creatively. In an educational system, creativity in the student is monthly neglected. Teachers in the school are so busy in their academic routine that they find little time to think of creativity and the means to foster it. Therefore, proper learning styles established during the academic years have a lasting impact. There are many factors, which may influence the learning styles like - effective study, reading, observation, conclusion, self- confidence etc. If the teachers provide the rich learning experiences through magazines, newspapers, journals, books and other mass media. It will definitely help in good learning styles among students and create them interest in learning. Mathematics is very essential in any learning programme. It is most important

school subject because of its utility in personal use, home, finance, clerical work, book keeping, teaching, statistical engineering etc. Mathematical aptitude measurement gives an indication of ability to succeed in mathematics such as achievement in mathematics. It is more important for the researcher so, that they can capitalize the opportunities according to the interest, taste and aptitude of the trainees. A control goal for all levels of mathematics education is the development of mathematical power for all the trainees. In particular, mathematical power include the ability to explore, conjecture and reason logically; to solve non – routine problem's, to connect concepts within mathematics and between mathematics and real–world situations, to read, write, listen and speak mathematically. This power will help the learners in their future life.

The primary education of Sikkim is entirely depending upon the teachers trained in different DIETs of Sikkim. The Mathematical aptitude of pre-service teachers of DIETs can determine the course of mathematics education at the primary level. A considerable number of pre-service elementary teachers belong to the tribal society of Sikkim and their performance in teaching mathematics can lead the mathematics education in the state.

Therefore, it is important to study the aptitude level of the pre-service teachers of DIETs and make a comparison of the mathematical aptitude, intelligence and problem-solving aptitude between tribal and non-tribal pre-service elementary teachers. The study is also going to compare between male and female; government and private colleges; mathematical and non- mathematical background trainees of their mathematical aptitude, intelligence and problem-solving aptitude. Such study can help the state govt. to design better training module to equip pre-service elementary teachers in mathematics education. So, that they can impart proper mathematical skills on the learners at primary level which can further improve mathematics education at secondary and tertiary level. Findings of the present study will be helpful to state government and DIETs authorities including teachers and principals to know and understand the level of mathematical aptitude, intelligence and problem-solving aptitude for their academic performance and better future.

Individuals' perspectives are changing today, and they are becoming more motivated to acquire a passion for mathematics. Mathematics has been acknowledged as

a symbol of human progress by all great educators, like Herbert, Pestalozzi, and others. Given the enormous importance of mathematics in everyday life, we can say that understanding of mathematics is essential and will continue to grow as requirements grow. The question is what are the variables that are most likely to lead to the development of mathematical aptitude? As soon we locate them, we will be able to begin orienting our children in order to help them in conquering their fear of mathematics and build an enthusiasm in it.

Research Questions

1. What is the Mathematical aptitude level, Intelligence and Problem-solving ability of tribal and non -tribal pre-service elementary teachers of Sikkim?
2. What is the relationship among of Mathematical aptitude with the variables like Intelligence and Problem-solving ability of tribal and non-tribal pre-service elementary teachers of Sikkim in relation to their gender, management and stream of study?

Statement of the Problem

The researcher assumes that mathematical aptitude, intelligence and problem-solving abilities are effective for the pre-service elementary teachers of Sikkim. Based on this assumption, the following problem for this study is formulated. **“Mathematical Aptitude of Pre-service Elementary Teachers of Sikkim in relation to Intelligence and Problem-Solving Ability”**

Objectives of the study

1. To construct a mathematical aptitude standardized scale for pre-service elementary teachers of Sikkim.
2. To study the mathematical aptitude, intelligence and the problem-solving ability of pre-service elementary teachers of Sikkim.
3. To compare the mathematical aptitude of tribal and non-tribal pre-service elementary teachers of Sikkim.
4. To examine the correlation between mathematical aptitude and intelligence of pre-service elementary teachers of Sikkim.

5. To examine the correlation between mathematical aptitude and problem-solving ability of pre-service elementary teachers of Sikkim.
6. To examine the correlation between intelligence and problem-solving ability of pre-service elementary teachers of Sikkim.
7. To examine the test of significance relationship between mathematical aptitude, intelligence and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.

