

**EXPLORING THE PERFORMANCE OF GRADE XI STUDENTS IN
CALCULUS-BASED TASKS**

**A
THESIS
BY
DROPATI JOSHI**

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Letter of Approval

This thesis submitted by **Mrs. Dropati Joshi** entitled on **Exploring the Performance of Grade XI Students in Calculus-Based Tasks** has been approved as for the partial fulfillment for the requirement of Master's Degree in Mathematics Education.

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Recommendation for Acceptance

This is to certify that **Mrs. Dropati Joshi**, has completed his thesis entitled **Exploring the Performance of Grade XI Students in Calculus-Based Tasks** under my supervision during the period prescribed by the rules and regulation of Tribhuvan University, Nepal. The study embodies the result of investigation conducting during the period of 2018-2019 under the Department of Mathematics Education, University Campus, Tribhuvan University, Kirtipur, Kathmandu. I recommend and forward her thesis to the Department of Mathematics Education for the final viva-voce.

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Defense Date: April, 2019

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Declaration

I hereby declare that this thesis is my original work. It contains no material which has been accepted for the award of other degree in any institutions. To the best of my knowledge and belief, this thesis contains no material previously published by any authors due acknowledgement has been made.

.....

(Dropati Joshi)

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As with the most things in life, even though it is my name on the cover, this is far from a solitary project. I would like to begin by thanking Tribhuvan University for giving me the wonderful opportunity to study here. The experiences I had in Tribhuvan University helped me both academically and personally. I grew so much during this period of my life that I will always look back on it all with the fondest of memories.

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Abstract

This study attempts to explore the performance of grade XI students in tasks involving calculus, especially application of differential calculus. The study aims to analyze the performance of secondary level students on calculus-based tasks and to explain the causes of achieving that level of performance by them. The research is conducted among 104 students in different nine secondary level schools of Baitadi district in Nepal. This research uses embedded design. The study uses interview and achievement test as its research tools of data collection. The research analyzes data obtained from achievement test with the help of mean, standard deviation and variance. In addition to this, raw data obtained from interview is coded and it is categorized into certain model then data is given certain themes. Cross match is adopted to maintain the credibility, trustworthiness and reliability of the data obtained from the interview. Related literatures, theories and concepts which are relevant to this study have been used to interpret and made reflection over the analyzed information.

The study shows that students' performance in mathematics especially in calculus is affected by nature of curriculum, students' attitude towards mathematics, their prior knowledge, tuition time they take, peer interaction, school environment, parental involvement and, teachers' attitude towards mathematics and students. Students in Baitadi district have low performance in calculus based tasks because of the lack of conceptual knowledge, lack of factorization skill, wrong substitution of the value and calculation error. This study is important for curriculum designers, parents, teachers and students as it presents the reasons for secondary level students' low performance in calculus-based tasks and suggests some ways to improve their performance in the same area.

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Chapter I

Introduction

Background of the Study

Mathematics is one of the core curriculum subjects taught in all schools in Nepal, from grade I to XII. Generally, learning mathematics is not fun for the majority of learners as they find it difficult to master. Kaufman (2015) said that students have unsatisfactory performance in mathematics especially in calculus compared to other subjects. Their condition is pathetic in calculus based tasks. This is because the mathematics curriculum contains specialized knowledge which requires analytical and logical thinking. As a result, a large number of learners choose to take theoretical subjects instead of mathematics. Dlamini (2017) concludes in his research that the poor performance by students in mathematics has negative consequences for the development for the country. One of the mathematics topics in which the learners continue to perform poorly is calculus. Khobo (2015) argues that the performance of learners in mathematics varies from topic to topic and calculus is the most difficult thing for them. We cannot find the proper solutions unless we know the causes of poor performance of students in mathematics especially in calculus based tasks.

It appears that no country has attained any breakthrough in its economic development without the development of minimum mathematics base. But, the problem is, most of the students in schools have poor performance in mathematics (Carroll, 2011). There is a worldwide concern about learners' poor performance in mathematics. In addition, mathematics is generally considered as the most important school subject all over the world. This may be due to the fact that it integrates with many subjects at school level, such as science, technology, accounting and technical subjects.

Table 1: Performance of grade XI and XII students in mathematics in Baitadi district, from 2072 to 2075.

	Year								
	2072			2073			2074		
School's name	No. Of student	Pass	Fail	No. Of student	Pass	Fail	No. Of student	Pass	Fail
	11/12	11/12	11/12	11/12	11/12	11/12	11/12	11/12	11/12
Shree Shigash Sec. School	18/16	5/6	13/10	14/18	4/3	10/15	9/12	3/7	6/4
Patan Sec. School	22/15	10/7	12/8	12/21	5/7	7/14	14/12	6/8	8/4
Shideshor Sec. School	12/9	4/3	8/6	10/9	2/1	8/8	7/10	3/5	4/5

Source: School document

The table shows that the result of the students in mathematics is not encouraging each year. Among 240 students only 88 students have passed mathematics in the board exam. The pass percentage is just 36.67. The data also proves that every year number of students studying mathematics has been going down. From this table, it can be proved that low performance in mathematics has been the cause of low admission in mathematics department.

The performance of learners in mathematics is poor when compared to other subjects. Almost every year when the grade XI and XII results are announced, the overall performance in mathematics is the lowest. The academic performance of grade XI and XII learners in Nepal has become a yardstick for measuring our education system. At the same time these academic performances are used as a standard to

determine which learners qualify for further studies in different field at good academic institutions. The major problem is that most of the renowned institutions require good mark in mathematics as an entry requirement for a career in engineering, medicine, accounting, technology and other fields that involve science.

Mathematics is a channel to various fields of study. In order to have many opportunities or choices of fields of study, learners have to do mathematics while at school. Without mathematics career options are limited in Nepal. For a career in science, learners have to pass mathematics in grade XI and XII. Therefore, there is a need to improve learners' performance in mathematics so that the number of learners who will pursue careers that regard mathematics as a prerequisite may increase in the days to come.

Statement of the Problem

Mathematics has become the integral part in every field of study. In Nepal, mathematics takes the central role in school level education. There are many misconceptions regarding mathematics like calculating ability is inborn, mathematics is all about calculating and girls cannot do mathematics as the boys do. Along with these, there are various reasons why secondary level learners are unable to do well in mathematics. Students encounter various problems like calculation, lack of factorization skill and conceptual problem. Students do not get opportunity to deal with calculus-based tasks in grade IX and X. When they suddenly should deal with calculus-based tasks without prior knowledge in grade XI, They are unable to deal with it. In my experience of school life-my friends who were slow in mathematics used to leave the mathematics class. They did not use to do home work by themselves. They used to lose confidence by seeing mathematics problem and used to follow talented friends for coping the mathematics notes and homework. When doing

calculus-based tasks my friends' used to bow down their head instead of looking at the white board. They were insulted by teacher due to their incomplete homework which made them shy and frustrated but they never improved their habit. Most of my friends were weak in calculus-based tasks and they failed mathematics in grade XI. I wanted to know the reason behind it. Thus I choose this topic for the research. This study focused on to analyze the performance of secondary level students on calculus-based tasks and to analyze the causes of achieving that level of performance by secondary level students in calculus-based tasks. In order to explore the performance by grade XI learners in calculus-based tasks, the following research questions were developed:

- What is the level of performance of students in calculus?
- What are the causes of achieving that level of performance in calculus based-tasks?

Objectives of the Study

The main objectives of this study were as follows:

- To analyze the performance of secondary level students on calculus-based tasks.
- To analyze the causes of achieving that level of performance by secondary level students in calculus-based tasks.

Significance of the Study

The purpose of the study was to investigate the level of performance by grade XI learners, in mathematics especially in the application of differential calculus, in Baitadi district, Nepal. The poor performance by learners in mathematics had made it necessary to investigate the factors that contribute to poor achievement in mathematics. The study attempted to reveal the reasons for the poor performance and

looks at some possible ways that would help to improve students' performance in calculus based-tasks.

This study is helpful for secondary level students and mathematics teacher to find out the reasons for poor performance in mathematics by the students. It also suggests various ways to solve problems related to students' poor performance in mathematics. It is hoped that the information gathered in this study is helpful to identify the major causes of the poor performance in application of differential calculus. Once these are identified, possible strategies to alleviate the challenges are recommended that assist both teachers and learners in improving the teaching and learning of the two sections of calculus. The significance of the study can be mentioned as follows:

- This study would be helpful for secondary level students and mathematics teacher to find out the level of performance in mathematics by the students.
- This study would help to policy makers and curriculum designers to address the learning difficulties in mathematics.
- This study would be beneficial for teachers, students and guardians as it suggests the ways to improve students' performance in mathematics.

Delimitation of the Study

The study was limited to explore the causes of poor performance and low achievement in calculus-based tasks among secondary level students. It only focused on the performance of students in calculus especially in application of differential calculus. This study was based on the performance of students, in calculus based task, of just ten secondary schools in Baitadi district.

The researcher, in this study, used only two forms of data collection: the analysis of interview and achievement test. The use of more than these methods to collect the data would have strengthened the findings.

Operational Definition of Key Terms

Differential calculus: A branch of mathematics concerned with the differentiation, properties and application of derivatives and differentials.

Performance: The term performance in the study is defined as the marks obtained by students in mathematics in various tests conducted by the investigator.

Students: The students who are studying at secondary level. Also student means those who involve in learning secondary level school mathematics.

Teacher: The person who teaches mathematics at secondary level and is appointed as a teacher.

Secondary Level Teacher: A teacher who teach in Grade XI and XII.

