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CHAPTER-1
INTRODUCTION

1.1 INTRODUCTION

Science, Mathematics and languages are three main precursors of the success in this age. The computer and internet has made access of academic information very easy. The media whether printed or digital has expanded the span of information related to any academic subject. The books, magazines, web sites, CDs and many other sources of information provide us vast knowledge regarding any branch of study.

Today we live in the age of Science and Technology which is closely related to mathematical world. Mathematical knowledge and skills are required to accomplish any task related to science and technology. The scientific researches and inventions in the field of technology also need very accurate and meticulous mathematical calculations. All discoveries and inventions are based on mathematics. Even in the day today life, man cannot do without mathematics. In the present time mathematics is not only a branch of study or one of the school subjects but it is identical characteristic or a trait of universal human culture. Mathematics is a most important and fundamental skill of studying all sciences. It is a most valuable and unavoidable tool of studying engineering and an unique language of studying commerce. We cannot help ourselves without the knowledge of mathematics in identifying and perceiving the world surrounding us. In the most complex and advanced modern life, mathematics has a specific role to play. Today man cannot help without travelling whether on road, by rail or by air or on water, but can he do this without the mathematical knowledge? World’s business would have been crippled and stock market would have been dumbed, if there had not been mathematics in the world. Today’s society has become knowledge society. Technology and management have entered in to every field of knowledge and every walk of life. Now we are well aware with the terminology like chemical technology, education technology, computer technology, agriculture technology, space technology and many other such terms. Similarly, we hear the words like disaster management, health management, event management and many such words associated with the word management. This shows that in the more complex and fast changing world of today, none can do without the knowledge and skill of mathematics. The persons without the knowledge of mathematics will be soon outdated in the ever changing global society. The job providers all over the world seek analytical and computing skills in their employees. The problem solving skill is the most required skill in today’s world of occupation. The skills of logical reasoning, abstract
thinking and quantitative abilities will help the person with a good prospect in the challenging and much diversified professional world of today.

In the present age of globalization, the corporate sectors require the man power having mathematical skills and aptitude. The skills which can be naturally cultivated from mathematics are very much helpful to an individual in his personal life as well as professional life. The skills like calculations, reasoning, abstract thinking, problem solving are much required in any of the professional fields now a days. Thus the mathematical knowledge and skills enhance a person with more job opportunities in this competitive world of occupations than the persons lacking in mathematical knowledge and skills. Mathematical skill and ability will lead those individuals towards the prospective goals of life.

Mathematics has not only a good career prospects, but it is by nature an exciting and challenging subject. One can solve so many problems of the world using various mathematical models. Hence interest in and positive attitude towards mathematics are required in a person since his initial stage of learning.

People having mathematical knowledge and skills are esteemed and looked at high spirits by friends and colleagues. They are supposed to be more intelligent and cleverer. This is because the general mass of people thinks mathematics to be a very difficult subject. Normally the students are always worried about their study of mathematics. The negative attitude of students, parents and common people in the society can be seen through their discussions, presentation of negative thoughts about mathematics in media and antipathy towards the mathematicians in the society. Students often avoid mathematics because of their lack of opportunities to deal with the subject. (Hoklyes, 1982).

The students study various subjects in the school to achieve knowledge and develop skills pertaining to particular subject. The overall curricular and co curricular activities organized to provide various learning experiences to the students, contribute towards the all round development of the students. There are many factors that can influence the students’ achievement in various subjects. Students’ achievement in a particular subject may be influenced by students’ interest in that subject or their attitude towards that subject. Students’ innate qualities can also be responsible for his higher of lower achievement in any academic subject. Students’ intelligence, aptitude, capabilities and competencies effect on their achievement. The external or outer influencing factors may be related to teachers’ ability, his
effectiveness, his mastery over the subject, teaching and learning methods, physical environment at school and home and students’ efforts. The list of factors influencing students’ achievement may be endless but the research work in this area has proved that attitude of the students towards an academic subject is the key factor that affects students’ achievement in that subject.

Whatever reason may be, the students’ performance in mathematics has been found lower in comparison to other subjects. Besides, it is often observed that the students are rather scared of mathematics to study. Sometimes, they are told by the teachers that learning of mathematics is not so easy; it requires a lot of hard work and mental ability. Sometimes, parents judge the learning of mathematics with their own experiences. The parents think that whatever they suffered in their life, their children should not, so they advise their children not to study mathematics. It is a common belief that mathematics is meant for intelligent persons and only scholars are able to learn it. Sometimes, students like to study mathematics but they do not get opportunity for that. The general beliefs about learning mathematics are not so promising. Students do not prefer to study mathematics to any other academic subject.

No doubt, mathematics is a unique subject requiring a lot of perseverance on the part of the students. Without perseverance, skills are difficult to achieve. Thus, students’ attitude has a great influence on their study. It influences the achievement of students in the subject of mathematics. According to Barton (2002) and Furinghetti and Pekhonen (2002), the school atmosphere, teachers’ support, methods of teaching and the attitude of teachers and parents towards mathematics affect the students’ attitude.

Researchers concluded that students’ attitude and achievement has a positive relationship. So, attitude should be developed from the very initial stage of learning which can build a strong foundation for a student to learn and succeed. Ma and Xu (2004) found the positive relationship between the attitude and achievement.

Researches also showed the disparity between boys and girls in learning mathematics. Arnot David and Weiner (1986) proved that such disparity caused the discouragement of girls for learning mathematics resulting into their disliking and inability to work in industrial sectors.
In his research report Costello (1991) has stated that most of the researches on influence of gender on the attitude of towards mathematics concluded that mathematics is more consistent with the self image of male than it is with the self image of female. The self image of male or female is a result of the impact of the male dominated society. In the male dominated society, the self image of male is generally superior to that of female. So it is a common scenario in the secondary schools that participation of female in mathematics classes is passive in comparison to the participation of male. The participant of girls in mathematics classes is poor because their mathematical perceptions are poor.

Researches of Boswell (1979), Fennema and Sherman (1977), Sherman (1882), Leader (1982) and Ethington (1992) showed that in the male dominated society, females are conscious about their specific role in the society. So they are negatively influenced by the society.

Some other researchers found that women are not eligible for most of the professions only because they are lacking in mathematical skills which are the pre requisites to join any profession. Thus it is seen that gender differences matter very seriously in any community. (Willis, 1995; Cuttance, 1995; Barnes and Hoene, 1996).

The life has been changed very drastically and male dominance in the society has been reduced. So to study the influence of gender was the need of the time so that the results of the research studies may be helpful to increase the girls’ participation in mathematics at higher level. It will be helpful to us to adopt some planning and programmes for participation of girls in mathematics at higher level. Researches by Leader (1984), Subotnik (1988), Cohen and Kosier (1991), Honson (1992), Dickens and Cornell (1993) concluded that it was normally observed that girls do not opt for mathematics so much as the boys opt for at higher education. As a result of this they do not get employment in the domains where mathematics is required. There are many barriers for girls to have their employment in the domain of mathematics. Sometimes girls do like to opt for mathematics but at the same time their parents despise them to do so. Sometimes it is found that the girls do not seem to be confident enough unlike the boys who seem to be more confident. The results of male and female students are also found to be different. (Leder, 1984; Subotnik, 1988; Cohen and Kosler, 1991; Hanson, 1992; Dickens and Cornell, 1993).