Hypothesis of the study

1. There is no significant difference between the mathematical aptitude and intelligence of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.
2. There is no significant difference between mathematical aptitude and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.
3. There is no significant difference intelligence and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.
4. There is no significant difference between mathematical aptitude, intelligence and problem-solving ability of pre-service elementary teachers of Sikkim in relation to gender, management, stream and category.

Operational Definitions of the Key Terms: The key terms used in this study are given below: -

Mathematical Aptitude: It is a special ability of a person to counter the logical, intellectual, abstract or any other practical problem of daily life.

Intelligence: It is also an innate ability that helps one make adjustment, do abstract thinking and acquire the ability to understand.

Problem-solving ability: It is an ability to solve the difficulty or problem in the respective subject.

DIETs: District Institute of Education and Trainings. It is a nodal agency for providing academic and resource for elementary education where students are getting trainings after passing the class 12.

Tribal and non-Tribal: Tribal refers to ST (schedule tribe) and non-tribal refers to General, OBC (other backward class) & SC (Schedule Caste).

Pre-service elementary teachers: Students who are enrolled in D.El.Ed /Elementary teachers training course in different teacher training Institutions.

Review of Related Literature

Alibraheim and Al-hussary (2021) Studied on Investigating Pre-service Elementary Teachers' Mathematical Power. The findings showed that pre-service teachers had a low level of mathematical power, and there were three factors that contributed to the pre-service elementary teachers' low level of mathematical power. It could improve pre-service teachers' mathematical power domains including mathematical communication, connection, and reasoning.

Borja, Ompoc, Temblor and Torello (2019) Studied on The Challenges among Pre-Service Elementary Teachers. The study revealed that there is a remarkable difference in the pre-service elementary teachers and the challenges they encountered when grouped according to age and gender and advised to engage the pre-service elementary teachers in different seminar-workshop that caters with the existing aspect as well as providing them with containing and development in teaching

Ghatak and Mittal (2019) Studied the topic on the "Problem-Solving Ability of school students in relation to their academic performance" Studies were reviewed to explore the bond between problem-solving ability and academic performance of students going to school. It was discovered that for the last few years, there is a notable positive relation between problem-solving ability and academic performance of students going to school. The study found that the problem-solving ability of school boys is significantly higher than that of the school girls.

Karademir (2019) Studied on Pre-Service Teachers' Problem-Solving Skills and Curiosity Levels. The study found that pre-service teachers' problem-solving skills are seen to be above the average value. It was determined that there was a significant difference in terms of gender according to scores obtained from the "monitoring" sub dimension and the "Problem Solving Inventory". It was determined that there was no significant difference in terms of grade level according to scores obtained from the Problem-Solving Inventory. It was also found that pre-service teachers' curiosity levels for "depth" sub dimensions are seen to be above the average value and there is an increase in the problem-solving skills scores of the pre-service teachers, the curiosity scores will increase.

Hudda and Devi (2018) Studied on "effect of problem-solving ability on mathematics achievement among secondary school students: an empirical Study" The purpose of the present study is to investigate the mathematics achievement of students from secondary school in association to problem solving ability and gender. Descriptive survey method was used. Problem Solving Ability and Gender were treated as independent variables whereas Mathematics Achievement was treated as dependent variables. The study revealed that problem solving ability and gender has a significant main effect on the mathematics achievement of secondary school students. However, no significant double interaction effect of problem-solving ability and gender on mathematics achievement of the secondary school students was found. Thus, efforts should be made to help the students to improve their problem-solving ability which will help them in improving their mathematics achievement.

Aher (2017) Studied on Co-operative learning strategies academic achievement interest and problem-solving ability of students. The researcher showed that the developed intervention programme (including the lesson notes, the support material and the Achievement test) was suitable to be implemented in the classroom. It is also found that Co-operative learning strategies improves academic achievement, interest and problems solving ability in Mathematics.