Chapter II

Review of Related Literatures

This chapter is related with empirical literature, theoretical and conceptual framework of the study. A collective body of work done by earlier researchers is technically called the literature. Review of related literature is essential part of the research because it helps to identify variables relevant to research, to avoid the repetition and synthesis of prior works. It also determines the meanings and relationship among the variables (Sing, 2008). This chapter includes the analysis of various related articles and findings of different researches in the field of causes for poor performance of students in calculus based tasks. The main purposes of related literature is to develop some expertise in one's area to see what new contribution can be made, receive some idea for developing research design in a systematic manner by providing the general outline of the research study, and avoid the unnecessary duplication.

This chapter deals with the work carried out in the area of this research project. Some research works that have been reviewed to conduct this research effectively includes the following: theories, books, journals, articles and internet resources.

There are two type of literature named: empirical literature and theoretical. The empirical literature includes the different research in the area of this project and theoretical literature for linking different theories to solve the stated problem of the study about poor performance of students in calculus based tasks. This chapter presents a critical review which includes the following: Methods of teaching, students' attitude and performance in mathematics, teachers attitude and performance in mathematics, textbooks, anxiety and students', culture and parental involvement, tuition time, and curriculum.

Students' Attitude and Performance in Mathematics

Students express like or dislike for mathematics depending upon the manner in which the content was delivered. They naturally form an attitude on the subject that eventually determines their level of success in that particular course.

When students positively perceive the content to be learnt as interesting, fun, meaningful and relevant they get motivated to learn and their interest is aroused in readiness to understand the content being presented to them by the teacher. Wills (2010) asserted that positive attitude towards a subject is related positively to performance. In Baitadi district, students have some kind of anxiety regarding mathematics. Many students think mathematics is unimportant to their personal development. Students have little confidence in their ability to do mathematics and tend to take the minimum numbers of required mathematics courses which has greatly limited their career choice options.

In their research, Nui and Wahome (2006) argue that consistent failures in mathematics might be attributed to the attitudes of students and teachers have towards the subject. Based on this research, attitude is a key component that influences students' performance. In agreement to this Manoh, Indoshi and Othuon (2011) in their study observed that attitudes play a critical role in students' performance. Students with positive attitude tend to perform well in exams which are an indicator that it is a very essential element that affects the students' performance. From my study in some secondary schools of Baitadi district, I came to the conclusion that students find themselves tensed, frustrated, distressed and helpless when handling mathematical tasks. The problem they have regarding mathematics is emotional rather than intellectual. The role of attitude from these literature shows that it is a key factor that determines the performance of the students.

Teachers' Attitude and Performance in Mathematics

Most of the secondary level mathematics teachers in Baitadi district were not well trained. They did not encourage students to do mathematics instead they dominate them saying that they cannot do mathematics and better change their major subject. Njoroge (2004) carried a study on "Teaching Methodology in Secondary Schools" and explained that teaching and learning of mathematics has been subject of debate for a long time. Attitude is one of the key components that determine the performance. They observe that teacher centered methods of teaching which results in learners not enjoying lessons and missing the benefits of discovering what they know on their own. This has led to the low achievement in the examination. Only few teachers were experienced and qualified among many who have been teaching mathematics to secondary level students in Baitadi district. Most of the teachers teaching mathematics had done Bsc. in physics. They were found of following teacher centered approach of teaching rather than students centered approach. They were found to dominate students instead of encouraging them saying that they do know anything. Many teachers even suggested students to change their subject of study.

SMASSE (1998) observes that some mathematics teachers are still using lecture methods and students are given rigidly formulated statements, which they have to memorize and tell when required. In addition, little or no emphasis is placed upon understanding. This makes learner unable to conceptualize what is being taught in class and it leads to the formation of negative attitude towards the subject. Bolaji (2005) in a study of the influence of the students' attitudes towards mathematics found out that the teachers' method of teaching mathematics and his personality generally accounted for the students' positive attitude towards mathematics. The main reasons for students' poor performance in mathematics in Baitadi district was found as

follows: less qualified and unexercised teachers, demanding parents and poor teaching method.

Methods of Teaching

An emphasis on drill without understanding the core concept of the content had led students to the poor performance in mathematics in Baitadi district. The performance of students in mathematics depended on the teaching method used by the teacher. There are various views about the nature of mathematics. Teachers should have insight and be resourceful in whatever methods they use. Classroom organization is very important in this case. SMASSE (2005) shows, practical work, investigations, group experiments and individual assignments are required more frequently than the usual 40 or 45 minutes lesson of lecturing. Once these activities are done, it is hoped that overall objectives of attitudes and personal and social development will be achieved.

We must give prominence to the students' participations in class discussion. These could be done by allowing one student to demonstrate a concept and others to pay attention to what is said. It can also be done by trying to correct or improve upon the statements made. According to Wambui (2002), Mathematics is a complex social activity in the context of the society. He distinguishes between relational and instrumental understanding as far as Mathematics is concerned. Relational understanding includes all descriptions, classifications and understanding the relationship which help to explain the social phenomena.

Mathematics is a difficult subject to learn as well as to teach (SMASSE 2005). This is because; mathematics is a hierarchical subject since the new work depends on the previous one. Students learn at different speeds, therefore some will get the concept in one period and others will get it after a long time. As such, the subject

requires hard work and practice. If teaching is too fast, understanding is not developed. On the other hand, if the pace is slow the students become bored, particularly the fast learners. Whatever the level of attainment, the students should not be allowed to experience repeated failures.

A study carried by SMASSE (1998) also indicates that most teachers lack clear vision on the set objectives in mathematics and science. The perceptions of the teachers towards subject affect the level of the achievement of a lesson that is being presented in class. In Baitadi, most of the classes start without clear and specific aims and they become fruitless. Teachers are not clear on what to be achieved at the end of the lesson.

Textbook

Textbooks play an important role in preparing learners to understand mathematics, especially in the lower grades. Textbooks are guidelines for the students to move in a certain direction smoothly. But in Baitadi district, there were unintelligible textbooks written by less qualified writers. These books did not include clear cut objectives and things that must be learnt at the completion of every lesson. In the article “Mathematics in the school curriculum: An International Perspective” Ruddock (1989) points out that in countries like Japan and Singapore texts books are either produced or have to be approved by national or local Education Ministries. On the other hand, in the Netherlands there is no system for the official approval of textbooks. In the USA, 21 out of the 50 states have to obtain approval from the local Ministry of Education. In Nepal, students get textbooks for the course they are going to deal with. But most of the course in the curriculum is not practical.

Anxiety and Students' Performance

Most of the students in Baitadi district think that they do not have enough foundational knowledge in mathematics so they cannot perform well in it. Studying mathematics for them is like doing something impossible in life. They want to spend their time doing other subjects instead of mathematics. According to Abuja (2006) research studies have revealed that a dislike or anxiety towards mathematics has an effect on mathematics performance. These studies have shown that Singapore students' dislike for mathematics is much lower than that of their counterparts in the USA. These may explain why Singapore performed better than the USA in TIMSS. It has been suggested that in order to develop a positive attitude towards learning mathematics children need to be shown from an early age that mathematics can be fun (Abuja 2006). Students are found of being anxious to mathematics problems. According to some of the students, mathematics creates frustrations in them and they cannot do it effectively. Among secondary level students in Baitadi district the problem of mathematics anxiety was basically caused by the lack of basic knowledge of the content and complexity of the content. Students' were forced to memorize most of the things of the course without understanding the core idea which had led students to poor performance in mathematics.

Culture and Parental Involvement

The culture of teaching in Baitadi district involves a little partnership with the family. Teachers were to some extent accountable for their students' behavior and well being in the school hours. Lack of parental involvement was the main cause of students' poor performance in mathematics. In other countries children get more parental involvement than Nepalese children. Masturell (2002) points out that Japanese parents especially mothers take an active role in their children's' education.

She said few Japanese women have jobs and once they get married, their primary major of success becomes the education of their children. This means that their children get more support from them in terms of their education or school work. Many students in Baitadi district did not get good support from their family members. Family members made students involve in household works than to help them in their academic activities. Due to more involvement in household works, students did not get time to focus on their study. This has led them to the poor performance.

Tuition Time

Students in Baitadi district go to school Sunday to Friday a half day. Nepalese students attend school an average of 180 days per year. Compared to other Asian countries like Japan, Nepalese students spend more time at home with their family members than at school. Mastrull (2002) said, time spent by learners at school work seems to have an impact on success in Mathematics achievement. She said that success of Japanese students in Mathematics does not mean that they are smarter than American students or other students elsewhere in the world. They just work harder. American students attend school an average of 178 days per year as compared to 200 days in Japan. Japanese students go to school Monday to Saturday a half day (Mastrull, 2002). Students in Baitadi district are found of not taking tuition classes before and after the school hours. Teachers also do not attend estimated classes in an academic calendar.

Curriculum

In Nepal mathematics curriculum is more theoretical than practical. It is not so much associated with day to day activities like mathematics curriculum of some other countries. This curriculum mathematics must be connected to reality and at the same time as a human activity. So the real-life contexts are used as starting points.

Gravemeijer and Doorman (1999) said that learning becomes effective when the curriculum is designed according to day to day activities of human beings.

In Nepal problem solving is the central theme of the curriculum. Concepts are thought to an extent that students should master them. The revision of past examination papers to help the students secure pass marks i.e. 35% in the board exam has led them to their poor performance in mathematics. Curriculum of mathematics in Nepal is much theoretical than practical. Much of its part is not connected to reality and human activity.

Nepal's mathematics curriculum and performance

In Nepal learners' performance in mathematics is generally poor even though learners are considered to have passed mathematics if they obtain 35%. National Education System Plan was introduced in 1971 in Nepal. It was a revolutionary step made by those people who had some ideas about European and American system of Education. The mathematics carrying 100 marks has been made compulsory from class one to then and optional in class XI. Different researchers have come up with different reasons that cause learners to perform poorly in mathematics. Poor performance in mathematics in Nepal has been caused by poorly trained teachers. Students have developed "mathematical phobia", which results in fear and failure. In Baitadi district what I found is that dislike of mathematics is linked to teachers' methodology. Most teachers in cannot use modern technology, such as computers, which are now commonly used in advanced countries.

