LEARNING STRATEGIES OF MATHEMATICS STUDENTS

Bishnu Khanal

A DISSERTATION

Submitted to

Tribhuvan University, Faculty of Education

for the Degree of

Doctor of Philosophy in Education

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LETTER OF RECOMMENDATION

This is to certify that Mr. Bishnu Khanal, a student of academic year 2011-2015 with T.U. Registration Number 19991-90 has completed his Ph D dissertation under our supervision for the period prescribed by the rules and regulations of Tribhuvan University. The dissertation entitled "Learning Strategies of Mathematics Students" embodies the results of his research conducted during the period of 2011-2015 A.D. under the Faculty of Education, T.U. We recommend and forward his dissertation to be submitted for evaluation and awarding the Degree of Doctor of Philosophy in Education.

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(Prof. Hari Prasad Upadhyay, Ph.D)

Dissertation Guide

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(Prof. Lekhnath Sharma, Ph.D)

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Date: March 9, 2015

ABSTRACT

An abstract of the dissertation of Bishnu Khanal for the degree of Doctor of Philosophy in Education presented on October, 2015.

Title: Learning Strategies of Mathematics Students.

Abstract approved by: ....

(Prof. Hari Prasad Upadhyay, Ph.D)

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Mathematics students of Nepalese secondary schools, have difficulties in understanding, investigating and generalizing the mathematical situation. Therefore, the number of students failing in mathematics examinations is remarkably high. Only a small number of students seem to have gained success in this subject. In this context, the major purpose of conducting the study was to investigate the various learning strategies adopted by mathematics students, and the different contributing factors required for the promotion of learning strategies used by mathematics students in the secondary schools of Nepal. In the meantime, it tried to find out the differences in learning strategies used in terms of gender, ability group, school locations and school types, effective learning strategies associated with the students' best performance in mathematics, and the existing classroom practices prevalent in Nepalese secondary school mathematics classes along with the teachers' role to promote effective learning strategies.

Data from 1394 students, selected through multi-stage sampling, were gathered using MSLQ tool. Classroom observations in two schools were done throughout a year to find out the practices of students and teachers followed by interview. Quantitative data were analyzed through mean, correlation, chi-square test, Univariate General Linear Model and regression analysis. Qualitative information was analyzed corroborating with theory and previous studies to conduct a more meaningful interpretation of the quantitative analysis.

The results of the study indicated that students used nine learning strategies categorized by Pintrich, Smith and McKeachie which are characterized under "cognitive strategies" and "resource management strategies" to learn mathematics. Peer learning, elaboration and help seeking were the most preferred strategies adopted by students. However, girls were more likely to use peer learning, help seeking and rehearsal strategies, and boys were more likely to use elaboration, effort management and critical thinking strategies. Similarly, remarkable differences were found from observations and interviews between high achievers and low achievers in the use of learning strategies. High achievers used multiple learning strategies consciously with appropriate reasons whereas low achievers used them less consciously. There were differences in attitude, environment, participation and family background between high achievers and low achievers. Similarly, urban school students preferred peer learning, elaboration, help seeking and effort management strategies; however, rural school students mostly preferred elaboration and organizational strategies. Likewise, public school students preferred elaboration, help seeking and rehearsal strategies, whereas private school students mostly preferred peer learning, effort management, and critical thinking strategies,

though students of both types of schools used all the strategies discussed in this study. However, rehearsal, time and study management, and peer learning were seen as the most effective learning strategies required for higher achievement.

As the study found, different factors can influence the formation and promotion of learning strategies. Among them, teachers' teaching strategies, cultural value system towards mathematics education, students' background, environment, economic circumstance and attitude, mathematics curriculum design, goal oriented and career-related teaching and learning, and classroom management were found to be some of the important contributing factors. Despite their roles, these factors more particularly the teachers' teaching strategies and design of mathematics curriculum did not contribute much for the formation of effective learning strategies among the Nepalese students. The implication of the result of the study is that the effective use of learning strategies helps the students significantly for better performance in mathematics. Similarly, the knowledge of learning strategy use helps the teachers to rethink about their instructional design and establish relationship among the various teaching strategies adopted by them, and awareness on the different factors contributed to the formation of effective learning strategies helps all the stakeholders of mathematics education including curriculum designers, school administrators, and mathematics teachers to design mathematics curriculum, classroom practices and instructional strategies.