Summary of review of literature

All these studies reflect that in some cases, variables like intelligence and problem-solving ability affect the mathematical aptitude of an individual, while in other cases we fail to trace their impact. Reason may be many. It may be due to different socio-economic status, cultural background, geographical diversities, support from parents and teachers or any other cause. A review of literature does not indicate a clear-cut relationship of these variables, viz. intelligence and problem-solving ability with mathematical aptitude. Though it appears that the variables undertaken are significant determinant, yet they need to be subjected to scientific corroboration.

So far none of the reviews talked about the study of mathematical aptitude of pupil teacher who can lay a strong foundation of mathematics education at primary level of education. Further, no such study was found to be done in the state of Sikkim. Therefore, the present study may be a unique and original piece of study which can accelerate mathematics education in the state of Sikkim.

Research Design

“Research design is a plan, structure and strategy of investigation so conceived as to obtain answers to research questions or problems” - Karlinger

A research design is a planned structure of the study outlines the method and it is a strategy and technique used to find answers to the research questions and to test the hypotheses thereafter. The present study purports to know the current status of mathematical aptitude of pre-service tribal and non-tribal elementary teachers of Sikkim in relation to their intelligence and problem-solving abilities as influenced by gender, management and mathematical and non-mathematical backgrounds. The researcher aimed to find the level of mathematical aptitude of tribal and non-tribal elementary teachers and further investigated its relationship with their intelligence levels and problem-solving abilities, if any. The role of gender orientation, private and government management and mathematical and non-mathematical backgrounds has also been explored to having any kind of influence on mathematical aptitude of these tribal and non-tribal elementary teachers. In order to attain these objectives, descriptive method of research was considered as the most suitable method for conducting the present study.

Method of the Study

Descriptive method of research was considered as the most suitable method for conducting the present study.

Population of the study

Sikkim had divided in 4 districts initially i.e., East Sikkim, West Sikkim, North Sikkim and South Sikkim but at present 6 districts i.e., Gangtok, Pakyong, Gyalshing, Soreng, Mangan and Namchi. There are 3 Government DIETs in East, South and West of Sikkim and one private managed DIETs college, Pakyong in East of Sikkim. In the present study, population refers to all the pre-service teachers of DIETs of East, South and West districts of Sikkim for 400 populations. All pre-service teachers of three DIETs and one privately managed elementary teacher training Institution namely Carmel teachers training Institute, Pakyong, Sikkim have been considered as population.

List of DIETs

Table No. 1

Sl.No.	Name of the DIETs
1	District Institute of Education and Training (DIETs) Gangtok East of Sikkim
2	District Institute of Education and Training (DIETs), Namchi, South of Sikkim
3	District Institute of Education and Training (DIETs), Gyalshing, West of Sikkim
4	Carmel teachers training Institute, Pakyong, East of Sikkim.

Sample of the study

The sample is the representative group of persons taken from this population in order to study their characteristics/attributes. Simple random sampling technique was used to collect the data for the present study. Initially the researcher planned to take all the 400 pre service elementary teachers from all the DIETs of Sikkim. After reputed visiting of all the DIETs data has been collected from 346 pre-service teachers of all the elementary teacher training institutions of Sikkim. Out 346 pre-service teachers 53 are Male and 293 Female.

Frequency Table of Samples

Table No. 2

Gender	Male	Female	Total
	53	293	346
Management	Government	Private	Total
	249	97	346
Stream	Mathematical Background	Non-Mathematical Background	Total
	106	240	346
Category	ST	NON-ST	Total
	155	191	346

Tools and techniques used for data collection

The research tools are very important for any research study. It plays a vital role in collection of data and research process. In the present study, the investigator has used standardized scales for the assessment of intelligence and problem-solving ability. Investigator has used a self-constructed mathematical aptitude test also for present study. For the collection of data following tools were used:

1. Problem solving ability scale standardized by L.N. Dubey (2008)
2. Wechsler's Adult Intelligence scale developed by David Wechsler (2008)
3. Self-constructed Mathematical aptitude test: in order to know the mathematical aptitude of pre-service elementary teachers.