American Association of University Women has designed several measures and intervention programs for improving female’s attitude towards mathematics (American Association of University Women, 1992; Mulryan, 1992).
Observations and researches indicate that “women are more clustered in the life sciences than in any other subject like physical sciences or technical sciences.” (Gavin, 1997).

Ainley and Fordham (1991) researched to find the relationship between school life and other functions. They looked into the relationship between students and teachers and found that there is no significant correlation between the student’s school life and his results in his studies. They concluded that the studies on students’ attitude towards mathematics showed no such correlation. During the last ten years the Mathematics teachers undertook researches to know the correlation between the students’ attitude towards mathematics and their performance in the same subject. They concluded that the process of teaching and learning in mathematics depends upon the positive attitude towards the subject of mathematics. Therefore the positive attitude towards mathematics among the students should be developed and their level of confidence should be raised.

A positive attitude towards mathematics does not mean just enjoying to do the tasks of mathematics, it requires student’s confidence in his mathematical knowledge and skills. The positive attitude of a student towards mathematics does not remain the same for all components of mathematics for all the time. They may differ in their attitude towards mathematics while taking into consideration different types of tasks of mathematics. (Robson, 1996).

Students’ attitude towards mathematics may differ according to their liking or disliking for mathematics. The students who love mathematics may have good results in mathematics and they may develop positive attitude towards mathematics. Contrary to this fact, the students who do not like mathematics may not have good results in mathematics which can lead them to develop negative attitude towards mathematics. This indicates that mathematics is a difficult subject for some students. Such attitude of the student contributes a lot to build his perception and develop his ability to adapt or apply mathematics. (Booker, Briggs, Davey, and Nisbett, 1992; Schiefele and Csikszentmihalyi, 1995).

The research conducted by Mathematical Sciences Education Board and National Research Council concluded that mathematics develops the problems solving skills among the students. So encouraging them to accept the challenges of life can improve their attitude towards mathematics. (Mathematical Sciences Education Board and National Research Council, 1989).

The researches on learning of mathematics stated that in the modern society, if you want to be successful, you must have your proficiency over mathematics along with sciences
and languages. Such results gave way to more researches to look into the variables effecting the achievement of the students. To improve the performance of students in mathematics requires proper methods of teaching and learning. The teachers in the schools, the parents in the families and above all communities in the society and national education policy should help the students with proper strategies for the better results of the students in mathematics. As the results of the researches showed, students’ attitude towards mathematics was found to be the main factor which influenced the students’ performance in mathematics.

Some other researchers tried to look into the more complex factors influencing the students’ performance in mathematics. Singh, Granville and Dika (2009) found that there are many factors which influenced the students’ achievement in mathematics. There are many interrelated variables related to students themselves, their families, teachers and schools. Most of the researchers agreed that attitude of the students is regarded as an important variable or key factor influencing the students’ performance in mathematics. (Kogce et al., 2009; Nicolaidou and Philippou, 2003).

Since 1935, the different psychologists tried to define attitude towards mathematics in different ways. Among all these definitions, Eshun (2003) has given the definition of attitude towards mathematics. He says that an attitude towards mathematics is nothing but an individual’s thinking in a positive way towards mathematics. Looking at the individual experiences of the students, there should be emphasis on considering students’ interaction with others and with mathematics.

Fraser and Kahel (2007) through their research indicated that attitude of the students towards mathematics has been greatly influenced by variety in environments students’ homes, their schools and their peer groups. They say that environment at home, school and within their groups is not same. This variable of atmosphere influences the students’ attitude towards mathematics. Besides this, the class ethos also contributes towards the development of students’ attitude towards mathematics.

Mohamed and Waheed (2011) attempted to understand the attitude through their research. They looked into the factors influencing the development of attitude. They identified some of the factors influencing the development of attitude and classified them into three groups. The factors in the first group were related to students’ individual traits such as their achievement in mathematics, anxiety, self-efficacy, self-concept, motivation, their experiences in the school and so on. The factors in the second group were related to school, teachers and teaching process. Such factors also comprised teaching materials, classroom management, teacher knowledge, teacher’s attitude towards mathematics, their guidance,
beliefs etc.. The factors in the third group were related to environment of student’s home and society. These factors included educational background of student’s family, expectations of parents, social environment and beliefs.

Attitude reflects the positive or negative emotional disposition. Student’s positive attitude towards mathematics creates a positive emotional attachment of the student towards mathematics as a subject and his negative attitude may force him to be refrained from the subject. (Zan and Martino, 2008).

Extending the results that attitude reflects on emotional disposition of a student, the further researches established the fact that emotional disposition reflects on individual behavior of a student. If a student likes the subject and enjoys the task, his achievement in that subject will be naturally better. If enjoys mathematics, he will have confidence in doing the tasks and he will also find it useful. Therefore, positive attitude of the student towards mathematics is desirable because positive attitude generates willingness of the student to learn mathematics and gain the benefits of learning mathematics. (Eshun, 2004).

As positive attitude influences on the willingness to learn mathematics and achieve better results in mathematics, negative attitude is a great hindrance to learn mathematics. How this negative attitude develops was also interesting to know for the researchers. Nicolaidou and Philippou (2003) found out that negative attitude of students towards mathematics results from frequent failures of the student. If the student is not confident enough to tackle with the problems of mathematics, he becomes depressed and starts developing negative attitude towards mathematics. Gradually such negative attitude becomes permanent. These researchers studied children of initial level to higher level of school. They concluded that initially the children have positive attitude towards mathematics but gradually their positive attitude becomes less positive and finally it becomes negative when the student reaches to higher level of school.

Kogce et al. (2009) also attempted to find the variation between the attitude of the students at initial stage and higher stage. They concluded that there seems to be the significant difference between the attitude of younger and older students. They found out that the attitude of the students of 8th grade towards mathematics was lower than the attitude of the students of 6th grade.

Now the factors affecting such difference in the attitude of the students as they progress towards the higher grade became interesting for the researchers. Nicolaidou and Philippou (2003) searched for such factors and concluded that the stress of performing better, more tasks to be completed in less time, uninteresting content, less positive attitude of
teachers etc. cause developing negative attitude towards mathematics among the students gradually.

Sex differences in studies is the topic recurrently dealt with in research studies. The results found are not the same. Gender differences in studies and particularly in mathematics were more significant before ten years. But the studies after a decade showed different results. Mathematics used to be considered the male’s domain but researches of 2010 found no significant difference between the achievement of male and female. (Scafidi and Bui, 2010; Lindberg et al., 2010).

Lindberg et al. (2010) conducted meta analysis taking the data of 242 studies which represented 1,286,350 people. Their study also indicated no sex differences. The male and female variances were nearly equal.

