



## Factors Affecting the Achievement of Students in Mathematics

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### **Abstract**

*The program offered at the secondary level (specially in class 9 and 10) of Nepal requires the completion of mathematics courses. To go to science and technology subjects in class 11 and 12 as well as in university level, the students should succeed in the class 10 examination (SEE) in mathematics so that this will provide the pathway for them to be succeed in the study of university level. This research aims to investigate the factors affecting the achievement of students in mathematics at secondary level. For acquiring this aim, this study has used qualitative research method for completing the entire work. The primary data for this study was collected through focus group discussion with mathematics teachers and head teachers. All secondary schools in Nepal were considered as the population of the study and selected four districts viz Chitwan, Gorkha, Makawanpur and Parsa as the first stage of sampling. In the second stage, secondary level mathematics teachers of Chitwan, Gorkha, Makawanpur and Parsa districts were taken as sampling population. Eight groups of mathematics teachers consisting of two groups from each district and two group of head teachers from Chitwan district chosen using purposive sampling method were sample for this study. The collected information was analyzed using constant comparison method of data analysis. The results of the study showed that teachers beliefs solely not responsible for the students' achievement in mathematics, but integrated effects of variables such as students' factors, teachers' factors, system factors, environmental and societal factors were the causes for the low achievements of students in SLC/SEE.*

**Keywords:** Students' achievement; mathematics teachers; teaching mathematics; affecting factors

### **Introduction**

Mathematics is the basis and foundation for every field of study in the global context of the 21<sup>st</sup> century. The study, development, and extension of scientific knowledge in all sectors are not possible without mathematical knowledge and skills. The prime concern of every education system is to improve student's learning and achievement. Mathematical competency performed by the students in mathematics is known as mathematical achievement. Several attempts are made at the policy and program level for the improved mathematical achievement in the country. The government of Nepal with the commitment of improvement in students' mathematics learning and achievement has brought intervention at policy and program through the National Curriculum Framework (2007, 2019), implementation of the grading system in evaluation, School Sector

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Development Plan -2016/23 (SSDP-2016/23), School Sector Reform Plan (2009/15) and many other international collaborative initiatives. School students' achievement in mathematics has not been improved despite several interventions to teachers' training, curriculum improvement, testing, and other occasional supports of need-based training and workshops to the teachers. About 49.3 % of students in the year 2079 SEE examination were found under GPA 2.4 (Setopati,2023). This indicates that there is sufficient effort on input level, but problems might be at process level particularly on the implementation of the curriculum and this goes to the responsibility of the teachers and school. There are several factors listed in research that can impact on students' learning and achievement. Teachers' understanding and beliefs towards mathematics and mathematics teaching learning may play an important role in the process, and this will impact on the output i.e., in achieving students' learning outcomes.

Several studies have been conducted in Nepal to find out what factors impact on students' achievement. The school type, local government type, nature of examination, and age & ethnicity of students make a significant difference in student achievement whereas gender does not (Chapagain, 2021 p22). Different research (Chapagain, 2021; Duwal & Khonju, 2020) have established different factors associated with students' achievement in mathematics but have not rightly pointed out how teachers' beliefs work in students' achievement. Teaching method and students' attendance have a great impact on students' achievement but gender, age, faculty, study year and guardian occupation do not have impact on students' achievement (Duwal & Khonju, 2020). The discussion of conceptual and empirical research about students' achievement gives some issues, which must be researched in the context of Nepal to add knowledge to initiate improvement in teacher education and classroom practices. The issue focused on in this study is affecting factors students' achievement in mathematics at the secondary level.

The main aim of this study is to provide the information to concern authorities and stakeholders regarding factors affecting the mathematical achievement of the secondary level students in the context of Nepal. The objectives of the study are:

- i. To identify the factors affecting secondary level students' mathematical achievement in Nepal.
- ii. To categorize the factors affecting the mathematical achievement of secondary level students.

### **Theoretical Framework**

The General Systems theory (GST) which was proposed by the biologist Ludwig von Bertalanffy in 1940 and further explained by Ross Ashby (1964) is the main theory used in this study. According to this theory, the characteristics of the whole system cannot be explained by explaining the characteristics of their parts in isolated form (Bertalanffy, 1968). This theory is

taken to fulfill the objectives of this research because as it identifies not only the different affecting factors (inputs) of students' achievements (outputs), but it gives emphasize on interactions and interrelationship among the different affecting factors, and their combine effect on the achievement of the students. The General Systems theory thinks from whole-to-part as well as part-to-whole to establish interrelationship among the various factors of the whole to understand the phenomena.