Mode of data collection

In order to collect data, the researcher visited each DIETs and private managed elementary teacher training institution of Sikkim. Prior permission of the principals was taken from these institutions to conduct the study. The process of data collection began with the sharing of the objectives of study with the pre-service teachers. The various queries raised by them were addressed. They were also apprised about the response pattern. The pattern of response was selection of one item out of multiple-choice type

items. There was no negative marking for the wrong response. They were well informed about the time-limit. They were requested to respond to the questionnaire without consulting with their batch mates. They were assured of maintaining confidentiality of their responses. After this, data collection was done using different tools.

Mode of tabulation and analysis of data

The data collected from all the respondents were scrutinized and tabulated. The data collected from questionnaire was analyzed quantitatively. The responses of the pre-service elementary teachers on the questionnaires were tabulated using Excel worksheets. The tabulated data from questionnaire were analyzed using simple percentages, Descriptive statistics, 't' test, and correlation between independent and dependent variables. The data were analyzed with the help of SPSS and Excel.

The present study examines the significance differences between mathematical aptitude, intelligence and problem-solving ability with respect to male and female pre-service elementary teachers of DIETs Sikkim, government and private pre-service elementary teachers of DIETs Sikkim, mathematical and non- mathematical background pre-service elementary teachers of DIETs Sikkim and tribal and non-tribal pre-service elementary teachers of DIETs Sikkim. The results were discussed on the basis of 0.05 level of significance.

Major Findings of the Study

1. The study found that reliability of the self-constructed tool of mathematical aptitude was considered to be reliable. Factor loadings of the five dimensions undertaken in the study are considerably high which shows test is valid. Thus, the present test (MAT) is a valid and a reliable tool for measuring the mathematical aptitude of elementary level pre-service trainees.
2. The study found that level of intelligence of pre-service elementary teachers of Sikkim is high in respect to developing the thinking skills, building the capability, developing the innovative ideas creativity and developing the better understanding.

3. The study found that level of mathematical aptitude of pre-service elementary teachers of Sikkim is moderate in respect to developing the thinking skills, building the capability, developing the innovative ideas creativity and developing the better understanding.
4. The study found that level of problem-solving ability of pre-service elementary teachers of Sikkim is low in respect to developing the thinking skills, building the capability, developing the innovative ideas creativity and developing the better understanding.
5. The study found that level of mathematical aptitude of male pre-service elementary teachers is slightly better than female pre-service elementary teachers.
6. The study found that mathematical aptitude scores of ST and non-ST pre-service elementary teachers are normally distributed. The value of mean of ST pre-service elementary teachers is slightly more than non-ST. It shows that level of mathematical aptitude of ST pre-service elementary teachers is slightly high than non-ST pre-service elementary teachers.
7. The study found that positive and significant relationship between intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim It shows that intelligence and mathematical aptitude were highly correlated in this study.
8. The study found that positive and significant relationship between problem-solving ability and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim. It shows that problem solving ability does get influenced by the mathematical aptitude of pre-service teachers.
9. The study found that positive and significant relationship between intelligence and problem-solving ability of pre-service elementary teachers of DIETs Sikkim. It shows that intelligence does play a

dominant role in impacting the problem-solving ability of pre- service elementary teachers

10. The study found that positive and significant relationship between mathematical aptitude, intelligence & problem-solving ability of pre-service elementary teachers of DIETs Sikkim in relation to gender, management, stream and category.
11. The study found that mathematical aptitude, intelligence & problem – solving ability level of pre-service elementary teachers of Sikkim is not influenced by category (ST and non-ST)
12. The study found that mathematical aptitude, intelligence & problem – solving ability level of pre-service elementary teachers of Sikkim is not influenced by the Stream (Mathematical and non- Mathematical background)
13. The study found that mathematical aptitude, intelligence & problem – solving ability level of pre-service elementary teachers of Sikkim gets influenced by the gender (Male and Female)
14. The study found that mathematical aptitude, intelligence & problem – solving ability level of pre-service elementary teachers of Sikkim gets influenced by the Management (Government and Private institution)
15. The study found that mathematical aptitude, intelligence and the problem-solving ability of pre-service elementary teachers differs significantly.