Nevertheless, these studies showed no gender differences in the performance and achievement in mathematics, some studies did show noticeable differences in the beliefs and self concept of male and female regarding mathematics. Skaalvik and Skaalvik (2004) found lower self-concept of female regarding mathematics than that of male.

Unlike the results of gender differences in attitudes, the results of self-concept are more consistent. The studies of Eshun (2004), Asante (2012), Ma and Kishor (1997) indicated significant differences between the attitude of male and female towards mathematics but the studies of Korgce et al. (2009), Mohamed and Waheed (2011), Nicolaidou and Philippou (2003), Georgiou et al. (2007), Etsey and Snetzler (1998) did not find differences attitude of male and female students towards mathematics. However, Etsey and Snetzler (1998) conducted a meta analysis taking data of 96 studies and they did find the differences between the attitude of male and female towards mathematics but the differences were small. Although the difference showed that the attitude of male towards mathematics was more positive than that of female, the elementary school studies favoured female with the effect size of about .20 and the studies for the grades 9 to 12 favoured male with the effect size of .23.

The Meta analysis conducted by Hyde et al. (1990) found the small gender effect but it was being increased with the progress of their grades. The older students were holding more negative attitude towards mathematics but the girls were holding more negative attitude towards mathematics than the boys.

After a decade the researches of Asante (2012) and Sanchez et al. (2004) also support the results of researches of 1990. Asante (2012) justified with his results that females are less confident than males. Girls have debilitating casual attribution pattern for mathematics. They
believe mathematics as male domain. The girls found to be more anxious than boys about mathematics. These researches were conducted in Ghana. They indicated that male students have more positive attitude towards mathematics than the female students have.

In North America Sanchez et al (2004) undertook a research study taking 8th grade students as their target group. They attempted to find students’ attitude towards mathematics. They found that the North American boys were more interested in mathematics than the North American girls, but the girls believed mathematics to be more important than the boys. The received higher scores regarding mathematical difficulties than boys’ scores.

Asante (2012) also enlisted the factors influencing the gender differences. He said that the factors like school environment, developmental changes in the identity of gender, the attitude and beliefs of teachers and parents towards mathematics influence the differences between the attitude of male and female towards mathematics.

However, the research studies of Kogce at al. (2009), Mohamed and Waheed (2011), Nicolaidou and Philippou (2003), Ma and Kishor (1997), Georgiou et al. (2007) concluded that there is no influence of the variable of gender on the attitude towards mathematics.

Ma and Kishor (1997) conducted meta analysis taking the data of 113 research studies. The researchers found that the variable of gender did not significantly affected on the attitude towards mathematics and it showed no effect on the relationship attitudes towards mathematics and performance in mathematics.

The study of Georgiou et al. (2007) concluded that significant difference was found neither in the achievement in mathematics nor in the attitude of male and female students towards mathematics. The results also highlighted the fact that the achievement of male and female students in mathematics was high and both liked mathematics as an attractive subject but there was a significant difference between their explanations about their performance in mathematics. The male students had higher ability which led them to believe that they were more intelligent than female students.


In the Meta analysis of Ma and Kishor (1997) the correlation between attitude and achievement found to be very weak. The relationship between students’ attitude towards mathematics and their achievement in mathematics was influenced by some factors. The researchers looked into the variables like size of a sample, grade in which the student studied, the ethnicity. The results showed that the higher the grade, the stronger the relationship
between attitude and achievement. The study covered the students from seventh grade to twelfth grade.

The results of the recent researches show a positive relationship between the attitude of the students towards mathematics and achievement of the students in mathematics. As it is shown in the study of Nicolaidou and Philippou (2003) there is significant correlation between positive attitude and achievement.

In the research study of Mato and De La Torre (2010), a positive correlation between attitude and achievement of the secondary school students was shown. The students having more positive attitude towards mathematics were found having better academic performance.

Sanchez et al. (2004) conducted a research collecting the data from the students of the secondary school of nine countries on a wider scale. They also confirmed the relationship between attitude and achievement.

Lipnevich et al. (2011) conducted a research study on the students of middle school of USA and Bielo Russia. They established the fact that attitude is important to predict the achievement. The results of the study showed 25% to 32% variance in the students’ achievement in mathematics affected by students’ positive attitude towards mathematics.

Georgiou et al. (2007) derived at the conclusion that the positive attitude towards mathematics can be predicted by the high achievement of the student in mathematics, but students’ high achievement in mathematics cannot be predicted by their positive attitude towards mathematics. These researchers stated that the attitude of the students towards mathematics can be changed by providing them self motivated teachers and conducive schools with more effective teaching methods, quality teaching leaning materials. Teachers’ role is important for changing the students’ attitude towards mathematics.

Akey (2006) studied the relationship of students’ attitude and behavior with some variables which were affecting their attitude and behavior. The researcher looked into some aspects related to school such as teachers’ guidance and support to the student, individual interaction with them, teachers’ expectations from the students regarding their studies and behavior. He concluded that the classroom environment is important to support and promote the students’ feelings and build up their confidence which may result in their success using their best abilities.

Maat and Zakaria (2010) and Vaughan (2002) worked on attitude towards mathematics in relation to learning environment. The results showed that there was a significant relationship between the students’ perception of the individual qualities and characteristics of their teacher and their attitude towards mathematics. The higher the
perception the higher the students’ attitude. The students’ perception of their teacher’s supportive behavior affects the attitude of the students. Their researcher study established the fact that the learning environment of students influences on their attitude towards mathematics.

Student’s attitude towards mathematics is greatly affected by learning environment in the classroom of mathematics. Rawnsley and Fisher (1998) presented their research results in a conference at Adelaide where they attempted to look into the correlation between the students’ attitude towards mathematics and their positive perception of their teacher.

Many researchers studied on the attitude of the students and their social environment. The social and emotional aspects have also positive correlation with students’ attitude towards mathematics and their learning. Pekrun et al. (2005) and Goetz et al. (2006) studied effect of student’s academic emotions on learning. The appraisals related to controls and values affect students’ emotional disposition.

The role of motivation is important in development of attitude. Wigfield (1997) studied on reading motion and student’s attitude towards mathematics.

Guthrie and Knowles (2001) consider attitude as affective responses which can initiate behavior. Thus attitude has a direct relation with motivation.

Singh et al. (2002) undertook a research study on the achievement of the students in mathematics and science. They attempted to look into the effect motivation, students interest in the particular subject and their involvement in the academic activities. They studied motivation in related to students’ attendance in the school and classroom and motivation related to students’ readiness and participation in the class. These researchers found that students’ attitude towards mathematics was significantly influenced by the motivational aspects. So students having highly motivated had more positive attitude towards mathematics, while the students having low motivation had negative attitude towards mathematics. The less motivated or unmotivated students were possessing the characteristics of being late comers, bunking the classes, lacking in their updates with their books or homework. Such students were seemed to have negative attitude towards mathematics.