Bishnu Khanal, Author

DECLARATION

I hereby declare that this Ph.D dissertation entitled "**Learning Strategies of Mathematics Students"** submitted to the office of the Dean, Faculty of Education, Tribhuvan University is an entirely original work. I have made due acknowledgements to all ideas and information borrowed from different sources in the course of writing this dissertation. The results presented in this dissertation have not been presented or submitted anywhere else for the award of any degree or for any other reason. No part of the content of this dissertation has ever been published in any form before. I shall be solely responsible if any evidence is found against my dissertation.

I understand that my dissertation will become a part of permanent collection of Tribhuvan University Library. My signature below authorizes the release of my dissertation to the interested readers upon their request.

....

Bishnu Khanal, Degree candidate

March 9, 2015

ACCEPTANCE AND RECOMMENDATION

The undersigned certify that we have read, approved, and recommended to the Faculty of Education, Tribhuvan University for acceptance, a dissertation entitled LEARNING STRATEGIES OF MATHEMATICS STUDENTS submitted by Bishnu Khanal for the degree of DOCTOR OF PHILOSOPHY IN EDUCATION.

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Date of Approval: October 5, 2015

DEDICATION

This Dissertation is dedicated to my father Mr. Shiva Prasad Khanal and mother Mrs. Yuba Kumari Khanal in honor of their contributions to make me what I am now in spite of the adverse circumstance of life.

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Bishnu Khanal, Author

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LIST OF ABBREVIATIONS/ACRONYMS

AAUW	American Association of University Women
ANOVA	Analysis of Variance
BPEP	Basic Primary Education Project
CDC	Curriculum Development Center
CERID	Research Center for Educational Innovation and Development
DLE	District Level Examination
ESL	English as a Second Language
FIMS	First International Mathematics Study
FSD	Freeport School District
GLM	General Linear Model
GMIN	Grassroot Movement in Nepal
IAE	International Academy of Education
MOE	Ministry of Education
MOHP	Ministry of Health and Population
MSLQ	Motivated Strategies for Learning Questionnaire
N.D.	No Date
NCED	National Center for Educational Development
NCTM	National Council of Teachers of Mathematics
PALS	Principles of Adult Learning Scale
PBL	Problem-based Learning
SD	Standard Deviation
SEDP	Secondary Education Development Project

SIMS	Second International Mathematics Study
SLC	School Leaving Certificate
SPSS	Statistical Package for Social Science
T/L	Teaching/Learning
USA	United States of America
U.S.	United States

CHAPTER I

INTRODUCTION

Background of the Study

Mathematics is used in day-to-day life of people; however, it is projected as a mysterious subject, and a number of myths are associated with it. These myths include some of the commonly expressed views including: "mathematics is just computation", "mathematics is only for clever people (and males)"; "your father is a maths teacher so you must be good in mathematics too" and so on. Such myths and images are widespread, and seem to be present in all classes of people in many countries. Moreover, most of these myths are negative (Buxton, 1981; Ernest, 1996; Peterson, 1996). There are many people who are afraid of maths and take it as one of the most difficult subjects. They are really scared of mathematics and have got very bitter experience with it during their school days. Naturally, some questions arise including: Where does the problem lie? Is mathematics a problematic subject? Does problem lie in the teachers and their teaching methods or in students' learning strategies?

The problem elicited by the questions just mentioned might have been created due to the problem of projection of mathematics as a difficult subject. The researcher's teaching and learning experiences showed that the real problem lies in the incompatibility between teachers' teaching strategies and students' learning strategies. Khanal (2011) has also claimed that the reason behind this is the existing mismatch between teachers' teaching strategies and students' learning strategies. Teachers can re-adjust their teaching strategies if they understand students' learning strategies. Realizing this fact, the researcher has tried to uncover students' learning strategies in this study.

Many students in their school days have difficulties in understanding mathematics, investigating, generalizing the mathematical situation, adopting mathematical skills, solving problems, and applying mathematics. The evidence can be seen in students' fear and the School Leaving Certificate (SLC) results in mathematics. Many of the students have no interest in studying mathematics (Research Centre for Educational Innovations and Development [CERID], 1999). The reason behind this awful situation in mathematics could be because of content issues in curriculum, evaluation system, classroom instruction and the problem in using effective learning strategies. The average achievement of grade VIII students in Mathematics is 28.87%, which is lower than Science (29.62%), English (34.29%) and Nepali (68.80%) (CERID, 1999). This shows that students are scoring poor in mathematics. They have learning difficulties; or there is teaching difficulty with teachers; and they have not been able to harmonize their teaching according to students’ learning strategies.