Theoretical Framework

According to the Concise Oxford Dictionary (1990) the term "theoretical" means "based on theory rather than experience or practice". At the same time the term "framework" is defined as "an essential supporting structure". From these two

definitions one can then say that the theoretical framework in a research is a structure that helps a researcher to pursue their study using the existing theories or ideas.

Eisenhart (1991) defines a theoretical framework as a structure that guides research by relying on a formal theory constructed by using an established, coherent explanation of certain phenomena and relationships (p.205).

This study attempted to explore the causes of poor performance in the learning of calculus. The theory that guides this study is the social Learning Theory of Albert Bandura as edited by Pajares and Schunk (2001). The theory attempts to tackle the forces that influence one to behave in a certain way, in this case the influences that changed the learners' and teachers' attitudes to be either positive or negative towards Mathematics curriculum. The theory further point out that human behavior is due to a reciprocal determinism that involves behavioral, cognitive and environmental factors. Contemporary psychologists agree that attitudes are vital due to the fact that they act as directive factors in daily endeavors of mankind. Jung (2006) asserts that the basic work of attitudes is to give some form of organization of the universe we live in. Moreover, they act as standards that assist human beings to understand the world. Both the students' and teachers will always from certain opinion in regard to the tasks head of them. Mathematics may therefore be viewed either negatively or positively and this will determine the level of success in the task to be undertaken.

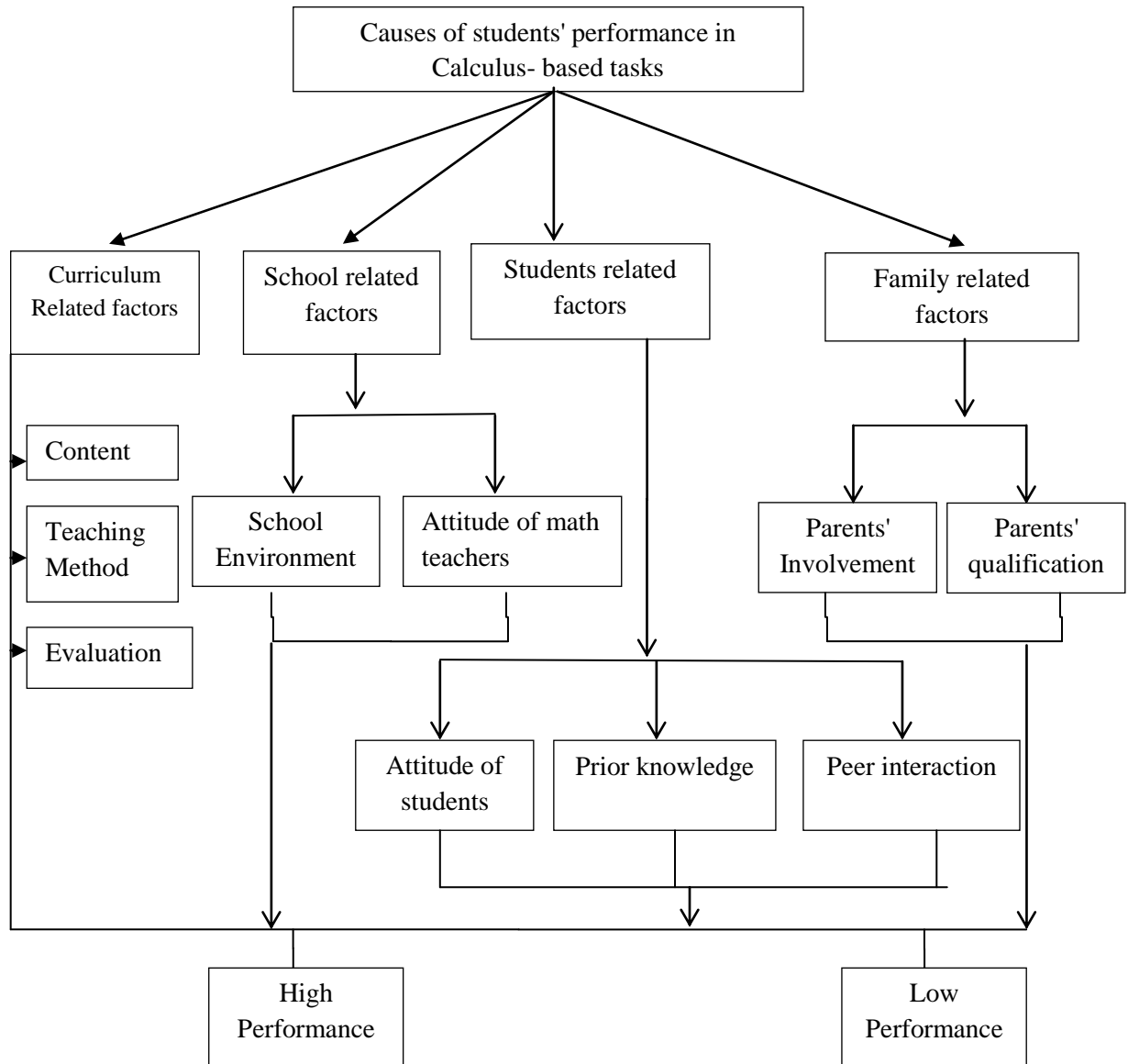
According to the perceived self-efficacy theory by Bandura, people judge their capability to accomplish certain levels of performance. This theory relates to our feelings of the confidence that we can achieve from a desired outcome in specific areas. Beliefs of personal efficacy influence choices of activities, situations and ultimately shape lives. Bandura (1997) has defined self-efficacy as one's belief in one's ability to succeed in specific situations. Luszczynska and Schwarzer (2005)

point out that one's sense of self-efficiency can play a major role in how one approaches goals, and challenges particularly when handling mathematics tasks.

Understanding the mechanism in Bandura's theory that determines perceived self-efficacy judgment is important. This will reflect and shed some light when trying to understand students/teachers' attitude towards mathematics curriculum and contributing reasons. The beliefs of personal efficacy may influence the time one spends on each concept taught in Mathematics. For instance, one is likely to spend more time to learn/teach algebra and ignore vectors if self-efficacy is higher in algebra than vectors.

Conceptual Framework

A conceptual framework is an analytical tool with several variations and contexts. It is used to make conceptual distribution and to organize ideas. The conceptual framework is established on the basis of research topic. Since the topic of the study is "Exploring the Performance of Grade XI Students in Calculus Based Tasks", the conceptual framework for the causes for certain level of performance can be shown as follow:



This conceptual framework intends to assist the researcher to develop awareness and make a good understanding of the performance of secondary level students' in calculus-based tasks. It also helps to take the situation under scrutiny and communicate it. Mathematics is a key subject that is mandatory to all students' in secondary school in Nepal. The teaching and learning of the subject depends on curriculum related factors, school related factors, students related factors and family related factors.

Chapter-III

Methods and Procedures

This section discusses the research design, field of study, population of the study, sample of the study, sample size and sampling techniques, data collection procedure, research tool, data analysis techniques, validity and reliability of the instruments and ethical consideration.

Research Design

Research design is an overall plan and strategies to fulfill the goals of the purposed study. It leads the researcher to know what the study is about; why it is being studied, where the study is carried out, what type of data is required and where can it be received, what techniques of data collection can be used and how data is analyzed etc. Cohen, Manion and Morrison (2010) say that by methods we mean the range of approaches used in educational research to gather data which are to be used as a basis for inference, interpretation, explanation and prediction.

The study uses mixed method research design. In this research, an embedded design was adopted as the study attempted to establish the view held by students' and teachers on teaching and learning of mathematics in secondary schools in Baitadi district. Mugenda and Mugenda (2003) notes that survey research seeks to obtain information that describes existing phenomena by asking individuals about their attitude and behavior. Interview was used to collect responses from participants. Gay (1992) asserts that descriptive survey design involves data collection in order to answer questions concerning the status of the subject of study. The design was preferred for this study because of its appropriateness in educational fact-finding as it gives accurate information.

Field of Study

The field of study was Grade XI students and secondary level Mathematics teachers of Baitadi district.

Population of the Study

Nine secondary level students and mathematics teachers in Batadi district were considered as the population of the study.

Sample of the Study

Simple random sampling method was used to determine the sample of the study. To fulfill the objective of this study researcher selected nine secondary level schools of Baitadi district. The researcher will also select grade IX students and IX secondary level mathematics teachers (one from each school) for an interview. Along with this, the researcher selected 104 students from nine secondary level schools to take their achievement test.

Instrument for Data Collection

The main data collection instruments for this study were: achievement test and interview schedule. For achievement test, some questions are developed by researcher herself; some were taken from teacher's guidance and specification grid of grade XI.

The reliability and validity of achievement test paper was determined under the guidance of supervisor. The content validity of the test was established and approved by the thesis supervisor, mathematics education experts as well as mathematics teachers of the selected school.

To estimate reliability of the test the researcher used split-half method. For this the obtained scores of the students on odd and even items out of twenty items were reported. Then researcher calculated the reliability of the test($r=0.99$).

Achievement Test Paper

This achievement test paper was the basic tool for collecting the data to compare achievement of students. The test consisted twenty multiple choice questions with four distracters and two subjective questions. The researcher thoroughly analyzed the annual plan of examination unit committee of Baitadi, mathematics curriculum and text book, teacher's guidance, specification grid prescribed for grade XI mathematics subject.