Some researchers studied on the effect of students’ effort on their attitude towards mathematics. Hemmions and Kay (2010) found a significant effect of motivation on attitude. The results showed that the students’ prior achievement, their effort and their attitude towards mathematics were the predictors of the students’ achievement. These researchers studied on the students of the tenth grade. They concluded that effort had a positive and significant correlation with attitude towards mathematics.
Reynolds and Walberg (1992) studied the performance and attitude of the students of the class 11th. They also found a significant correlation between motivation and attitude of the students towards mathematics.

The Education Commission (1964) headed by Dr. D.S. Kothari emphasizes the teaching of mathematics. Today we live in the age of science and technology which requires specific skills on the part of job seekers. So the curriculum of mathematics should also be modified according to the needs of the time. The National Policy of education (1986) and National Council of Education Research and Training (1986) have found that teaching of Mathematics at the school level was far from satisfactory. It is undoubtedly true that students should be provided with the opportunities to develop their abilities. Their specific needs should be satisfied. Besides, they should be involved in the tasks in which they have interest. Along with linguistic and scientific skills, the student needs to develop mathematical skills because the mathematical skills are required not only in day to day life of a student but they are needed in his professional life also. The mathematical knowledge and skills are necessary for further study whether in mathematics or in other subjects like physics, chemistry and technology directly and languages and humanities indirectly. Thus mathematical skills are at the base of learning. Hence the students should be provided with the opportunities to experience mathematics as a source of joy. They must know the importance of mathematics and realize the aesthetic value of the subject. The students should enjoy the beauty and uniqueness of the numbers and their infinite creative power so that they may develop their creativity and resourcefulness, their reasoning and problem solving ability.

The students who are gifted with mathematical knowledge and skills may become mathematician. They may specialized themselves as statisticians or contribute their valuable services becoming an engineer or a scientist. But if the students are not interested in learning mathematics, they will have to choose for some other career. The teaching of mathematics in many of the classrooms is not so promising and hopeful which leads the students away from learning mathematics. Sometimes students have talent and wish to learn mathematics but they do not get an opportunity to fulfill their desire. On the other hand, sometimes the students have facility to learn mathematics in a proper way but they themselves are lacking motivation and commitment to learn. Today in the world of globalization, one finds rapid changes in the social and professional needs. So the students also need to update themselves with the new knowledge and skills required in the newly opening fields of careers. In such a demanding times, the students who are multi skilled will be able to make their niche in the professional
world. For this, they need to be prepared and opt for the proper group of subjects in Higher Secondary School.

In our country, the educational planning took place during the second half of the eighteen century. However, there was proper planning for the Science Stream in school. In 1857 three universities were functioning at Mumbai, Calcutta and Madras which were providing education through two major branches of science, medical and engineering. Science along with Mathematics appeared in school curriculum during the beginning of the nineteen century. Following the recommendations of Kothari Commission, the Higher Secondary Schools started with three main streams- Science, Commerce and Arts. In Science Stream, the subjects of Physics, Chemistry, Biology, Mathematics and two languages were compulsory.

The Gujarat Secondary and Higher Secondary Board introduced a new curriculum design consisting three groups of subjects in the Science Stream of Higher Secondary Schools of Gujarat. Among these groups, Group-A included, Mathematics, Physics and Chemistry; Group-B included Biology, Physics and Chemistry while Group-AB included Biology, Mathematics, Physics, Chemistry all subjects. The main choice of the students is between Group-A which is Mathematics group and Group-B which is Biology group because Physics and Chemistry are common in both the groups. According to the students’ career aspirations, they choose their group of subjects. Yet it is interesting to study the attitude of students for opting a specific group of subjects. The researcher being a teacher in Higher Secondary School has experience of teaching Mathematics in the Higher Secondary Classes. The researcher has observed for several years of his teaching that the students face difficulties in making their choice of the subjects. Sometimes they opt for Mathematics at their liking and interest but sometimes they are forced by certain agencies like parents, friends and others. Hence, the researcher has decided to undertake a scientific study to find out the attitudinal facts regarding students’ opting for Mathematics group in the Higher Secondary Schools of Gujarat.

1.2 IMPORTANCE OF THE STUDY

The research study aims at informing about action to be taken so any research study should contextualize its findings and add to the pool of knowledge existing in the universe. Thus any research study must generate the facts unknown to the world and apply them to the large population. The findings should be applied to the entire group beyond the selected
sample. Besides this, the implications of the results of the research study should be clearly stated to help the policy makers and the authority liable for project implementation.

Many previous researchers have found that the achievement of the students in mathematics is greatly related to the attitude of the students towards mathematics. If the students have positive attitude towards mathematics, they will more like to participate in the tasks of mathematics.

In the present study, the researcher has decided to undertake a scientific study to find out the attitudinal facts regarding students’ opting for Mathematics group in the Higher Secondary Schools of Gujarat. Through this, teachers could know the students’ trend towards opting the group during their study in higher secondary science stream. This will consequently help the concerned persons to know the students’ trend towards their choice of the fields of career. This study can also motivate the teachers and educationists to inquire into the reasons of their likes and dislikes and make modifications in methodology, resources and support services provided to the students.

1.3 RESEARCH PROBLEM

A research problem means any such situation that requires to be solved applying various solutions. When there is no similarity between the situation existing and the ideal situation which should be, the problem is there to be solved. Something which is unknown till the date, or not recognized to be used in some other way may be a problem of a research study for an investigator. Identifying the research problem and describing it through a statement is the very first task that any researcher has to accomplish. Before the researcher can identify his research problem very clearly and concisely, he has to identify the area to which his research problem is related. Then the researcher goes through related literature to inquire into the researches done in the chosen area of the study to conceptualize the problem and confine its target group, and variables to be measured.

Thus identifying the problem very precisely and practically, an investigator has to formulate a statement of his research problem. A statement of the research problem is a statement which describes the problem to be solved. The research problem statement helps the researcher to frame research questions to be answered though the research study. The statement of research problem is a focal point of the study. The problem statement is a one sentence which includes three major research aspects. The first thing which a researcher
should describe and include in the problem statement is what is to be measured. The variable covered under the study to be measured should be included in the statement. Then other variables and the target group should also be mentioned in the statement. Sometimes the method of study is also mentioned in the problem statement. For example, if it is said, ‘A survey of.’ An experiment of ‘.’ or ‘A case study of.’ However, the target group and the variable to be measured must be there in the problem statement. If the problem is related with finding relationship with one or more variables, an investigator should mention that one variable or for more than one variable, he can mention the names of those variables or to be precise he can use the word ‘some variables’ instead naming all the list of variables.

It is said that well begun is half done. Similarly, for the research problem, it can be said that a problem well-stated is a problem half-solved. A problem statement should describe the problem in a clear and straightforward way so that the reader can understand it very easily. The statement should not be too long or too short. It should be just one simple sentence concise and clear. It should be a very brief piece of writing which is usually known as a title of the research topic or a problem statement. Such statement should include the fundamental facts of the research study. The problem statement can answer all the what, how, why, when, where and who questions.