The International Academy of Education (IAE) carried out the First International Mathematics Study (FIMS), which indicated that the mean scores were below 50%, in fact, the majority below 40% (NCTM, 2001 as cited in Ghimire, 2010). The Second International Mathematics Study (SIMS, 1976-1989) investigated mathematics education at three levels: (1) curricular intentions, (2) implemented curriculum and (3) student achievement (Ghimire, 2010). CERID conducted the study in 1985 among the grade five students and identified that the majority of students secured less than 45% marks in mathematics. This was reiterated by another study which stressed that low achievement is a major problem in mathematics education (Ghimire, 2010).

The performance of SLC students in mathematics is distinctly poor. Ghimire (2010) finds that the average scores of mathematics in SLC examination was 27.57% and the pass percent was only 41.21% in 2002. These studies provide the evidences that the students' achievement in mathematics is considerably low. However, the achievement of students also varies according to the branches of the subjects, gender, class, ethnicity, ability of the individual, types of schools and even the geography.

An effective classroom teaching will make a difference in students' standard in mathematics. However, teaching mathematics effectively is a big challenge for most of the mathematics teachers. Teachers' teaching strategies and students' learning strategies in mathematics may not be harmonizing in practice which might have affected the mathematical achievements of the students. To reduce teacher-student styles and strategies conflicts, some researchers advocate that teaching and learning styles and strategies should be matched (Griggs & Dunn, 1984; Smith & Renzulli, 1984; Charkins et.al, 1985 as cited in Zhenhui, 2001). Kumara Voldivelu (1991, p. 98) states, "………the narrower the gap between teacher's intention and learner's interpretation, the greater are the chances of achieving desired learning outcomes" (as cited in Zhenhui, 2001). Van Lier (1996) & Breen (1998) also conclude that bridging the gap between teachers' and learners' perceptions play an important role in enabling students to maximize their classroom experience (as cited in Zhenhui, 2001).

Similarly, mathematics teachers need to develop their practice so as to fit more closely with the roles, values and philosophies underpinning the mathematics curriculum they teach. Park (2001) asserted that teachers need to match their teaching styles to students' preferred learning styles for difficult tasks, and to reinforce the learning of contents by employing diverse teaching strategies.

The school curriculum aims to provide quality education in Nepal. It has been designed to enhance students' ability to learn; moreover, every student is expected to learn. In the current era of high stakes testing, however, teachers often "teach to test" and spend little time helping the students to learn. The preferred learning strategies of secondary school students are not considered in the learning of mathematics. According to Dunn (1995), the mismatch between teachers' teaching styles and the learning styles and strategies of students leads to frustration and lack of continued achievement in learning career. Similarly, Doolan and Honigsfeld (2000) explain that when students are taught with methods dissonant from their learning style and strategy preferences, they do not succeed in mastering the subject matter as quickly as they could. In order to improve the academic performance of all students, teachers need to help them develop effective learning strategies. Students are expected to construct their own mathematical knowledge, discover relationships and find facts by using their own learning styles and strategies rather than memorizing mathematical formulas and procedures (Cangelosi, 1996). As research suggests, effective use of learning strategies can greatly contribute to improve students' achievement (Protheroe & Clarke, 2008).

How teachers teach is the outcome of how they had learnt. Research supports the concept that "most teachers teach the way they learn" (Stitt-Goheds, 2001, p. 137, as cited in Chang, 2010, p. 6). Dunn and Dunn (1979) claimed that teachers' teaching styles correspond to their learning styles. Based on their personal learning experiences, teachers tend to teach students how they themselves learn the best and introduce learning strategies that have benefited their own learning. The same learning strategies, however, may not work well for all of their students. Therefore, Dunn and Dunn indicated that teachers should adjust their preferred way of teaching to reach each student. Grasha (1996) supported the idea of viewing teaching style in terms of its elements. He defines teaching style as an amalgam of several elements that teachers demonstrate in every teaching-learning moment - behaviors, roles, instructional practices, characteristics, and beliefs. Grasha agrees with Dunn and Dunn and claims that teachers should modify their teaching styles so as to meet the needs of all students.

Many researchers support the view that matching teaching and learning styles and strategies improves students' achievement (e.g., Stitt-Gohdes, 2001; Henson, 2004; Hou, 2007). Zeeb's (2004) research indicated that aligning learning styles of students with teaching styles of instructors led to an improvement in academic performance. He examined how junior high school students learned and how their teachers taught and found that there was a disconnection between students' learning styles and their teachers' teaching styles which resulted into students' low achievement. Zeeb used the information obtained from assessing learning and teaching styles to help teachers modify their teaching styles to accommodate varying learning preferences, which resulted in improving students' test scores.