Procedure for Preparing Test

In this research an achievement test was the main tool for quantitative data collection. The researcher thoroughly analyzed the annual plan of examination until committee of Baitadi district, mathematics curriculum and text book, teacher's guide, specification grid prescribed for Grade XI mathematics subjects. In this regard, the unit that should teach before half yearly exam was identified. For this researcher made conform about the units and contents that finished in selected school by visiting the subject teacher of the selected school.

Pilot Study of the Test

The prepared achievement test was administered test in Pushpasadan Secondary School Kirtipur, Kathmandu among twenty students of Grade XI for item analysis and reliability. This achievement test contained twenty multiple choice questions with four distracters. Each question was of one mark. The time taken by each student was recorded and average time was calculated which was found to be one minute per item.

Item Analysis of the Test

Item analysis is the process of analyzed a one by one question on different perspective. It decides whether to retain or eliminate an item, whether distracter should be modified or eliminate, whether an item is mistake, whether guessing

occurred and ambiguity is present. Therefore item analysis is a technique through which those items which are valid are selected and rest are either eliminated or modified to the purpose. In this research the researcher did item analysis on thirty multiple choice questions with the help of pilot study of the test and calculated P-value i.e. difficulty level and D-value i.e. discriminating index of the test item. The upper 27% of score i.e. higher score of 8 students and lower 27% of the score i.e. lower score of 8 students were used for item analysis (Appendix-D)

Difficulty Level (P-value) of item

Difficulty level indicates the percentage of pass student to each time. It takes the value ranging from 0 to 100. The P-value of each item was calculated by the formula; $P = (U_R + L_R) / (U_N + L_N) * 100\%$

Where, P = Difficulty Level of item

U_R = Number of upper 27% students who answered correctly

L_R = Number of lower 27% students who answered correctly

U_N = Total number of upper 27% students

L_N = Total number of lower 27% students

The interpretation of P-value is as follow;

Criteria	Item Evaluation	No. of item	Remarks
Above 76%	Easy	4	Need Improvement
75%-61%	Substantial	13	Accepted
60%-40%	General	3	Need Improvement

Discriminating Index (D-value) of item

Discriminating index is a number which differentiates the strong and poor students. It takes the value ranging from -1 to +1. The D-value of each item was calculated by the formula; $D = (U_R + L_R) / (U_N \text{ or } L_N)$

Where D is discriminating index and U_R , L_R , U_N and L_N denoted as stated above of P-value.

The interpretation of D-value is as follow;

Criteria	Item Evaluation	No. of items	Remarks
0.40 and above	Very Good	16	Accepted
0.30-0.39	Good	0	Accepted
0.20-0.29	Marginal	4	Revision
Below 0.19	Poor	0	Need Improvement or Reject

On the basis of P-value and D-value obtained on the item analysis four items were edited and revised. Hence 20 items were selected for achievement test (Appendix-D)

Examination of Validity and Reliability

The content validity of the test was established and approved by the thesis supervisor, mathematics education expert as well as mathematics teachers of the selected school.

To estimate reliability of the test the researcher used split-half method. For this the obtained scores of the students on odd and even items out of thirty items were reported. Then Spearman-Brown split-half method was used to calculate reliability of the test and it as found 0.99 (Appendix- E). It shows that the test was highly reliable.

Interview Schedule

Interview is an interaction between interviewer and interviewee where interviewer creates certain situation and ask interviewee various questions related to

certain field and interviewee puts his/her understanding on the field. The interview was one of the major sources of data collection in this research. The researcher took interview of different students and teachers especially focusing on the issues that lead students to perform poorly in mathematics. The researcher asked various questions to the students and teachers which were related to the performance of students in mathematics and things that can be done to minimize the problems. The type of interview that was based in this research was individual interview.

For this study all the required information was gathered through the interview, achievement test and students' documents analysis. To go in-depth of the information, researcher here carried out open ended interview along with structured questions. On the basis of objectives the researcher developed the interview theme in semi-structured form (Appendix-B,C).

Data Collection Procedure

After preparing data collection instrument and deciding the sample of the study the researcher visited the district education office of Baitadi district. She requested the officers of the district education office to provide her list of secondary level schools where mathematics is taught. Then the researcher contacted to various nine secondary level schools and requested principals for letting her to conduct her research. The researcher informed to the principals about her research work and the time she wanted to take for it. All the principals agreed to the researcher request and allowed her to conduct the research.

Then the researcher visited the schools and took achievement test of the students. Along with this the researcher took interview of one mathematics teacher and one student from each school. The researcher took achievement test of total 104 students from different nine schools. Achievement test included twenty objective

questions-each carrying one marks and two subjective questions-each carrying five marks. The researcher marked all the copies of the achievement test and analyzed students' answers to find out where they struggled to solve the question correctly. The researcher took interview of nine students and nine secondary level mathematics teachers in total. The researcher asked students and teachers various questions related to curriculum, school, student and family. The researcher used achievement test and interview as tools in this research to collect data.

Data Analysis Procedures

The researcher analyzed and interpreted the collected data with the help of statistical techniques. In this study researcher used the following procedures:

- Mean, standard deviations and variance were calculated for each group with their secured marks in the achievement test and analyzed where and why the students struggled to solve the subjective questions. The answer sheet of students are also presented and analyzed descriptively.
- The collected information i.e. raw data was given certain codes. And the codes were categorized into certain model or framework. Then, these codes were taken as themes. The similar code version of respondent were collected together and explained in their perspectives. Cross match was adopted to maintain the validity, credibility and reliability of the result of the study.

Ethical Considerations

The researcher ensures that the study abides to lay down research protocols by the university. Further, the respondents were assured of total confidentiality on any information availed to the researcher. The study acknowledges any reference made on other researchers and scholarly works. The researcher tries to keep to the time lines set so as the results of the study can be of use in a time frame set.

Chapter IV

Analysis and Interpretation of Result

This chapter deals with analysis and interpretation of the collected information from achievement test result and interview. The researcher interviewed various students and observed their performance through achievement test. The researcher interviewed students mainly emphasizing on their interest on calculus-based tasks, peer interaction, their prior knowledge related to calculus based task, their attitude towards mathematics, tuition time they take at school at home, mathematics curriculum and infrastructure of the school. Along with this, the researcher interviewed some secondary level mathematics teachers teaching in Baitadi district about their qualification, their experience in this teaching field and their attitude towards mathematics.

The method used in this study was basically interpretative because this study analyzed and described the performance of secondary level students in mathematics. This study was mainly focused to analyze and discuss on the performance level of the students in calculus based task who are from different cultural and social background.

This was a qualitative and quantitative type research entitled “Exploring the Performance of Grade XI Students in Calculus-Based Tasks”. The objectives of this study were to analyze the performance of secondary level students on calculus based task and to analyze the causes of achieving that level of performance by secondary level students in calculus based task. It dealt with statistical analysis and interpretation of data obtained from marks obtained by students in achievement test at school and information gathered from the interview of students and teachers. The researcher analyzed the achievement test result of 104 students from nine secondary schools of

Baitadi district and interpreted teachers' and students' response regarding calculus based task when they were interviewed.

The method used to fulfill the objectives of this study was quantitative and qualitative approach in the form of achievement test and interview. The data achieved from achievement test were tabulated and analyzed using mean, standard deviation, variance and data collected from interview were categorized into certain model. These model were taken on themes and they were taken as codes cross match was adopted to maintain the validity and reliability of the data. The collected data in this research are analyzed in the following ways to fulfill the first objective of this research study. The first objective is:

To analyze the performance of secondary level students

The researcher analyzed the exam result of grade XI students in Baitadi district. The researcher found that in 2073 there were 84 students studying mathematics. Among 84 students 33 passed the HSEB exam and 51 failed. Likewise in 2074, 92 students appeared in HSEB exam and 39 students passed the exam. The pass percentage of the students in mathematics in 2073 is 39.28% and pass percentage in 2074 is 42.39%. This data showed that students have poor performance in mathematics in Baitadi district. The first objective of this study was to explore the performance of Grade XI students' in calculus based task. In order to achieve this objective an achievement test was conducted on 104 students of grade XI from nine randomly selected secondary schools' in Baitadi district. To determine their level of performance the mean, standard deviation and variance of the marks obtained by the students' in achievement test was calculated. According to the Nepalese grading system of class XI and XII, if the students secure below 40% marks that falls under 'C' grade and it is taken as low performance (Appendix-G). Here the researcher

presents the marks obtained by the students in achievement test in Appendix-F. The data in appendix-F shows the number of students' that participated in achievement test. The marks obtained by the students' ranged from 2 to 24 with the mean score 12, standard deviation 4.41 and variance 19.87.

The appendix-F shows that the calculated standard deviation is 4.41 which prove that there is variation or dispersion in the marks secured by the students' in the test. Mean value 12 also shows the certain level of performance of grade XI students' in calculus based task in Baitadi district. Among 104 students, 47 students are unable to secure 40% marks in the achievement test which shows their poor performance in calculus based task.

Subject and objective questions related to the application of calculus were used to evaluate students' performance in calculus based tasks. There were total 20 objective questions each carrying one marks and 2 subjective questions each carrying 5 marks were used for the test. All the questions were from the application of derivative and anti-derivative because this study intended to explore the performance of grade XI students in calculus based task in Baitadi district.

The main purpose of the researcher in taking test was to interpret how students thought and responded to different mathematical questions involving calculus. The researcher had to note common errors, misconceptions, and lack of knowledge in solving certain questions. The researcher tried to find out why learners made certain errors. Students' performance varied, with only few showing full understanding of when they had to do, others understood partially a while some candidates were totally lost.

Analysis of Subjective Questions

Below are the solutions of subjective question by some students which carries full marks 5. The question required from candidates to find the absolute maximum (greatest value) and absolute minimum (least value) of the function $f(x) = x^3 - 4x^2 - 11x + 30$ defined on an interval $[-1, 5]$.