### **Research Methodology**

The constant comparative method of qualitative research was applied for completing the study in a systematic manner. There are five interrelated, but not linear steps are followed in qualitative research: identify participants and sites, gain access to these individuals and sites by obtaining permissions, decide types of information that answer the research questions, design protocols or instruments for collecting and recording the information, and finally administer them for the data collection (Creswell, 2013). This study has followed the above-mentioned sequence for qualitative design. The constant comparison analysis method (Leech & Onwuegbuzie, 2007, 2008) was used for completing the research. This study was based on secondary level mathematics teachers. So, the total number of secondary level mathematics teachers of Nepal was considered as a target population.

The non-probability sampling method is more suitable than the probability sampling procedure when the research is qualitative (Gupta, 2005; Best & Kahn, 2006; Cohen, Manion & Morrison, 2010). Topographically, Nepal is divided into Mountainous region, Hilly region, and Terai region. The convenience sampling method is the best method for selecting sample from the population among the different methods of non-probability sampling when the researcher wants to take the information from easy way and maintain the desirability of the study (Cohen, Manion & Morrison, 2010; Gupta, 2005). To represent the target population, it is necessary to consider topographical variability as a frame for drawing samples. Therefore, Chitwan, Parsa, Makwanapur and Gorkha districts were selected in the first stage by using convenience sampling, as the field of study. All the head teachers and the mathematics teachers of these districts were considered as sampling population for the study.

The purposive sampling method is the best method for selecting a sample from the population among the different methods of non-probability sampling when the researcher must find solution of certain issues and fulfill the purposes of the study (Cohen, Manion & Morrison, 2010; Gupta, 2005). Two groups of mathematics teachers from the Chitwan district, two groups of mathematics teachers from the Makawanpur district, two groups of mathematics from the Gorkha district, and two groups of mathematics from the Parsa district were selected schools by using purposive sampling method representing the rural and urban areas of these districts. Thus, these eight groups of mathematics teachers were considered as a sample for this study. The

convenience sampling method is also the suitable method for selecting sample from the population among the different methods of non-probability sampling when the researcher wants to obtain the supplement information of the qualitative study (Cohen, Manion & Morrison, 2010; Gupta, 2005). Two groups of Head Teachers/Principals from Chitwan districts were selected by using convenience-sampling procedure representing the rural and urban areas. Therefore, these two groups of Head Teachers were also the sample for this study. To gather the information from the informants, two focused group discussions (FGD) were used. The first was for eight groups of mathematics teachers and second FGD was for Head Teachers to determine the causes of low achievements of students in SLC/SEE examination from their viewpoint. Two types of FGD were used to compare the affecting factors of students' achievements from different perspectives.

Research instruments of qualitative research cannot be validated by using the methods (Content, Criterion related and Construct) used in quantitative research (Creswell & Miller, 2000). Multiple approaches should be used for enhancing the researcher's ability and to assess the accuracy of findings as well as convince readers of that accuracy (Creswell & Miller, 2000). Therefore, this research used triangulation and external auditor procedures for establishing validity and reliability in its qualitative aspect. The data obtained from the FGD were discussed with the two college level teachers having at least M. Phil degree and two mathematics teachers having at least master's degree and 20 years of teaching experience for external auditor of validating. In data collection, I used the focused group discussion of selected mathematics teachers. Two focused group discussions were conducted in each district for two groups of mathematics teachers in those districts. I also used focused group discussion for two groups of Head teachers in Chitwan district. The name of groups, name of districts, number of participants presented, FGD conducted time, and date were mentioned in the following table.

Table 1

*Participators presented in focused group discussions.*

S. No	The name of groups	Name of districts	FGD date	FGD time	Number of participants	Remarks
1	CH T1	Chitwan	Sept 1, 2018	10:00-11:30	8	Math Teachers
2	CH T2	Chitwan	Sept 1, 2018	3:00-4:30	7	Math Teachers
3	GO T1	Gorkha	Sept 29, 2018	11:00-12:30	6	Math Teachers
4	GO T2	Gorkha	Sept 29, 2018	11:00-12:30	6	Math Teachers
5	MA T1	Makawanpur	Sept 15, 2018	10:30-12:00	8	Math Teachers
6	MA T2	Makawanpur	Sept 15, 2018	2:00-3:30	9	Math Teachers
7	PA T1	Parsa	Sept 22, 2018	10:00-11:30	6	Math Teachers

8	PA T2	Parsa	Sept 22, 2018	2:00-4:30	7	Math Teachers
9	CH H1	Chitwan	Sept 8, 2018	10:00-11:30	6	Head Teachers
10	CH H2	Chitwan	Sept 8, 2018	3:00-4:30	8	Head Teachers

From table 3.1, the FGDs are conducted ten times for this study. The first FGD was for teachers of eight groups representing two groups for each district. The second FGD was for head teachers of two groups representing from Chitwan district. The FGDs were conducted as scheduled above table.