The problem statement is the base of the research planning. Writing a problem statement is the first step towards goal of solving the problem. There are various ways to write a problem statement but the easiest way is to write a simple statement covering the variables to be measured and the target group for whom they are to be measured.

In the present study the attitude towards opting mathematics group is to be measured and the target group is the higher secondary students of science stream of the schools of Gujarat. Hence, the following problem statement was formulated by the investigator.

THE ATTITUDE OF HIGHER SECONDARY STUDENTS OF SCIENCE STREAM OF GUJARAT TOWARDS OPTING MATHEMATICS GROUP

To become more clear and confined, the researcher defines the key words of the problem statement.
1.4 DEFINITIONS OF SOME OF THE TERMS

1.4.1 STUDY:

Study means an individual’s attempts to gain knowledge of any particular subject. Study is a gain of organizing and utilizing time and energy to reach the proposed goals. In research, study is meant to be an in depth investigation or experiment to derive conclusions by analyzing the data collected and observed from the target group or specific situations.

For the present research, study is meant to compile information about the attitudes of higher secondary students of science stream of Gujarat towards opting Mathematics group.

1.4.2 ATTITUDE:

There are different definitions of attitude. The dictionary meaning of attitude is a person’s liking or disliking of a person or a thing or a situation. But attitude is not just liking or disliking, it is caught by the behavioural pattern. A person’s response towards any action, situation or a thought is generally considered as an attitude. Allport (1980) also defines attitude as a response of an individual to any situation or an object or a person. But response of an individual is the result of organization of his experiences which can generates readiness within the respondent. This readiness directs and influences dynamically upon the response of an individual. Thus attitude is a mental state of an individual. His neural state also contributes to his readiness to response. So attitude is a state of readiness which directs dynamic response of an individual.

According to Leder (1985) an attitude predisposes a person towards action whether it is favourable or disfavourable. Rajecki (1982) is in view that attitude comprises an emotional reaction to an object. It is a behavior towards and a belief about an object. McLeod (1992) gives us the theory of attitude formation. Attitude towards an academic subject is developed through emotional reaction to the subject and transfer of attitude to a new attitude. According to Tylor (1992), formation of academic attitude is a very complex process. The social aspects, student-teacher relations, teachers and parents attitude and nature of the subject are some of the factors which influence the process.
Looking at the various definitions of attitude, three major views are found.

1. As McLeod (1992), Haladyna, Shaughnessy & Shaughnessy (1983) view, attitude is an emotional disposition towards any subject.
2. Hart (1989) believes that an attitude is not only an emotional response but it is a belief and a behavior of the respondent towards an object.
3. Daskalogianni & Simpson (2000) considers the attitude towards an academic subject as a pattern of beliefs and emotions.

As Ma and Kishor (1997) and many other researchers have proved, attitude is the most powerfully influencing variable on students’ achievement.

The examination of various definitions reveals that attitude is by and large concerned with the feeling aspect. So the emotional disposition of a student towards his academic subject affects the student’s attitude towards that particular subject.

According to Good’s ‘Dictionary of Education.’

“Attitude is readiness to react towards or against some situation, person or thing in a particular manner with love or hate or fear or resentment to a particular degree of intensity”.

In ‘The Measurement of Attitude’ Thurston (1946) writes that attitude is an effect towards an object. The effect may be either positive or negative. Attitude shows the degree of effect whether it is positive or negative.

The concept according to him denotes the sum total of man's inclinations and feelings, prudence or bias pre-concerned notions, ideas, tears, threats and conviction about any specific topics.

Guilford says, "An attitude is disposition a person has to favour or not to favour a type of social object or social action."

The examination of various definitions reveals that attitude is by and large concerned with the feeling aspect.

For the present study, the score achieved on the attitude scale will be considered as attitude of an individual.

1.4.3 HIGHER SECONDARY STUDENTS:
Students who are studying in Std. XI and XII

1.4.4 SCIENCE STREAM:
One of the three streams leading to the choice of specific careers like medical, engineering and so on.
1.4.5 GUJARAT:

Gujarat is a state in the western part of India.

1.4.6 MATHEMATICS GROUP:

Mathematics group is one of the elective Groups of subjects. This group is known as Group-A comprising Mathematics, Physics and Chemistry in the curriculum designed by Gujarat Secondary and Higher Secondary Education Board for Higher Secondary students of Science Stream.

1.4 OBJECTIVES OF THE STUDY

After identifying and clearly describing the statement with clear and operational definitions of the terms included in the problem statement, the researcher has to confine the problem by formulating research objectives for his study.

Research is an organized study of a problem which aims at finding the solution of the problem and for finding right solution of the problem, it is most important of an investigator to formulate clearly and concisely defined objectives which can direct him the path on which he has to go ahead.

Generally research objectives focus on the ways to measure the variables or to find the relationship between the variables. Research objectives display the results of the study to be achieved by the investigator at the end if the study. Thus the research objectives summarize the results of the study to be achieved by the investigator.

Objectives of the study should be in correlation with the problem statement. Research objectives are also in correlation with the research questions to be answered or the hypotheses to be tested in the study. The formulation of the research objectives is helpful to the investigator in focusing on the study without any deviation. They help him to avoid unnecessary data collection and above all the researcher can understand the problem very well with help of research objectives. The research objectives become the base of the planning to organize the study in clearly defined parts and procedures. They help the researcher to develop his research methodology including data collection, data analysis data interpretation and data utilization.

Formulating the objectives of the research study implies the broad planning and developing a framework for the study. The objectives of the research study set the guidelines for research planning. Objectives of the research study are the decisions on what and how much information should be required for solving the research problem. Objectives indicate what is to be measured in the research study, from whom and how the information is to be gathered.
An investigator should be careful while formulating the objectives for his research study. He should write the objectives of his study in a form of simple statements which should be clear and concise. The objectives are always written in the form of declarative statements in a simple language. The investigator gets guideline to investigate the variables of his study from the objectives of the study.

The present study aimed to know the attitude of the higher secondary students studying in the science stream in the schools of Gujarat towards opting mathematics group. So the objectives for conducting the research study were formulated by the investigator. The study was conducted keeping in view the following objectives.

- To construct the attitude scale to measure the attitude of the Higher secondary students towards opting Mathematics group.
- To study the attitude of higher secondary students towards opting Mathematics group.
- To study the attitude of higher secondary students towards opting Mathematics group with respect to their class.
- To study the attitude of higher secondary students towards opting Mathematics group with respect to their category.
- To study the attitude of higher secondary students towards opting Mathematics group with respect to their sex.
- To study the attitude of higher secondary students towards opting Mathematics group with respect to their area.
- To study the attitude of higher secondary students towards opting Mathematics group with respect to their achievement.

1.5 VARIABLES

A variable as its name suggests is anything whose quantity or quality varies. There are two types of variables, independent and dependent. A variable which affects the dependent variable is called independent variable over which an investigator has his control and manipulates it to see the effect on the dependent variable. Thus the variable which affects some other variable to change without changing itself is an independent variable. While the variable which accepts the effect of some other variable that is independent variable and goes on changing itself is called a dependent variable.