While analyzing the scripts, including those where candidates had secured full marks. The researcher had to examine such scripts in order to determine whether the answer was from a correct working or not.

Some candidates seemed unsure of what they had to do when they had to find the maximum and minimum value of the function. They wasted time by trying to find the factors of the given function. There was no attempt at following the correct procedure of calculating minimum and maximum value of the function. This means that these candidates were not proficient in the strand procedural fluency.

QUESTION 2

$$f(x) = x^3 - 4x^2 - 11x + 30$$

$$f(2) = (2)^3 - 4(2)^2 - 11(2) + 30 = 0$$

$\therefore (x-2)$ is a factor.

$$x^3 - 4x^2 - 11x + 30 = (x-2)(x^2 + Kx + 30)$$

$$-4x^2 = -2x^2 + Kx^2$$

$$-4 = -2 + K$$

$$K = -2$$

$$(x-2)(x-6)(x-3)$$

$$x = 2, x = 6 \text{ or } x = 5$$

The candidate is unsure about the process. She has tried to solve the function without any clear concept. She even seems unknown about what she is doing. She is unable to find coordinate of turning points. She indulged in trying to find the factors of the given function. There does not seem correct procedure of calculating the coordinate of turning points.

Another error occurred when a candidate derived correctly to get a quadratic equation but made a wrong substitution by taking the value of b outside the square root to be 3 instead of -8. This was really a slip because the candidate substituted the value of b correctly in the discriminate such a careless mistake caused this candidate to obtain incorrect substitution by taking his values of X and substituted them in the derivative instead of into the original function.

Q 2

Soln

$$f(x) = x^3 - 4x^2 - 11x + 30$$

$$f'(x) = 3x^2 - 8x - 11$$

$$0 = 3x^2 - 8x - 11$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-3 \pm \sqrt{(-8)^2 - 4(3)(-11)}}{2(3)}$$

$$= \frac{-3 \pm \sqrt{196}}{6}$$

$$x = 1, 83 \quad \text{or} \quad x = -2, 83$$

The candidate has committed a mistake when he goes to put the value of b. The value of b is -8 but the candidate put it 3. This led the candidate to obtain incorrect solution and he got less marks due to this error.

A lack of algebraic skill was noticed when a candidate derived the function correctly but failed to factorize $3x^2-8x-11$ correctly. This showed that these candidates were not proficient in the procedural fluency. The error detected under strand involved the factorization of the first derivation.

Q. no. 2
 Soln-
 $f(x) = x^3 - 4x^2 - 11x + 30$
 Now, Differentiating w.r.t. x , we get
 $f'(x) = 3x^2 - 8x - 11$
 $= (3x + 1)(x - 11)$
 $\frac{3x}{3} = \frac{-1}{3}$ or $x = 11$
 for $x = (-\frac{1}{3}) = (-\frac{1}{3})^3 - 4(-\frac{1}{3})^2 - 11(-\frac{1}{3}) + 30$
 $= \frac{896}{27}$
 for $x = 11$,
 $x(11) = (11)^3 - 4(11)^2 - 11(11) + 30$
 $= 756$
 $= (11, 756)$

A lack of factorization skills/knowledge led some that failed to score marks in this question. For example, the learner below had an idea that she had to find the first derivative first. The candidate managed to do the correct derivation but could not factorize $f'(x)=0$ correctly. Again this was an example of a candidate not being proficient in the procedural fluency strand.

There is evidence that some candidates lacked knowledge of how to find the maximum and minimum value of the function. Learners searched for factors of the function $x^3-4x^2-11x+30$ instead of just finding the first derivative and solve for x in $f'(x)=0$

$$\begin{aligned}
 2. \quad f(x) &= \frac{x^3 - 4x^2 - 11x + 30}{-2} \\
 (x-2)(x^2 + kx - 15) \\
 -2kx - 15x &= -11x \\
 -2kx &= -11x + 15x \\
 \frac{-2kx}{x} &= \frac{4x}{x} \\
 \frac{-2k}{-2} &= \frac{4}{-2} \\
 (x-2)(x^2 - 2x - 15) \\
 (x-2)(x-3)(x+5) \\
 x=2 \text{ or } x=3 \text{ or } x=5 \\
 f'(x) &= 3x^2 - 8x - 11 \\
 &= 3(2)^2 - 8(2) - 11 \\
 &= -15 \\
 f'(x) &= 3x^2 - 8x - 11 \\
 &= 3(3)^2 - 8(3) - 11 \\
 &= -8
 \end{aligned}$$

Learners searched for factors of the function $x^3 - 4x^2 - 11x + 30$ instead of just finding the first derivative and solve for x in $f'(x) = 0$. This is an example of not being proficient in conceptual understanding. These candidates did not know the procedures to be followed in finding the maximum and minimum value of the function. The candidate has not followed the correct procedure. The candidate seems finding factors without finding first derivative.

Calculation or calculator skills challenges were also shown in the work of the candidate below. This candidate could have obtained full marks but ended up getting 3.5 out of 5 marks. He/she substituted correctly in the function $f(x)$ but got -24 instead of 36.

Questions

$$F(x) = x^3 - 4x^2 - 11x + 30$$

$$F(x) = 0$$

$$0 = 3x^2 - 8x - 11$$

$$(3x - 11)(x + 1)$$

$$3x = 11 \quad \text{or} \quad x = -1$$

$$x = 11/3$$

<p>For $11/3$ sub into $F(x)$</p> $F(x) = x^3 - 4x^2 - 11x + 30$ $= \left(\frac{11}{3}\right)^3 - 4\left(\frac{11}{3}\right)^2 - 11\left(\frac{11}{3}\right) + 30$ $= -\frac{406}{27}$	<p>For $x = -1$ sub into $F(x)$</p> $F(x) = x^3 - 4x^2 - 11x + 30$ $= (-1)^3 - 4(-1)^2 - 11(-1) + 30$ $= -24$
<p>For 5 sub into $F(x)$</p> $F(x) = (5)^3 - 4(5)^2 - 11(5) + 30$ $= 0$	<p>For $x = -1$ sub into $F(x)$</p> $F(x) = (-1)^3 - 4(-1)^2 - 11(-1) + 30$ $= -24$

The candidate has substituted a wrong value in the function. Though, he has got the correct value of X. The candidate got wrong answer when putting the value of X as -1. The correct answer would be 36 but the candidate got it -24.

In this chapter, the data collected from the nine secondary schools of Baitadi district was analyzed and interpreted. The responses unveiled a variety of challenges experienced by the students when answering questions that involved the application of derivative and anti derivative. It was found that the challenges not only emanated from difficulties posed by calculus but also from incompetence in other topics such as algebra, measurement and functions. The analysis of the data also indicated that candidates made mathematical errors, which resulted in the loss of marks, leading to a poor performance in calculus based tasks.

From the achievement test of the students it was concluded that most of the students had not got even pass marks. There was no student who had performed excellently in the test. Low marks obtained by students in the test proved that students had poor performance in application of derivative and anti-derivative.

The researcher concluded that students were unable to perform well in calculus-based tasks because of lack of concept, lack of algebraic skill, lack of factorization skill, wrong substitution of the value and due to calculation error. Some students seemed unsure about what they had to do when they had to find the maximum and minimum value of the function. They were unable to follow the correct procedure. Students also had a problem regarding substitution. Some candidates derived the value correctly but made a wrong substitution. Along in addition, lack of algebra skill was noticed among the students derived the function correctly but failed to factorize the function correctly. A lack of factorization skill led some of the students to score less marks in the exam.

The second objective of this study was proved with the help of interview with nine teachers and nine students from different nine schools in Baitadi district. The following was the second objective of the study:

To analyze the causes of achieving that level of performance

Interviews with Students and teachers

To complete my second objective, I took interview with students and teachers of selected schools. The interview was taken based on the conceptual understanding of the study. The interview guidelines were developed for students and teachers separately. The responses of teachers and students are analyzed and interpreted on different thematic subheadings.

Curriculum Related Factors

Students' performance in mathematics was found to be dependent on curriculum related factors. Curriculum related factors include: content, teaching method and Evaluation. Curriculum refers to subject or academic content taught in a

school or in a specific course. One of the students said, "*Curriculum of mathematics of grade XI is not practical i.e. it is not applicable to day to day activities. Students should memorize different theoretical ideas without clear concept of them.*" The candidate's response proved that students like those courses which are practical to day to day life instead of the content that demands memorization. Gravemeijer and Doorman (1999) said that learning becomes effective when the curriculum is designed according to day to day activities of human beings. Students study application of derivative and anti-derivative but that is not used anywhere in their life. The study also concluded that learning becomes effective and fruitful when we get an opportunity to apply whatever we have learnt in our day to day life. When students don't find anything practical and applicable in their life it becomes top for them to learn. They do not get clue how something happens. So curriculum should be applicable to day to day human activities. Curriculum related factors can be explained as follows.

Content

The things or exercise that students deal with in a certain course is called content. In Nepalese mathematics curriculum, application of derivative and anti-derivative is totally new thing for grade XI students as they do not deal with such exercises in their previous class. Some of the students said, "*Application of derivative and anti-derivative is a new thing for us so we find it quit difficult to do. We find it difficult more because the exercises are given in a book without general concept related them.*" This study found that students find the content related to application of derivative and anti-derivative difficult because they lack prior knowledge related to it. Students do not go through such type of exercises in grade IX and X.

When the students suddenly need to do such exercises related to application of calculus, they do not know from where to start. Some of the teachers say, *“The content in the curriculum in various text books is given without enough background information. Lack of background information makes content difficult for student to understand.”* This study found that the way content was presented in various text books is not satisfactory in our country. Most of the content is presented without necessary background information. Course has been designed not on the basis of simple to difficult things but without caring about the difficulty level of content.