Finding of study in relation to Mathematical Aptitude

Researcher done the test of significant difference between means of male and female of pre- service teacher trainees on mathematical aptitude and calculated the value of t which is 4.119. and it is significant. Test of significant difference between means of government and private of pre- service teacher trainees on mathematical aptitude calculated the value of t which is 3.131 and it is significant. Test of significant difference between means of mathematical background and non-mathematical background of pre-service teacher trainees on mathematical aptitude calculated the value of t which is 0.540

and it is not significant. Test of significant difference between means of ST and non-ST of pre- service teacher trainees on mathematical aptitude calculated the value of t which is 1.252 and it is not significant.

Finding of study in relation to Intelligence

Researcher done the test of significant difference between means of male and female of pre- service teacher trainees on intelligence and calculated the value of t which is 3.352. and it is significant. Test of significant difference between means of government and private of pre- service teacher trainees on intelligence calculated the value of t which is 10.551 and it is significant. Test of significant difference between means of mathematical background and non-mathematical background of pre- service teacher trainees on intelligence calculated the value of t which is 0.702 and it is not significant. Test of significant difference between means of ST and Non-ST of pre- service teacher trainees on intelligence calculated the value of t which is 0.823 and it is not significant.

Finding of study in relation to Problem- Solving Ability

Researcher done the test of significant difference between means of male and female of pre- service teacher trainees on Problem- Solving Ability and calculated the value of t which is 2.908. and it is significant. Test of significant difference between means of government and private of pre- service teacher trainees on problem- solving ability calculated the value of t which is 4.728 and it is significant. Test of significant difference between means of mathematical background and non-mathematical background of pre- service teacher trainees on problem- solving ability calculated the value of t which is 0.948 and it is not significant. Test of significant difference between means of ST and non-ST of pre- service teacher trainees on problem- solving ability calculated the value of t which is 0.971 and it is not significant.

Educational implications of the study

The main objective of any research, directly or indirectly has a high chance of finding some practical applications and proper implementation. In the light of above findings of the present investigation the educational implications may be suggested.

The following educational implications can be followed: -

1. The present study presents the mathematical aptitude of pre-service elementary teachers of Sikkim in relation to intelligence and problem-solving ability that can be utilized by management, teachers, educators, administrators, planners and guidance personals for exceptionally enhancing the academic achievement of students, especially for those who are taking training in educational and professional Institute.
2. The present study was found that level of intelligence of pre-service elementary teachers of Sikkim is high. This may be due to the fact that from the beginning of teaching mathematics and its application in DIETs is well done and pre-service elementary teachers of Sikkim had developed good attitude towards this subject in their everyday lives.
3. The study showed that the mathematical aptitude level of tribal and non-tribal pre-service elementary teachers of Sikkim is not influenced by category and stream. It shows that their mathematical aptitude, intelligence and problem-solving ability are equally good and no significant difference between tribal and non-tribal pre-service elementary teachers is present.
4. The study also showed that the mathematical aptitude level of pre-service elementary teachers of Sikkim gets influenced by the gender and management. It shows that their mathematical aptitude, intelligence and problem-solving ability are equally not good and notable difference is present between male – female and government- private institution of pre-service elementary teachers. This is a data that educationists and educational planners should be concerned about. Lecturer may think and find the solution so that no such difference further exists in the development of mathematical aptitude, intelligence and problem-solving ability between male-female and government-private institution of pre-service elementary teachers.
5. The teacher of DIETs can help to spark aptitude, intelligence and problem-solving ability among pre-service elementary teachers; as one of the major

responsibilities of teaching community is the promotion of mathematical aptitude among pre-service elementary teachers for this purpose full freedom should be provided to pre-service elementary teachers to experiment with new ideas. The lecturer should not emphasize the confirmatory behaviour but new ideas, novel plans should be accepted and develop the problem-solving ability and encourage to pre-service elementary teachers.