For the present study, Mathematics is a psychological object and the purpose is to study the attitude of students towards opting Mathematics group in relation to their class,
category, sex, area and achievement. Generally attitude is related to the likes and dislikes of a person. Psychologically, it is an emotional disposition towards an object. Thus attitude is associated with one’s emotions or feelings. Such feeling can be positive or negative and sometimes there can be the degree of positivity or negativity. In this way attitude displays the favourable or disfavourable feeling towards an object. Attitude can be favorable or unfavorable (positive or negative) but the attitude depends upon several factors in a particular situation. From discussion with the experts of the field of education and psychology, it was concluded that the following factors may affect the attitude of students and therefore they should be taken into consideration for verification.

1) Class-XI and Class-XII
2) Category- Reserved and Non-reserved
3) Sex- Male, Female
4) Area- Rural and Urban where the school is situated.
5) Achievement- below 60 % and with 60 % or above 60 % achievements

Thus for the present study, attitude of the higher secondary students of science stream of the schools in Gujarat is the dependent variable and class, category, sex, area and achievement with their dichotomous levels are independent variables covered under the study.

Table 1.1 represents the various variables and their levels at which they operate throughout the study. Figure-1.1 shows the graphical presentation of the variables covered in the study.
<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Variable</th>
<th>Nature of Variable</th>
<th>No. of Levels</th>
<th>Name of Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Class</td>
<td>Independent</td>
<td>2</td>
<td>Class-XI and Class-XII</td>
</tr>
<tr>
<td>2.</td>
<td>Category</td>
<td>Independent</td>
<td>2</td>
<td>Reserved and Non-reserved</td>
</tr>
<tr>
<td>3.</td>
<td>Sex</td>
<td>Independent</td>
<td>2</td>
<td>Male, Female</td>
</tr>
<tr>
<td>4.</td>
<td>Areas</td>
<td>Independent</td>
<td>2</td>
<td>Rural, Urban</td>
</tr>
<tr>
<td>5.</td>
<td>Achievement</td>
<td>Independent</td>
<td>2</td>
<td>below 60 % and with 60 % or above 60 % achievements</td>
</tr>
<tr>
<td>6.</td>
<td>Attitude</td>
<td>Dependent</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

TABLE 1.1
VARIABLE AND THEIR LEVELS
Figure-1.1
VARIABLES IN THE STUDY
The above described variables led an investigator to formulate the following hypotheses.

### 1.6 HYPOTHESES

Hypothesis in any research study is the pre assumption of the result of the study or solution of the problem speculated by an investigator. It can be defined as an educated prediction of the result of the study which can be tested to prove the prediction. The related expressions for a hypothesis are a preliminary postulate. Any hypothesis must have three characteristics that it is specific, testable and predictive. Hypotheses are described in the form of a simple direct statement showing the relationship between two variables, or showing an effect of one variable on the other variable. The main purpose of finding such relationship or effect of the variables is to answer the research question. For this, it is important for the hypothesis to be testable as the test will prove the correlation between two variables. An investigator manipulates the dependent variable and measures it to have the test scores. Thus, it can be said that a hypothesis should also be measurable. A good hypothesis should always describe what the investigator expects to happen. It should be clear and understandable. It contains variables- independent and dependent. Above all, it should be testable and measurable.

In qualitative studies, the investigator formulates research questions instead of research objectives or hypotheses but in scientific study, the investigator has to formulate research objectives and research hypotheses. The research objectives indicate the specific goals of a research study and research hypotheses indicate the predictions involving variables and statistical tests.

A hypothesis is quite different from a theory. A theory is a dogma or principle developed to explain some aspects of nature. A theory is generated from the repeated observations and tested hypotheses while a hypothesis is a testable prediction. A theory predicts in general while a hypothesis predicts specifically. A theory is the result of tested hypothesis, while a hypothesis is an assumption to be tested. Thus hypothesis is a basic requirement to establish a theory. There are two types of hypotheses. They can be simple hypothesis or complex hypothesis, directional hypothesis or non directional hypothesis, associative hypothesis or causal hypothesis, research hypothesis or null hypothesis. When the relationship between a single independent and a single dependent variable is assumed, it is a simple hypothesis and when the relationship between more than one variables is assumed, it is a complex hypothesis. Directional hypothesis is based on theory. The hypothesis specifying expected direction of the relationship between variables is called a directional hypothesis, while a hypothesis without the stipulation of the direction of the
relationship between the variables is called a non directional hypothesis which is used when a little, contradictory or no theory is found. Associative hypothesis proposes relationships between the variables without indicating cause and effect. Here the changes in one variable effect the changes in other variable. A causal hypothesis is involved in the cause and effect between more than one variables. Here investigator manipulates the independent variable to affect one or more dependent variables. A research hypothesis is based on adequate theoretical or empirical information, while a null hypothesis is used when the investigator wants to state no relationship between two variables.

In the present study, attitude is the dependent variable while class, category, sex, area and achievement are independent variables. The investigator wanted to study the influence of the independent variables on dependent variable. Hence, the hypotheses formulated by him were categorized under simple, non directional, causal, null hypotheses. Taking the variables covered under the study into consideration, the null hypotheses formulated for the study were as below.

The following null hypotheses were formulated for the investigation.

1. There is no significant difference between the mean scores obtained by the students of class-XI and class-XII, on the attitude scale.
2. There is no significant difference between the mean scores obtained by the students of reserved category and non reserved category, on the attitude scale.
3. There is no significant difference between the mean scores obtained by the male and female students, on the attitude scale.
4. There is no significant difference between the mean scores obtained by the rural and urban students, on the attitude scale.
5. There is no significant difference between the mean scores obtained by the students with below 60 % achievements and students with 60 % or above 60 % achievements in Mathematics, on the attitude scale.

1.8 RESEARCH METHODOLOGY

Research methodology is a strategy of the research study. It describes the detailed planning of the procedure of investigation. It outlines the components and stages of the procedure and paves the way for the research to be undertaken. The methodology generally involves in selecting the suitable research method for the problem. Accordingly, selection of suitable tool to collect required data, selection of adequate sample, selection of appropriate techniques of data analysis and data interpretation also takes place.
1.8.1 RESEARCH METHOD:

For the completion of research, the selection of methods of research has its own importance. Judicial choice of method is the basis of success. Research studies adopting different methods, however, as a rule, differ significantly in their procedures. When the problem has been selected, an investigator has to study its characteristics and nature with great care. Then he has to clarify understanding of basic principles of research methodology and decide upon which type of research method his study falls so that it will be helpful in making the analysis of research process more comprehensible. Actually any research method needs observation of the situation, analyzing and describing the observed state.

According to Best, educational research has been classified into three types.

1) Historical research deals with the past facts.
2) Descriptive research describes present state, and
3) Experimental research deals with the influences of two or more variables.