Teaching Method

The way teachers teach various subject matters to the students is taken as teaching method. Teaching learning activities becomes effective when teacher becomes able to use proper teaching method according to the subject matter. Some of the students say, *“Most of the teachers fail to teach according to the need of the students and nature of the subject matter. Often teachers are not confident enough to teach the required thing to the students. They use teacher centered approach to teach application of derivative and anti-derivative which is not effective.”* This study concludes that teachers in Baitadi district are unable to use various teachings methods according to the nature of the students and the subject matter most of the teacher were found to use teacher centered approach to teach mathematics. Teachers lack the knowledge of teaching methods and they cannot use different teaching methods according to the situation. The study found that most of the classes are boring to the students because of the monotonous teaching methods followed by the teachers.

Evaluation

Evaluation is the process of finding the performance of the students in certain

subject matter. Most teachers said, *“We take various test of the students to evaluate their performance. These tests include class test, monthly test and annual test.”* This study found that students’ performance is evaluated in terms of the marks obtained by then in various test. There is no other process of evaluation in Baitadi district.

Evaluation of the students’ achievement only depends on the tests in Baitadi. There is no system of regular evaluation. Some of the students said, *“We just get an opportunity to show our performance in various tests only. The school does not conduct any other activities to evaluate the performance of the students.”* This study concluded that students want to involve in various extracurricular activities related to mathematics to develop their proficiency in mathematics. Whether students are good at mathematics or not should be evaluated not only through various tests but also through different extracurricular activities. Instead of focusing on marks obtained by the students, their conceptual understanding should be taken into consideration. Evaluation of the students’ performance in Baitadi district was found to be dependent on various tests only.

School Related Factors

Students’ performance was found to be affective by various school related factors like attitude of teacher and school environment. These school related factors influencing students performance in application of derivative and anti-derivative can be elaborated and explained with the help of interview from students and teachers.

Attitude of the Teachers

The way we take various things is attitude. This study found that teachers in Baitadi district discourage students’ instead of encouraging them to involve in doing mathematics teachers dominate students’ saying they even do not know the basic

things related to derivative and anti-derivative teachers are unable to make effective use of various teaching materials. Some teachers said *“Students do not have even basic knowledge of the things related to calculus. This may be the reason is they do not deal with derivative and anti derivative in grade IX and X.”* Students have problem related to derivative and anti-derivative because it is totally new thing for them. Teachers were found to compel students’ to memorize formulas only without giving them clear concept of the subject matter.

But the students have different view on this. Some students said, *“Teachers neglect their capacity to deal with mathematics. Teachers directly enter into the course without giving us background information which makes us unable to solve the problem. Teachers just think that it is their duty to complete course without caring about whether students have understood the things or not.”* This study found that teachers do not care about whether students understand the subject matter or not. They just want to complete the course. Teachers do not give background information to the students before teaching them various contents. Teachers were found neglecting students capacity to do mathematics.

This study also found that teachers are unable to use different teaching methods according to the subject matter. Teachers do not care about the need of the students instead they teach to them in whatever way they like in the classroom. SMASSE (1998) observes that some mathematics teachers are still using lecture methods and students are giving rigidly formulated statements which they have to memorize and tell when required. Teachers lack effective teaching methodology. Most of the teachers teaching mathematics secondary students in Baitadi district are untrained. The study concluded that most of the teachers are not competent in the

subject matter. Instead of realizing their weakness and developing their proficiency they accuse students'.

School Environment

The situation and physical structure of the school is called environment of the school. Schools should have peaceful environment with enough physical structure facility make teaching learning productive. One of the students said, *“There are not good infrastructure and enough teaching learning materials to make learning productive. The school environment is crowded as there are strict rules and regulations. Many teachers do not take regular classes and students do not get extra tuition classes whenever they need them.”*The study came up with the conclusion that students do not get enough tuition time at school. They even do not get an opportunity to take regular classes because most of the time teachers remain absent.

The school environment is crowded and there are no proper rules and regulation. It was also found that there are not sufficient teaching learning materials in most of the schools. Some of the teachers said, *“As we most of the teacher remains busy in household work like farming so we cannot attend class on time. It is our compulsion because we are paid low salary that is not enough to afford our basic needs.”*The study concluded that teachers focus more on household work then teaching profession. The reason behind there less attachment to job is they are pad low salary which is not enough to afford their basic needs. Teachers are not interested in teaching because of the crowded environment of the school. Mastrull (2002) said, time spent by learners at school work seems to have an impact on success in mathematics achievement. Most of the time teachers remain absent in the class.

This study concluded that students in Baitadi district don't get an opportunity to go for extra tuition classes when they encounter serious mathematical problems. Various schools also don't have enough teaching materials to make teaching learning activities effective. Due to lack of teaching learning materials classroom environment and lack of tuition time students' are unable to do good in calculus based tasks.

Students Related Factors

Some students related factors like their attitude towards mathematics, prior knowledge on the subject matter and peer interaction were found influential in students' performance in application of derivative and anti-derivative. Students related factors affecting their performance in application of derivative and anti-derivative can be explained with the help of interview can be explained as follows:

Attitudes of the Students

The way we look at the things is attitude. Everyone should keep positive attitude to what they do. One of the students said, *"I don't like calculus when I look at a math problem related to calculus, my mind goes completely blank. I feel stupid, and I can't remember how to do even the simplest things. In calculus there is lengthy solution to a problem. That makes me crazy. Sometimes it's clear to me in math class, but when I go home it's like I was never there. I feel that I can't catch up and I am particularly weak in math subject. I have no bad experience with math teacher, but elementary level math teacher was very strict if when we failed to do homework he used to punish us very badly, we used to be afraid by seeing math teacher, I remember very well when I was in four classes he gave us to learn multiplication table up to ten, I had learnt and could tell at home, next day when my turn came I forgot all tables and couldn't speak anything. From my child hood fear settled in my mind, so I can't be friendly and can't express fillings."* Students of grade XI in Baitadi district were

found to have negative attitude towards mathematics. They think that they are not capable enough to do derivative and anti-derivative. Students lack basic knowledge to do various mathematical problems.

Most of the students feel stupid and cannot remember how to solve even the simplest mathematical problems. Students do not find themselves capable enough to solve mathematics problems. They believe that to do mathematics their needs extraordinary mind and students like them cannot perform well in mathematics. Students have developed negative attitude towards mathematics. This study found that students' don't like mathematics especially math problems related to application of derivative and anti- derivative.

Another student said, *"I don't like math. I got headache when I take math class. I am majoring mathematics not because I am interested in mathematics but because my parents forced to study mathematics. I totally lose my concentration in math class. I become physically agitated when I have to attend math class. It is very difficult to get correct answer; many different formulas for a question can be used, lots of common sense and a high IQ is needed to do math. The never ending amount of the formulae to be memorized, too many methods and it is just difficult to remember and solve."* This study found that most of the students are study mathematics not because it is their favorite subject but their parents forced them to study mathematics. Some of the students totally lose their concentration in mathematics class. Students find it quite difficult to memorize different formulas to solve as single question. Students believe that to solve mathematics problem high IQ is needed so they cannot do mathematics.

In calculus students have to make length solution to a problem which they do not like. They think that they are not capable enough to do mathematics. Some teachers said, *“Students have problem with calculation and conceptual understanding. So they do not want to deal with mathematics problem.”* From teachers view point it is concluded that students have problem with calculation and lack of conceptual understanding to various mathematical problems so they think that cannot do mathematics. This all happens because they lack prior knowledge of the subject matter. Wills (2010) asserted that positive attitude towards a subject is related positively to performance. Due to their negative attitude toward calculus based tasks students’ cannot perform well in this area. Manoh, Indoshi and Othuan (2011) in their study observed that attitudes play a critical role in students’ performance. The study concluded that students in Baitadi district have negative attitude towards mathematics. They think that they are not capable to do application of derivative and anti-derivative.

Prior Knowledge

The knowledge we have regarding any subject matter before dealing with any subject matter is called prior knowledge. One of the students said, *“Derivative exam terrifies me. My palms get sweat, I breathe too fast, and often I can’t even make my eyes focus on the paper. The main reason why I am not good in calculus based tasks is I did not have any prior knowledge regarding it. As we did not deal with such thing like derivative and anti-derivative in our lower classes? I do not know the applicability of calculus in human life. We are not taught such things. Only we are taught is to solve questions without any proper concept.”* This study found that students’ of grade XI have frustration in doing derivative and anti-derivative because it is new thing for them. They do not deal with such exercise in grade IX and X. Due

to lack of prior knowledge students' do not have rational understanding of derivative and anti-derivative.

Students find something easy when they deal with it time and again. Students in our country do not get an opportunity to learn various things on derivative and anti-derivative in grade VI to X. When they need to deal with it in grade XI, they find it new thing without any concept to them. So, they find it difficult to deal with the application of derivative and anti-derivatives.

One of the teacher said, *"It is very difficult and challenging to teach derivative and anti-derivative because it is new thing for them. We should teach students basic things before entering into the application of derivative and anti-derivative."* This study found that due to the lack of the prior knowledge on derivative and anti-derivative among the students, it becomes tough for the teachers to make students understand various concepts related to it. Wambui (2002), mathematics is a complex social activity in the context of the society. Rational understanding of mathematics includes all descriptions, classifications and understanding the relationship which help to explain the social phenomena. Without prior understanding of any subject matter learning remains incomplete. Prior understanding is the basic foundation for learning application of derivative and anti-derivative effectively and efficiently.

Peer Interaction

Discussing with friends in group on various topics is called peer interaction. Peer interaction helps students to learn new insights on various topics. Some of the students said, *"There is no system of peer interaction in the class. We are taught individually in the class. So we hesitate to involve in group interaction."* This study found that there is no system of peer interaction among the secondary level students in

Baitadi district. Teachers and students are not aware about the importance of group discussion and peer interaction. It is found that students' even hesitate to express their understanding on various topics freely. They just neither follow to the teachers nor involve with group discussion with their friends. This has led students' incomplete understanding of application of derivative and anti-derivative.