### **Data Analysis of the Study**

The constant comparison analysis method of qualitative data analysis was used to investigate the affecting factors of students' achievements, which were originally developed by Glaser and Strauss (Glaser and Strauss, 2006). According to Leech and Onwuegbuzie (2008) there are seventeen methods of qualitative data analysis. Among them, the constant comparison analysis method is one of the suitable methods for analyzing the qualitative data got from focused group discussion. Initially, this method was used for grounded theory. The credit goes to Leech and Onwuegbuzie (2007) for using this method in other types of data analysis, including the constant comparison analysis method. There are three phases (open coding, axial coding and selective coding) of constant comparison analysis. It uses coding in data analysis and generates the theory with a clear visual picture (Creswell, 2011).

For identifying the underpinning factors for low achievement of students in SLC/SEE level, first, I used the information collected from FGD for mathematics teachers, FGD for Head teachers and formed initial categories for different underpinning factors which is open coding (Creswell, 2011) of the data analysis. I stated the sources of the information which support the categories of underpinning factors. Secondly, I used axial coding (Creswell, 2011) of open coding. For axial coding, I re-categorized the initial categories from the most influencing factors for low achievement of students in SLC level to the least influential factors. I also compared these categories with different theories and philosophies of students' achievement. Thirdly, I used selective coding (Creswell, 2011). In this process, I explained the different abstract processes which were used in the research process and developed a theory from the interrelationship of the categories in the axial coding model.

Mathematical anxiety related factors were aroused in most of the discussion process. "The thinking of students about mathematics is negative and they think mathematics is difficult subject" (FGD, MA T6). Mathematics teachers and Head teachers said that the main causes of students' mathematical achievement in SLC/SEE were mathematical anxiety, exam phobia from the lower level, students' negative attitude and behavior towards teachers and learning. They explained that few students were interested in active participation in presentation and problem solving. They

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further elaborated that students' lack of self-confidence and interest, difference in students' ability, students' absenteeism, unhealthy competition among peers for obtaining high scores, lack of regular and meaningful learning/practice of students were the factors which created obstacles for obtaining high scores. So, Students Related Factors (Thinking and Attitude of Students; Knowledge of Students; and Participation of students) are one of the reasons for low achievements of students in SLC/SEE.

Head teachers focused on teacher related factors that were the causes of low achievements of students. One head teacher added, "Some teachers have low level of mathematical knowledge and teachers are confused with choosing appropriate materials for specific content." (FGD, CH H1). Mathematics teachers partially accepted the teachers' related factors. They said that there were new mathematical contents, no proper training programs organized for these contents. So, the traditional and untrained teachers had lack of content knowledge and innovative techniques. "There is no culture of research for the improvement of the achievement of the students in schools" (FGD, PA T7). Mathematics teachers and head teachers also accepted that schools and teachers had no proper plan for the improvement of students. Teachers taught without any instructional planning, and they were engaging in different activities like side business and politics. So, mathematics teaching was ineffective, and teachers were unable to provide sufficient support to the needy students in terms of extra time, feedback and assisting. The discussion focused on these things as the causes of low achievement of students. Teachers responded, "We have to enroll students in grade six who come from seven different primary level schools, there are not subject specific teachers in the primary level of Nepal, mathematics is taught by nonmathematical background teachers and more than 50% of students are come without basic mathematical knowledge" (FGD, CH T4). Other teachers in this discussion extended, "Nonmathematical background teacher teaches mathematics up to class eight in my school, I am only mathematical background teacher and students come in class nine have very poor mathematical knowledge, in such situation how can I improve their mathematical knowledge and make them securing high scores in SEE?" (FGD, CH T6). Head teachers accepted the fact and said that they had no authority of recruiting teachers, they had only authority of managing the available teachers for teaching. So, using nonmathematical background in Basic Level, using below bachelor's level teachers for teaching mathematics in the secondary level (in case of some school) were also played vital role in low achievements of students in the secondary level. They also said that if teachers' beliefs and attitude towards mathematics and its teaching were not positive, it would decrease the achievements of students. So, Teachers Related Factors (Knowledge of Teachers; Activities of Teachers; Quality of the Teachers; and Beliefs of Teachers) influenced the achievement of students in SLC/SEE.