The investigator conducted the present study which is called descriptive research. Descriptive research is describing the present state of situation. The present phenomenon is observed and studied. The responses or the characteristics of the target group are described in this research method. The described characteristics are generally known as categories. The situations observed and described are analyzed using appropriate statistical techniques. Frequency distribution, mean, median, standard deviations, correlations and some other statistical applications are used to derive at the conclusions.

The present study was undertaken using the survey method which is a research methodology gathering empirical data regarding certain phenomenon in a systematic way so as to interpret the data in a broader perspective for organization.

1.8.2 POPULATION AND SAMPLE:

Population means the whole group to which the researcher wants to apply his findings. For the present study, the attitude of all the science stream students of higher secondary schools of Gujarat state towards opting mathematics was the population for the research study.

Sampling is a technique of selecting a representative group from the population. The results found from the sample can be inferred for the whole population. Sampling helps the researcher to save his time and energy by testing the part of the whole population. The statistical information whether it is qualitative or quantitative, can be derived from the small part of a population. Sampling is a scientific way of selecting units to collect data required for investigation.
There are various sampling techniques. The investigator selected 300 higher secondary students of Science Stream from the total population of the students of science stream of Higher Secondary Schools of Gujarat on stratified random selection bases as the target group of the study.

The present study covers the students of the science stream of higher secondary schools of Gujarat state. So a stratified sampling technique was the most desirable technique for this investigation. In this sampling method, the researcher has to divide the whole population into various small bits. The whole group of population is divided into small subgroups. Then from each subgroup, the units or members are selected in proportion of the group. The investigator uses stratified sampling techniques when the population consist variety of traits and the investigator wants to select a target group representing some specific traits. For his investigation, the researcher divided all the higher secondary schools district wise and then proportionately selected 300 students on random selection bases.

Thus for the present study, a stratified random sampling technique was adopted. To have as big a sample as one can, is desirable for better norms. But the representative sample should not be too large. Representative sample should be carefully determined. There are methods of sampling procedure. For the present study the stratified sampling method has been adopted.

According to Garrett, Stratified random sampling is a technique designed to ensure representativeness and avoid bias by use of a modified random sampling method. According to this idea of sampling by stratification it was decided to administer scale in practically all the parts of Gujarat state. This stratification is relatively homogenous for common spoken language is Gujarati; hence, sampling within the strata was random so that every individual in the strata had equal chance of being chosen. The following variables were considered at the time of selecting the sample.

1) Class-XI and Class-XII
2) Category- Reserved and Non-reserved
3) Sex- Male, Female
4) Area- Rural and Urban where the school is situated.
5) Achievement- below 60 % and with 60 % or above 60 % achievements

For the selection of the representative sample, the investigator had decided to cover most of the parts of Gujarat state.
1.8.3 TOOLS:

Data collection is the important stage in any type of research study. For data collection the selection of an appropriate tool needs a great care and thoughtfulness. The information required for the investigation can be collected through various sources. Data necessary for the study should be relevant to the research problem and also enough in quantity and adequate in quality. The information collected should have the quality of reliability, validity and sufficiency.

There are various devices for collecting required data. Such devices are known as research tools or research instruments. The instruments, appliances or apparatus used for collecting required data should be selected according to the nature of the information and objectives of the research study. The selected tool should be suitable for gathering suitable information to fulfill the requirement of the objectives of the study. For the fulfillment of more than one objective, the investigator may use more than one research tools to collect the various types of information required for the investigation.

There are different types of research tools to collect different types of information. There are inquiry forms like questionnaire, checklist, score card, schedule sheet, rating scale, opinionnaire, attitude scale and others. Some other type of information requires techniques like observation, interview, sociometry and so on. Some more specific psychological traits can be known using psychological tests like achievement test, aptitude test, intelligence test, interest inventory, personality test etc.. The investigator should have the knowledge of all research tools, their nature and advantages and their limitations. Sometimes the researcher does not find any suitable tool which can be suitable to collect information necessary for his study. When any readymade appropriate tool is not available, at that time the researcher needs to construct a suitable tool himself. Thus the investigator should have the knowledge of constructing and administrating the research tool successfully and effectively.

In the study of attitude, several tools can be used, e.g. direct questioning, direct observation, questionnaire and attitude scale. The tool which is usually used by the researchers to measure attitude is attitude scale. To measure attitude of higher secondary students towards opting Mathematics group, a readymade tool is not available. Hence, the investigator constructed the attitude scale for assessing the attitudes of higher secondary students towards opting Mathematics group.

The investigator, for his present study, could not find the readymade tool to gather necessary information. He had to measure attitude of the higher secondary students towards opting mathematics group of subjects. For this he needed attitude scale which can measure
students’ attitude towards opting mathematics group in science stream of higher secondary schools. So the investigator decided to construct the tool himself. For the present research study, the researcher used the attitude scale constructed on the bases of the theory of Likert.

A Likert type Attitude Scale is generally selected by the researchers. Most commonly in survey researches, Likert type attitude scale is more suitable to collect specific data. It is a psychometric scale consisting statements related to the inquiry topic or variable.

For the present study, the five point Likert type scale was constructed by the researcher and used for the purpose of collecting required data for the study.

1.8.4 STATISTICAL TECHNIQUES:

Data analysis is an important stage of the process of research. After data collection is completed successfully, data analysis process starts. The process of analyzing the data involves three main activities- organizing the data, describing the data and interpreting the data. If someone wants choose clothes to wear, before making his right choice, he collects some information about what the weather forecast is, which clothes are cleaned and which are dirty, what is the occasion you are going to attend, and above all your colour choice, feeling of being comfortable in certain clothes and many such questions’ answer will provide you data to help you in making right choice. Similarly in research studies, an investigator tries to seek answers of his research questions by gathering information related to the problem. He evaluates the collected information to reach at the final judgment. Analysis of data is a process of organizing and inspecting information. In quantitative research, it is a process of quantifying the information to derive the conclusions applying statistical techniques. The process of data analysis also involves cleaning, transforming and modeling data with a view to testing hypotheses to find the results. By interpreting the data, the investigator can make decision about the solution of the problem.

There are various ways and means of data analysis. Many statistical techniques have been sought for data analysis and data interpretation. Computer assisted techniques are also widely used in analyzing the collected data. Different techniques are used in the research studies of different disciplines. By analyzing and interpreting the data, an investigator tries to develop evidence to answer a research question of his study.

There are various techniques of data analysis. The data mining technique of data analysis is based on modeling. The finding of truth here aims at predicting the future consequences. Various statistical techniques are there to be applied for data analysis. According to the purpose of the research study, data analysis techniques of statistics are to be applied. And as such two types of data analysis can be used to arrive at the results. These two
types of data analysis are exploratory data analysis and confirmatory data analysis. Exploratory data analysis deals with the sample data only and explores the results gained from the data analysis of the sample scores, and also the results are applied to the sample only, they cannot be generalized for the whole population. While confirmatory data analysis is used to accept or reject the hypotheses of the study. An investigator can use statistical or structural models for predictive analytics. He can use text analytics for qualitative research studies. The text analytics apply statistical, linguistic and structural techniques to analyze the textual information. The process of data analysis also involve in synthesizing or integrating data. Visualization of data and dissemination of data are also included in the process of data analysis. That is why the term data analysis is substituted by the term data modeling.