Family Related Factors

Students' performance in application of derivative and anti-derivative was found to be affective with family related factors as well. Family related factors were parents' involvement and parents' qualification.

Parents' Involvement

The amount of time parents' separates for their children's all round development is parental involvement. This study concluded that the culture of teaching learning in Baitadi district involves little partnership with the family. One of the students said, *"There needs hard work to learn math in comparison to other subject. But as my parents are busy all the time working in the field, I should help them at home. I do not get enough time for my study. As my parents spend most of the time in the field, I do not get help and support from them regarding my study."* Most of the parents are unable to give time to their study. Most of parents even don't know when their children come and go to school. Instead of helping their children in their study parents ask children to help them in domestic works though parental involvement is essential in students' study.

Regarding parents' involvement, some of the teachers said, *"Parents of the students do not show interest to know about their children's progress in study. They rarely visit school to interact with teachers."* This study concluded that there is lack of

parental involvement regarding their children's study in Baitadi district. Parents remain busy in household works and do not get time to concentrate on their children's study. Even if some parents have time, they do not visit school and try to know about their children's progress in the study. Masturell (2002) points out that Japanese parents especially mothers take an active role in their children's education. She said few Japanese women have jobs and once they get married, their primary major or success becomes the education of their children. The case in Baitadi district is contradictory to Japanese culture students do not get support regarding their study from their parents'.

Parents' Qualification

Qualification refers to the educational degree one has achieved. This study came up with the conclusion that most of the parents in the Baitadi district are uneducated. They are unable to help their children in their study. Most of the student said, *"Our parents are not educated. Even if some of our parents have done their bachelors degree they cannot help us doing. Our parents find mathematics difficult subject like we do."* In some families males are educated and they spend most of the time away from home due to their job. Even if some of the parents have done their bachelors degree they cannot deal with mathematics. More than this, parents do not have any knowledge regarding application of derivative and anti-derivative. This study found that most of the parents in Baitadi district are uneducated. Some educated parents are also not good at mathematics. So, children do not get help and support from their parents.

From the interview with the students and teachers it was concluded that students performance in application of derivative and anti-derivative was found to be affected by poor school environment, lack of teaching learning materials in school,

impractical curriculum, students and teachers negative attitude towards mathematics, lack of tuition time, parents' less involvement regarding their children's study and less educated parents. These elements have led students to poor performance in application of derivative and anti-derivative.

Chapter V

Summary, Findings, Conclusions and Recommendations

This chapter is basically concentrated in deriving some findings from the discussion of previous chapter. Besides finding and conclusion it has presented an educational implication of the study and some recommendations which will be useful for further research.

Summary of the Study

The study was concerned with the “Performance of grade XI students in application of derivative and anti-derivative in Baitadi district” Main objectives of the study were to analyze the performance of secondary level students on calculus-based tasks and to analyze the causes of achieving that level of performance. The research is conducted in nine secondary level schools of Baitadi district. This research was mainly prepared on the basis of the interviews with nine students and nine teachers from different secondary level schools in Baitadi district. Along with this the researcher took test of 104 students from various schools to evaluate their performance in application of derivative and anti-derivative. This is qualitative and quantitative research as it includes interview of students and evaluates their performance in achievement test.

To fulfill the first objective of the study, the researcher took achievement test of 104 students from nine different secondary schools. Along with this the researcher evaluated the HSEB result of grade XI students majoring mathematics. For the second objective of the study, the researcher took interview from nine students and nine teachers from different schools. The interview questions were based on curriculum, school environment, family environment, and parents’ involvement, attitude of the

students, attitude of the teachers, peer interaction, teaching method, evaluation system, content and prior knowledge of the students in the subject matter.

Findings

This study found that the performance of students is affected by school environment, parents' involvement, attitude of mathematics teacher, parents qualification, attitude of the student, prior knowledge, peer interaction, content, teaching method and evaluation. This study came up with the conclusion that students in Baitadi district have negative attitude towards mathematics, there is lack of peer interaction in the class room, parents are irresponsible towards their children's study, teachers neglect the capacity of student, there is no proper evaluation system and teachers are unable to apply various teaching methods according to the nature of the student and nature of the subject matter. Students were found securing less mark in calculus-based tasks because of the lack of conceptual knowledge, lack of factorization skill, and wrong substitution of the value and calculation errors. These elements have led students to poor performance in application of derivative and anti-derivative in Baitadi district.

Conclusion

From the analysis of achievement test, HSEB result analysis and interview with teachers and students, it is concluded that students of grade XI have low performance in mathematics in Baitadi district. There are different factors responsible for their low performance. These factors can be categorized as curriculum related factors, school related factors, students' related factors and family related factors. Curriculum related factors that affect students performance in mathematics include content, teaching methods and evaluation. School related factors include school environment and attitude of math teachers. In the like manner, Students related factors

that influence students' performance includes attitude of the student, prior knowledge of the students in the subject matter and peer interaction. Likewise, family related factors influencing student performance includes parents' involvement and their qualification.

The researcher concluded that students in Baitadi district have not got proper environment for learning mathematics. To improve their performance in mathematics student should get an opportunity to take more tuition time, teachers should teach according to the nature of the students, parents should help their children in their study and conceptual understanding should be encouraged instead of memorization.

Educational Implication

Most of the students were found to have low performance in mathematics in Baitadi district. They have developed negative attitude towards mathematics and they think that they are not capable enough to solve mathematical problems. Negative attitude of the students towards mathematics is an emotional problem rather than intellectual problem like "I will never understand", "everyone knows the answer except me." Such types of thought have settled in students mind. This study is important because it suggest some ways to improve the performance of the students in mathematics. The study suggests the following ways to improve students' performance in mathematics:

- Teachers and school administration should take their responsibility. Teachers must think that teaching is not their responsibility they should work to produce capable, knowledgeable and multitalented manpower.
- Teaching methods must be re-examined. Teacher should focus on teaching methods which include less lecture, more students directed classes and more discussion.

- New concepts should be taught through acting, cooperative groups, visual aids and technology.
- Parents should make home environment suitable for learning. They should be aware in their children's academic achievement.
- Lessons must be presented in a variety of ways. This helps to increase the students understanding power and concept.
- Students should build high level of confidence and do more practice at home, students should learn math to gain more knowledge rather than to pass the exam.
- School administration should conduct extra classes for those students who are weak in mathematics. Also school should try to understand students' perceptions towards math.
- Students should be self-motivated to learn and teacher should provide some techniques to establish the mathematical concepts nicely and creatively.
- Parents should give time to their children. They should often visit schools and keep record of their children's progress in the study and problem faced by them.
- Teachers should be trained to use different teaching methods to teach according to the nature of the students and subject matter.
- Students should be encouraged to involve in group discussion and they should be encouraged to learn practically instead of making them memorize various concept.
- Concept of derivative and anti-derivative should be introduced in grade IX and X show that students get some knowledge about it and do not find it totally new thing in grade XI.
- Government should distribute enough text books to government schools and there should be library in every school show that students get opportunity to consult different books to get various insights to solve the mathematical problem.

- School should manage extra tuition classes for weak students without any cost. Teachers should be regular to the class and should be prepared enough before taking the class.

Recommendation for Further Study

To intensify future research into the performance of grade XI learners in calculus-based tasks, researcher must:

- Use more than one method to collect data. This is what is called data triangulation. The researcher must use other forms of collecting data, like interviewing learners, observation and classroom visits.
- Compare learners' performance in other mathematics topics that may influence learners' performance in calculus. It would be interesting to see whether there is any relationship or connection between learners' performance in these topics.
- Compare the performance of learners in calculus questions of those doing mathematics and science to those doing mathematics and accounting, especially in questions on optimization. There is a belief that accounting students usually struggle with questions that have a scientific context, such as velocity and acceleration.
- Investigate teachers' background of physics to the performance of learners in questions involving quantities such as displacement, velocity and acceleration.

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Appendix-A

Achievement Test

Subject- Mathematics: I

Class-XI

Students' name:

Date-

Schools' name-

F.M.-30

A. Circle the write answer.

$1 \times 20 = 20$

1. What is the instantaneous rate of change at $t=1$ for function $f(t)=te^{-t}+9$?
 a) -1 b) 9 c) 0 d) 2
2. What is the acceleration of a moving particle whose space time equation is given by $s= 3t^2+2t-5$?
 a) 0 b) 1m/s^2 c) 5 m/s^2 d) 6 m/s^2
3. What is the area of the curve $x^2+y^2=2 ax$?
 a) πa^2 b) $2\pi a^2$ c) $4\pi a^2$ d) $1/2\pi a^2$
4. What is the area bounded by the curve $y=\sin x$, $x=0$ and $x=\pi$?
 a) 0 b) 1 c) 2 d) 3
5. What is the increasing interval of the function $f(x)=x^2-2x$?
 a) $x \leq -1$ b) $x \geq -1$ c) $x \leq 1$ d) $x > 1$
6. What is the case with the function $f(x)=\frac{1}{1+x}-\log(1+x)$, $x>0$
 a) Always increases b) Always decreases
 c) Increases in some finite interval d) None of these
7. Which is the minimum value of the function $y=2x^3-21x^2+36x-20$?
 a) -128 b) -126 c) -120 d) None of these
8. Which is the interval in which the function $f(x)=2x^3-9x^2+12x-20$ is decreasing?
 a) $(0, \infty)$ b) $(1,2)$ c) $(2,\infty)$ d) $(-\infty,2)$

9. What is the area of the region bounded by the curve $y=3x^2-2$ between $x=1$, $x=4$?
- a) 75 b) 57 c) 65 d) 70
10. What is the area enclosed by $y=3x$, the x-axis and ordinates $x=0$, $x=4$?
- a) 27 b)20 c)25 d)24
11. What is the area of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$
- a) πa^2 b) $4a^2b^2$ c) $\frac{\pi ab}{4}$ d) πab
12. What is the graph of the curve $y=(x^2-1)(x^2-5)$ is concave upward for?
- a) $x>1, x<-1$ b) $x<1$
- c) $x<1, x>-1$ d) $-1<x<1$
13. What is the case with the function $f(x)=2x^3-24x+15$?
- a) increasing at $x=4$ and decreasing at $x=3$
- b) decreasing at $x=3$
- c) decreasing at both the points
- d) increasing at $x=3$ and decreasing at $x=3/2$
14. The graph of function $f(x)=x^4-8x^3+18x^2-24$ is concave downward in:
- a) $(-\infty, 1)$ b) $(3, \infty)$ c) $(1, 3)$ d) $(-\infty, \infty)$
15. What is the case with every continuous function?
- a) increasing b) decreasing
- c) differentiable d) not always differentiable
16. If the sum of two non-zero numbers is 4, what is the minimum value of the sum of their reciprocal?
- a) $1/4$ b) $1/2$ c) 0 d) 1

17. A man of height 2m walks directly away from a lamp of height 5m, on a level road at 3m/sec, What is the rate at which the length of the shadow is increasing?