“The course of mathematics is very long, and the common students are unable to remember the mathematical content for long time.” (FGD, GO T3). Head teachers and mathematics teachers also expressed that the length of the overload content in mathematics curriculum and available time based on the length of the content was not sufficient. So, completing the course on time was difficult. “There are uncontrolled and unauthentic practice books and questions sets in the market and the questioning pattern of SLC/SEE also has focused on these books which create the pressure to students, and they are unable to obtain the desire achievement.” (FGD, CH T1). This means that rote learning is promoted rather than meaningful learning. Drill practice was the way of learning mathematics. If the practice case is asked in the examination, students give correct answer, in case of creative solution expected questions students cannot do correctly. The mathematical contents included in the secondary level of curriculum were high for medium level and low-level students and there is lack of motivational program for these students. These factors were the causes of students’ low mathematical achievement. One mathematics teacher questioned, “Is three hours examination system sufficient to determine the achievement of the students in mathematics?” (FGD, CH T2). Teachers complained that there was not a practical and regular evaluation system applied in mathematics. There was variation of difficulties of test questions in different years of SLC/SEE, monopoly of so-called senior teachers and authority in examination and questions of SLC/SEE focused on specific practice book and textbook but not in syllabus and specification grid were also the causes of low achievement of students. The mathematics teachers and head teachers said that most of the students were not interested in learning mathematics after grading system used in SLC/SEE because they were not interested in extending their higher study in mathematics and mathematics related subjects. They accepted that the lack of regular supervision, facilitation and feedback system used in secondary level, teacher training program relevance and change in recruitment system of mathematics teachers (provisional authorization of untrained as eligible for teaching mathematics, sciences and English) in Nepal also influenced student’s achievement. So, System Related Factors (Curriculum system and Its Materials; Evaluation System; and Thinking of Authority) is another cause of low achievement of students in SLC/SEE.

The learning environment and the overall enabling condition in school differ. Factors affecting students differ by specific school conditions. There are no generalized factors, context specific factors are impacting students learning and achievement. One of the teachers in Parsa said, “There are high numbers of students in a class and the environment is not supportive to teach mathematics” (FGD, PA T8). The head teachers and mathematics teachers accepted that the available situations of the schools, high number of students in a class, traditional teaching culture and unmanageable extra of the school, pressure of parents, society, and school to the students for obtaining more scores and political influences on school were also responsible for low achievement of students in the secondary level. Mathematics teachers said that society and teachers

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made the higher percentage or GPA was taken as issues of prestige. They said that the parents and society's members flowed positive statements towards mathematics learning to the students which conveyed negative message in their mind. According to them, parents said to their children that mathematics is a difficult subject, and you must learn it much harder. This created mathematical anxiety in the mind of students towards mathematics and slowly they felt inferiority which caused low achievement in mathematics. So, environment and society related factors (school's internal environment; external environment; and society and its attitude towards school) are final factors of low achievement in mathematics.

### **Discussion and Finding**

Kang and Keinonen (2018) has concluded that student's behaviour, self-motivation and attitudes as well as time management are the main affecting factors which are responsible for students' achievement. The results from the discussion in this study inform us that the mathematics teachers have common consensus about the thinking and attitude of students towards mathematics and teachers, knowledge of students and participation of students affect the achievements of students in SLC/SEE. The study related to students' achievement concludes that the students' mathematical knowledge and ability (Pietsch, Walker, & Chapman, 2003; Williams & Williams, 2010), student personal attitudes towards mathematics (Raheem, 2015; Mensah, Okyere & Kuranchie, 2013; Cheung, 1988; Hannula, 2002), mathematics anxiety of students (Raheem, 2015; Siebers, 2015; Pourmoslemi, Erfani, & Firoozfar, 2013; Zakaria & Nordin, 2008) affect the students' performance and achievement. So, students themselves are responsible for their achievements, but motivating and preparing students for learning is the major responsibility of the teacher.

Different studies related to students' achievements have concluded with empirical evidence that there is positive relationship between teacher factor and achievements of the students (Vizeshfar & Torabizadeh, 2018). In the discussion process, mathematics teachers and head teachers accept that the knowledge of teachers, activities of teachers, quality of the teachers and beliefs of teachers have great influence on achievement of students in SLC/SEE. Teachers' related factors affect the students' achievement (Hill & Rowe, 1998).