6. The present study can help the state government of Sikkim to design better training module to equip pre-service elementary teachers in mathematics education so that they can impart proper mathematical skill on the learners at elementary level which can further improve mathematics education at secondary and higher secondary level.
7. The counselling of pre-service elementary teachers for aptitude testing and group interaction can be more effective than personal characteristics of trainees in improving aptitude capabilities. In groups, pre-service elementary teachers with special aptitude can involve themselves productively and learn new intellectual skills and aptitude, intelligence and problem-solving ability skills in that particular area.
8. This study will help the lecturer to focus pre-service elementary teacher's attention on their teaching of mathematical concepts and also to know about the ability of pre-service elementary teachers in applying the mathematical knowledge in problem solving skills.
9. Mathematical aptitude performance is the potential of a person to learn effectively in future endeavours, it is therefore important that educational institute should develop curricula that are effective in developing skills of pre-service elementary teachers in numerical and verbal domains as a means of improving performance of students in general aptitude tests, intelligence and problem-solving ability.
10. Findings of this study may help in understanding the mathematical aptitude of the pre-service elementary teachers. Lecturer can guide the trainees and tell them how important of mathematical aptitude for better career. Mathematical

achievement of a learners largely depends upon his/her mathematical aptitude and problem-solving ability.

Recommendations

Mathematical skills training should be given at elementary level in Sikkim. It is very importance to develop mathematical ability and problem-solving ability in pre- service elementary teacher trainees so that the basic objectives are attained and new patterns of skills of individuals, group and society as a whole towards mathematical aptitude, intelligence and the problem-solving ability is created. Furthermore, based on the knowledge gained through this study, the following measures are suggested as improvement to the study of mathematics education at the elementary level.

1. The findings of the present study revealed that mathematical aptitude of ST pre-service elementary teachers is slightly more than non-ST pre-service elementary teachers. It is general perception that mathematical aptitude of non-ST candidates is more than ST. We should omit this myth from our mind and teach and treat all pre-service elementary teachers equally.
2. The results of present study clearly found that intelligence and mathematical aptitude of pre-service elementary teachers of DIETs Sikkim closely associated and intelligence is a powerful determinant of deciding the mathematical aptitude of pre-service elementary teachers. Intelligence influences to improve mathematical aptitude in pre-service elementary teachers so, teachers of educational institute should keep in mind that motivate to students to apply their intelligence and improve the mathematical aptitude. It is general perception that Mathematics is very tough and boring subject. It is very necessary to encourage our learners to know more mathematics and apply it in daily life.
3. The results of present study clearly found that problem-solving ability and Mathematical Aptitude of pre-service elementary teachers of DIETs Sikkim closely associated. Problem-solving ability is a powerful determinant of deciding the mathematical aptitude of pre-service elementary teachers. It was found that problem

solving ability does get influenced by the mathematical aptitude of pre-service teachers. So, teachers can share the importance of mathematical aptitude to learners for their problem-solving ability.

4. The results of present study clearly state that intelligence and problem-solving ability of pre-service elementary teachers of DIETs Sikkim are integrally related. It was found that intelligence does play a vital role in impacting the problem-solving ability of pre-service elementary teachers. It was also found that the higher the intelligence level, more the problem-solving ability of the pre-service teachers. So, teachers of educational institute should keep in mind that motivate to students to apply their intelligence and improve the problem-solving ability. Problem-solving ability is correlated with day-to-day situation and good intelligence mind may solve the problem quickly.
5. The study showed that the mathematical aptitude level of tribal and non-tribal pre-service elementary teachers of Sikkim is not influenced by category and stream but gets influenced by the gender and management. Mean (20.49) of government Pre-service elementary teachers are more than mean (18.35) of private pre-service elementary teachers. It is recommended that private institute should focus more to provide good quality education rather than focusing on earning more money. Mean (23.13) of male pre-service elementary teachers are more than mean (19.39) of female pre-service elementary teachers. It is recommended that educational institute should more focus on female candidates by their faculty. Government can also provide better education to female candidates through more facilities.
6. The role of teachers of DIETs is very vital to provide more guidance to pre-service elementary teachers to solve their problems so that they are motivated to learn in a better way. Private institute is also providing more facilities and remuneration to faculties for their satisfaction so they may work honestly and encourage learners for better performance. Mathematics education is not a small thing, its development would lead to the development of the whole state and the people of Sikkim. Therefore, there is no effort too big for the development of this subject.