- a) 1.5m/sec^2 b) 3m/sec^2 c) 2m/sec^2 d) 4m/sec^2

18. What is the case with the derivative of an odd function?

- a) does not exist b) an odd number
c) an even function d) none of these

19. If $y=f(x) > 0$ and $\int_a^b f(x)dx$ gives the area enclosed by:

- a) $x=0, y=0, y=x$ and $y=f(x)$
b) $x=0, y=a, y=x$ and $y=f(x)$
c) $x=a, y=b, y=x$ and $y=f(x)$
d) $x=a, x=b, y=0$ and $y=f(x)$

20. What is the area between the curve $y=1-|x|$ and x-axis?

- a) 1 b) $1/2$
c) 2 d) $1/3$

B. Solve the following: $2 \times 5 = 10$

1. Show that the function $f(x)=x^2-3x+4$ is increasing at the point $x=2$ and is decreasing at the point $x=1$.

2. Find the absolute maximum (greatest value) and the absolute minimum value (least value) of the function $f(x)=x^3-4x^2-11x+30$ defined on an interval $[-1,5]$.

Answer Key

1.	c	2.	d	3.	a	4.	c	5.	d
6.	b	7.	a	8.	b	9.	b	10.	d
11.	d	12.	a	13.	d	14.	c	15.	d
16.	d	17.	c	18.	c	19.	d	20.	a

Appendix-B

Interview Guideline for teacher

Name of the school:

Name of the teacher:

Age:

Sex:

Teaching experience:

Education:

Address:

- How long have you been in this profession?
- What is your qualification?
- What problem you encounter when teaching derivative and anti-derivative to the student?
- What do you think is the most responsible element that obstructs students from doing application of calculus based tasks effectively?
- Have you got any training related to teaching learning from the government?
- How often do you make student involve in group discussion?
- Do you make the use of teaching learning materials?
- Do you taken extra tuition classes?
- How do you evaluate students' performance?
- Do parents visit school to keep record of their children's study?
- How do you encourage students to do mathematical problem?

- What type of teaching method do you follow to teach application of derivative and anti- derivative to the students?
- How do you react when students fail to do various mathematical problems?
- Do you make the sufficient use of teaching learning materials?
- Are there enough teaching learning materials at school or not?
- Do you take extra tuition classes?
- How do you evaluate students' performance?

Appendix-C

Interview Guideline for student

Name:

Age:

Sex:

Class:

Position in class:

Address:

The interview for students can be taken on the following main topics.

- Is mathematics your favorite subject or not?
- What is the obstruct you encounter when doing calculus?
- How much time do you give to your study at home?
- Do you get help from your parent's regarding your study?
- Did you have any prior knowledge on derivative and anti-derivative before you joined plus two?
- How often do you involve in peer interaction?
- How many students' are there in your class?
- Do you get enough support from your mathematics teacher to do calculus?
- Do you get enough reference books in the library of the school?
- How often do you take part in mathematics program?
- What encourages or discourages you to solve derivative and anti-derivatives?

- What are the causes of your anxiety regarding the application of derivatives and anti-derivatives?
- How do you feel in an application of derivatives and anti-derivatives class?
- Are you satisfied with your math teacher's teaching methods, activities and behavior toward students?
- Did you like math when you were in Elementary School?
- What are the main causes that made you anxious toward mathematic?
- How much time you have managed for practice of derivatives and anti-derivatives at home?
- How much help do you get from your parents regarding your study?
- What do you do when you can't solve or workout a math problem?
- What could teachers do to help you do well at calculus?
- Do you express your feeling, confusion, problem about subject matter freely with your math teacher?
- Which types of behavior and teaching method you prefer from your teacher?
- What do you want from school administration to improve your math? Do your school administrations address your problem on previous days?
- How do teachers evaluate your performance?
- Do you get an opportunity to take part in extracurricular activities related to mathematics?

Appendix-D

Item Analysis Chart

S.N.	U_R	L_R	$R=U_R+L_R$	P-Value	D-Value	Decision
1	5	3	8	70%	0.4	A
2	4	3	7	80%	0.2	R
3	5	3	8	75%	0.4	A
4	4	1	5	65%	0.6	A
5	5	2	7	70%	0.6	A
6	5	3	8	80%	0.4	A
7	5	2	7	75%	0.6	A
8	5	3	8	80%	0.4	A
9	4	2	6	70%	0.4	A
10	5	3	8	70%	0.4	A
11	5	2	7	75%	0.6	A
12	4	3	7	80%	0.2	R
13	5	2	7	70%	0.6	A
14	4	2	6	75%	0.4	A
15	5	3	8	75%	0.4	A
16	3	2	5	65%	0.2	R
17	4	2	6	60%	0.4	A
18	4	2	6	60%	0.4	A
19	5	4	9	75%	0.2	R
20	3	1	4	55%	0.4	A

Where,

A=Accepted Item

R= Need Revision

Appendix-E

Reliability of Achievement Test Item (Using split-half method)

S.N.	Odd(X_o)	Even(X_e)	$X=X_o-$ A	$Y=X_e-$ A	X^2	Y^2	XY
1	19	19	4	5	16	25	20
2	17	17	2	3	4	9	6
3	17	16	2	2	4	4	4
4	16	16	1	2	1	4	2
5	16	15	1	1	1	1	1
6	15	14	0	0	0	0	0
7	14	13	-1	-1	1	1	1
8	13	11	-2	-3	4	9	6
9	11	10	-4	-4	16	16	16
10	10	6	-5	-8	25	64	40
	$\sum X_o=148$	$\sum X_e=137$	$\sum X=-2$	$\sum Y=-3$	$\sum X^2=72$	$\sum Y^2=133$	$\sum XY=96$

Now, Correlation Coefficient (r_{oe})= $\frac{\sum XY}{\sqrt{(\sum X^2 \cdot \sum Y^2)}}$

$$=96/\sqrt{(72 \times 133)}$$

$$=96/97.86$$

$$=0.98$$

Total Reliability Coefficient (r_t)= $\frac{2r_{oe}}{1+r_{oe}}$

$$=2 \times 0.98 / 1 + 0.98$$

$$=1.96 / 1.98$$

$$=0.99$$

Appendix-F

No. of Students	F.M.	Marks obtained
1	30	12
2	30	16
3	30	18
4	30	13
5	30	20
6	30	10
7	30	14
8	30	17
9	30	13
10	30	22
11	30	11
12	30	15
13	30	10
14	30	13
15	30	12
16	30	18
17	30	13
18	30	16
19	30	19
20	30	12
21	30	14
22	30	9
23	30	17
24	30	13
25	30	15
26	30	16
27	30	19
28	30	24
29	30	20
30	30	12
31	30	15
32	30	9
33	30	10
34	30	4
35	30	8
36	30	10
37	30	2
38	30	11
39	30	15
40	30	4
41	30	8
42	30	12
43	30	11

44	30	11
45	30	14
46	30	10
47	30	15
48	30	16
49	30	4
50	30	11
51	30	14
52	30	11
53	30	15
54	30	17
55	30	9
56	30	4
57	30	20
58	30	6
59	30	19
60	30	8
61	30	6
62	30	17
63	30	4
64	30	5
65	30	11
66	30	13
67	30	15
68	30	10
69	30	6
70	30	11
71	30	13
72	30	11
73	30	9
74	30	4
75	30	12
76	30	16
77	30	11
78	30	15
79	30	13
80	30	9
81	30	14
82	30	3
83	30	16
84	30	17
85	30	12
86	30	15
87	30	10
88	30	12
89	30	6
90	30	6
91	30	12

92	30	15
93	30	9
94	30	11
95	30	5
96	30	11
97	30	9
98	30	15
99	30	14
100	30	10
101	30	7
102	30	12
103	30	8
104	30	13
Mean = 12		
S.D. = 4.41		
Variance = 19.87		

Appendix-G

Grading system of Grade XI and XII in Nepal

Percentage Obtained	Grade	Grade Description	Grade Point
Above 90%	A ⁺	Outstanding	4.0
80%-89%	A	Excellent	3.6
70%-79%	B ⁺	Very good	3.2
60%-69%	B	Good	2.8
50%-59%	C ⁺	Above average	2.4
40%-49%	C	Average	2.0
20%-39%	D	Below average	1.6
1%-19%	E	Insufficient	0.8
0	N	Not graded	0