The discussion concludes that curriculum and its materials, evaluation system and traditional thinking of authority are the causes of low achievement of students in SLC/SEE. "The design and development of the curricula program in a school plays a critical role in students' learning experiences" (Luciano, 2014, P 11). Attewall and Domina (2008) concluded that over the years, policy makers who are responsible for developing the curricula and reforming the content of courses in schools affect the achievement of the students. These causes are the new affecting factors in achievement of the students in the context of Nepal.



The discussion draws common consensus that school's internal environment is responsible for students' performance in the classroom and ultimate the achievement of the students. The classroom climate and other environment inside the school affect the achievement of the students (Ali, Elnour, & Mousa, 2016; Raheem, 2015). If the school administration and teachers have positive thinking and attitude towards school and teaching it positively effect on school performance and students' achievement (Caldwell, & Millikan, 2018; Hitt & Tucker, 2016). The discussions also derive the common theme that the external environment of school, parent's thinking about their children's education and attitude of society towards also have indirect impact in the achievement in mathematics in Nepal. The environment of home and society of the student (Ali, Elnour, & Mousa, 2016; Raheem, 2015; Ogbeide, Odiase & Omofuma, 2013), parental involvement (Levpuscek & Zupancic, 2009; Vukovic, Roberts, & Wright, 2013) for students learning and peer group (Berndt & Keefe, 1995; Wentzel, 1999) have great influence in his achievement and performance in school. After analyzing the data, the following findings have been drawn.

Students-related factors which include thinking and attitude of students, knowledge of students and participation of students in learning collectively show the enthusiasm of students towards learning. This factor affects the achievements of students in SLC/SEE. knowledge of teachers, activities of teachers, quality of the teachers and beliefs of teachers interact in the mental structure of a teacher and made the plan for developing teaching learning environment which directly influence the achievement of students in SLC/SEE. System related factors i.e., curriculum system and its materials, evaluation system and thinking of authority was another cause of low achievement of students in SLC/SEE. Environment and society related factors i.e., school's internal environment, external environment, and attitude of society towards school were also responsible factors of low achievement in mathematics.

The students related factors, the teacher related factors, the system related factors and the environment and society related factors are responsible for the low achievement of the students in SEE/SLC. These factors do not impact on the learning of students in isolated form but interact with each other based on the situation and show combined effect on the achievement of the students (Bertalanffy, 1968).

### **Conclusion**

This study was conducted to find out the affecting factors of students' achievements. The low achievement of students are the interactive outputs of the different factors. Student-related factors, teacher-related factors, system-related factors, and environment and society-related factors are the four categories which interact with each other and influence the achievement of the students. These factors do not influence the learning environment in isolation; rather, the

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interactions are made among them and influence one another and the achievement of students too. The policymakers, educators, teachers, and other concerned stakeholders must understand the multifarious nature of these factors. The concerned authorities must comprehensively address and collaboratively use these factors to create interactive and suitable learning environment for students and increase the achievement of the students ultimately develop more equitable and effective educational system. All members of society must take the responsibility to create suitable learning environments where every student can reach their full potential. It is a shared responsibility to create an environment where every student can reach their full potential, nevertheless of the obstacles created by these factors.

### **Implications**

The students' low achievement is shown due to the combined effect of factors related to students, teachers, the educational system, and the broader environment and society. The results of the study have indicated different implications in the field of education and academic system:

- i. The educators and policymakers should use comprehensive efforts to address all contributing factors by adopting a holistic approach to education for improvement of the education system.
- ii. The teachers can enhance their ability by investing in continuous professional development and use differentiated and personalized teaching methods by focusing on diversity of the students which can address the unique needs and strengths of the students.
- iii. The policymaker and curriculum developer can review and revise the policy and curriculum to align with the changing needs of students and society by incorporating innovative technologies and approaches.
- iv. Educators, policymakers, curriculum developers, psychologists, sociologists, and other experts can use collaborative interdisciplinary efforts to deal with these multifaceted challenges by focusing on comprehensive and innovative approach for improving the achievement.

Different factors which are responsible for the low achievement of the students imply that there need to be collaborative and comprehensive approaches in education sectors. Educators and academicians, who want to improve the educational outcomes by creating interactive and suitable learning environment and develop effective educational system for all students, should address these affecting factors collectively and strategically.

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