Suggestions for Further Research

The researcher would like that further research be done on the following objectives: -

1. The present study was carried out for DIETs teacher's trainees of Sikkim. A similar study can be carried out upon the teachers' trainees of different educational institutes for B.Ed and M.Ed trainees and for general degree and post-graduate college and university with different age groups and different educational streams.
2. The study may be conducted for the lecturer of DIETs and another professional institute to know their level of mathematical aptitudes.
3. The present study was limited to the state of Sikkim only. It can be extended to other states in order to have a broader and comprehensive perspective study.
4. An analysis of actions taken for policies and for the upgradation of mathematical aptitude for teachers training institute by the state government.
5. The present study was used self-made tools of mathematical aptitude. A similar tool can be developing for intelligence and problem-solving ability.
6. A critical study of expert works for the development of mathematical aptitude for trainees in relation to intelligence and problem-solving ability.
7. The present study was compared between ST and non-ST teachers' trainees. A similar study can be conducted among General, OBC, SC & ST.
8. A comparative study should be undertaken with similar variables and it can be comparison between mathematical aptitude and academic achievement.
9. A comparative study of Sikkim and other states of North- East India can be done.
10. The study needs to know the role of parental education, socio-economic status and their intelligence which is going to impact the development of mathematical aptitude in relation to intelligence and problem-solving ability.

Conclusion

Study reveals the mathematical aptitude of pre-service elementary teachers of Sikkim in relation to intelligence and problem-solving ability. There is no end point or a complete solution to each problem, so some important measures can always be taken in order to make positive steps towards betterment of learners. Keeping this in mind for the purpose of study to know mathematical aptitude of pre-service elementary teachers in relation to intelligence and problem-solving ability is one of the most important determinants of success in their career because, learners who achieve well academically have some advantages in their future.

Mathematical aptitude is a person's capacity to solve logical, intellectual, abstract, or any other practical challenge that arises in everyday life. Essentially, aptitude is a combination of natural attributes that point to a person's ability in a particular profession. Intelligence, on the other hand, is an innate talent that helps an individual in making adjustments, abstract thinking, and acquiring knowledge. As a result, intellect may have a role in the development of a person's mathematical aptitude.

Individuals' perspectives are changing today, and they are becoming more motivated to acquire a passion for mathematics. Mathematics has been acknowledged as a symbol of human progress by all great educators. Given the enormous importance of mathematics in everyday life, we can say that understanding of mathematics is essential and will continue to grow as requirements grow.

The present study found that mathematical aptitude level of tribal and non-tribal pre-service elementary teachers of Sikkim is not influenced by category and stream but gets influenced by the gender and management. It is general perception that those who have mathematical background they score more in mathematical aptitude test and their aptitude skills are good. It is a subject which can solve the problem based on their intelligence and day to day life experiences. It is also general perception that those have non-ST background like General OBC, SC they have more mathematical aptitude skills. It has also rejected in the present study. It means that acquiring the knowledge and develop the mathematical aptitude, intelligence and problem-solving ability is not based on category and stream it is based on individuals and guidance by teachers and educational environment of institute. Mean of government pre-service elementary teachers are slightly more than mean of private pre-service elementary teachers. So private institute should focus more to provide good quality education. Mean of male pre-service elementary teachers are slightly more than mean of female Pre-Service Elementary Teachers. So, educational institute should more focus on female candidates by their faculty. Government can also provide better education to female candidates through more facilities. Therefore, Sikkim should improve mathematics education provided by good skills teachers in such a manner so each and every learner develops the

mathematical aptitude. We need to give proper attention to the recommendations that have been made based on the findings of research and make effort for the development of mathematics education. Also, the state government needs to pay more attention for the advancement of mathematics education. It is clear that something is needed to be done in order to improve learner's attitude towards learning the concept of mathematics. However, for true change to be established, teachers, government, parents and the society itself need to co-operate and do whatever they can in order to improve this vital part of education. If each and everyone plays role there is hope that in the near future, this state will establish itself as one of the most well performing states in India in relation to mathematics education.