All the statistical techniques can be whether parametric or non parametric. The technique in which the population is completely known by the means of its parameters, that statistical technique is called a parametric statistical technique such as t-test, f-test, z-test, ANOVA. The technique in which the population is not completely known by the means of parameters, that kind of statistical technique is called non parametric statistical technique. In parametric test, the information about population is completely known, while in non parametric test, information about population is not available. In the parametric type of testing, specific assumptions are made regarding the population, while in non parametric test, no assumptions are made regarding the population. In parametric testing, the formulation of null hypothesis is based on parameters, while in non parametric testing; the null hypothesis is free from parameters. In parametric testing, test statistic is based on the distribution, while in non parametric testing, test statistic is not based on the distribution but instead it is arbitrary. Parametric test is applicable only for variable, while non parametric test is applicable to variable as well as attributes. Parametric test is used for nominal data analysis, while non parametric test is used for nominal data as well as ordinal scale data. However, parametric testing is more powerful than non parametric testing. In parametric testing, mean and variance are the commonly used techniques for a small sample test and mean and proportions are the techniques for a large sample test. Non parametric methods of testing hypothesis are not so effective as those of parametric methods. If an investigator wants to test the interaction in the analysis of variance model, he will have to use parametric statistics as there is no non parametric test which he can use for this purpose.

Present study had adopted descriptive statistics for data analysis and interpretation. Descriptive statistics employ the quantitative description of the qualities of collected data.
In research methodology, there are two types of statistics applied to the data analysis processes. They are known as descriptive statistics and inferential statistics. If the investigator wants to explore the results of selected sample of the study and confine their applications to the sample itself only, he uses descriptive statistical techniques for analyzing his data. The inferential statistics is also known as inductive statistics. If the investigator wants to generalize his results applying them to the entire population of the research study, he uses inferential statistics. The techniques of descriptive statistics are not based on the theory of probability while the techniques of inferential statistics are based on the theory of probability. However, the descriptive statistics are presented while using inferential statistics for drawing the conclusions by analyzing data.

The statistical techniques such as measures of central tendency like mean, median and mode, the measures of dispersion like standard deviation, kurtosis and skewness are common in descriptive statistics. Descriptive statistics describes the observations made about the sample. Descriptive statistics provides quantitative summaries in the form of text or graph. The initial results of the descriptive statistics may pave the way towards more extensive statistical analysis. In a recent time descriptive data analysis techniques are known as exploratory data analysis techniques.

The investigator used the descriptive parametric statistical techniques to analyze the data. The following statistics was used in data analysis:

1. The collected data were presented using frequency distribution in the form of tables and graphs.
2. The parametric statistical techniques of mean and standard deviation were used in order to describe the characteristics of information of samples.
3. The mean differences between the two levels of the variables were calculated through applying mean, standard deviation, and t-test as statistical techniques.
4. The significant differences were tested by post hoc test with LSD (Least Significant Deviation).

1.9 LIMITATIONS OF THE STUDY

Research is a vast and endless process that cannot be completed by an investigator in a précised time limit. Besides, there are some factors and situations that cannot be controlled by him. Every research study is a small part of the continuous the everlasting process of research. Hence, it is necessary for an investigator to limit and delimit his study. Limitations and delimitations in research study are the influences and restrictions that may affect the
procedure and the results of the study. Limitations are the situations over which a researcher has no control, while delimitations are the situations which are controlled by an investigator at his own choice. The uncontrolled situations place restrictions on the procedure of the research study. They influence on the methodology, analysis of the data and conclusions of the observations. Such limitations may include limitation of the sampling techniques, limitations of statistical techniques, nature of analysis and self reporting, limitations of the research tool used for the purpose of data collection, and the time limit of the study. Sometimes the investigator cannot generalize his results to the entire population. The investigator has to think about and mention such limitations of his study to the readers. Delimitations are the limitations accepted by the researcher at his own choice. Delimitations describe the boundaries set by the researcher himself for his study. As for example, the researcher does not want to review some literature, does not want to study some population or does not want to adopt some methodology, he has to mention these delimitations in his research report and explain them to the readers. The researcher should limit his delimitations to define the parameters of his research study. In the present study the delimitations are regarding sampling technique, statistical techniques and use of the research tool.

It is necessary for the investigator to keep the limitations of the research in mind for doing research in the right way and getting proper results. The present study was delimited regarding area, type of school, medium of instruction and specificity of the sample. They are as under:

1. The present study was limited only to Gujarat State.
2. It was limited only to Gujarati medium schools.
3. It was limited only to higher secondary schools.
4. Although the focus of the study is on selected sample from Gujarati medium science stream of higher secondary schools of Gujarat state only, the findings of the study cannot be generalized for the students of other streams in Gujarat and higher secondary schools of any other state of the country.

1.10 SCHEME OF CHAPTERIZATION

The entire report of present study is divided into five chapters.

The first chapter is devoted to the introduction of the study. It discussed the area of the research problem, the selection of the problem and identifying the problem to be solved undertaking the research study. The introduction has been followed by the justification of the research study by stating the importance of the present study. The formulation of the
statement of the research problem followed by the definitions of the terms covered in the title. From the statement of the problem, the research objectives have been generated. The variables covered under study have been clarified and listed. Looking at the variables, the null hypotheses have been formulated to be tested through this research study. The discussion of the research methodology covered the description of the selected research method, sampling technique, selection of research tools for data collection and statistical techniques adopted for data analysis and data interpretation have been described. The limitations of the study have also been shown to confine the study. At last, the scheme of chapterization in the research report has been shown in the first chapter. Thus the first chapter introduces the problem, describes the need and importance of the study. The first chapter also covers the discussion of the concept of key words and the objectives, variables, hypotheses, limitations and scheme of chapterization.

The second chapter deals with the review of the past studies undertaken in the area which has both direct and indirect bearing upon the measurement of attitude of the students. It covers introduction to the chapter, importance of the review of literature, research background for the theoretical development, research studies carried out in this field in abroad and in India and rational of the present study.

The third chapter presents planning and procedure of the study. It includes the introduction to the chapter, method of research, tools used in the study, detailed description of the procedure of the construction of the attitude scale, scoring key, scale norms, selection of the sample and sampling technique, sample size, data collection method, data analysis method. The whole planning of the research procedure is described detail in this chapter.

In the forth chapter, statistical analysis has been done of collected data on attitude scale. Statistical analysis of attitude of higher secondary students has been given in this chapter. The chapters covers the description of the procedure of data analysis, frequency distribution of data, class difference of students, category difference of students, sex difference of students, area difference of students, achievement difference of students. The data collected are distributed in frequencies and in the form of tables and graphs and also described in text form.

In the fifth chapter includes introduction to the chapter, summery, general observations, statistical observations, conclusions, implications of the study and suggestions for further research. At the end of the report, references and appendices have been listed.