Farkas (2003) investigated the effect of teaching styles on two groups of seventh-grade students. Students in the experimental group preferred similar learning styles and were taught according to their preferences, while the control group was taught with a conventional teaching style. In this study, the students in the experimental group, who received a teaching style that matched their preferred learning styles, outperformed the control group academically. The experimental group also showed more positive attitude towards learning, deeper appreciation of people's feelings, and an increased ability to transfer what they had learned from one area to another.

Looking at the assessment of teaching styles aforementioned, one can see that several studies (Farkas, 2003; Henson, 2004; Hou, 2007; Stitt-Gohdes, 2001; Zeeb, 2004) have shown that learners have higher learning gains when their teacher takes account of their needs to experience meaningful learning, encourages active engagement, empowers them to direct their own learning, and demonstrates flexibility in his or her teaching style. Learning mathematics is effective if students are exposed to construct or reconstruct mathematical concepts. This implies that mathematics teachers should rethink in the existing teaching and learning strategies.

Understanding of theories about how people learn and the ability to apply them in teaching mathematics are important pre-requisites for effective mathematics teaching. All the mathematics teachers should know what learning strategies have been used by the students in mathematics class.

Research conducted by Chang (2002) indicated that a constructivist teaching style affects students' perceptions toward physics teaching and learning. Chang explored views of the students who were instructed through constructivist approach and traditional approach. Students placed more value on having the opportunity to actively participate in group discussions and to examine concepts they learned when they were taught through the constructivist approach compared to the situation of learning through traditional approach. The study suggested that the constructivist teaching style fosters greater flexibility in teaching, and brings about students' use of deep learning strategies (thinking and discussing) and knowledge construction. Contrary to the study carried out by Chang, Kim's (2005) research in Korea indicated that even though students who received a constructivist teaching style for nine weeks had greater use of learning strategies than those who received a traditional teaching style, there was no significant difference between learning strategies used by these two groups.

Learning strategies are an individual's approach to a task. They are how a student organizes and uses a set of skills to learn content or to accomplish a particular task more effectively and efficiently either in or out of school (Schumaker & Deshler, 1984). According to NICHCY (1997):

> Learning strategies include what we think about (e.g., planning before writing, realizing when we are not understanding something we are reading, remembering what we have learned previously on the topic under study) and what we physically do (e.g., taking notes, rereading to clear up confusion, making a chart, table or story map to capture the most important information). (p. 3)

Teachers who teach learning strategies teach students how to learn and how to be successful in and out of the academic setting. Learning strategies give students a way to think through and plan the solution to a problem. Students who use learning strategies also become more effective and independent learners.

Students with disabilities in mathematics often do not learn these strategies naturally (Montague, 1998). They switch from strategy to strategy because they do not know how to use them effectively. However, they can be taught to use two basic types of learning strategies, cognitive and metacognitive. Cognitive strategies include how to read, visualize, estimate and compute (Montague, 1998). Students can easily be taught as the teacher (1) repeatedly models the strategies, (2) monitors the student's use of the strategies and (3) provides feedback to students. Metacognitive strategies are more difficult to teach because they involve self questioning and self-checking techniques (Montague, 1998). Students with difficulties often have less developed strategy banks and do not have access to these important problem-solving strategies unless the strategies are taught to them (Montague, 1998). However, learning to use the metacognitive strategies will enable learners to be successful throughout the learning opportunities in their lives.

The more active and involved students are in the learning process, the more motivated they become. In this context, Sheerin (1997) rightly affirms: "Learning is more effective when learners are active in the learning process…." (p. 56). For this, students are to be encouraged to use a variety of learning strategies such as applying prior knowledge, scanning for specific information, organizing information in graphs and charts, getting meaning from the context, keeping vocabulary notebook or word files and using outside resources and libraries. These strategies help students to become more aware of their own learning strategies. For Richards et al. (1999, p. 208) learning strategy is "a way in which a learner attempts to work out the meaning and use of words, grammatical rules and other aspects of language." In this regard Cohen (1998, p. 4) opines learning strategies in terms of "learning processes which are consciously selected by the learners." Ellis (1986, p. 167) conceptualizes learning strategy as "the process of hypothesis formation and testing." Similarly, Wenden (1987, pp. 6-8) envisages learner strategies as "language learning behaviours that learner consciously employs in the language learning process".

Students may choose inappropriate learning strategies or may approach learning with few strategies and use only these ineffective strategies while tackling a task, even when their methods repeatedly lead to failures. For this reason, Pressley and Harris (2006) suggested that educators can implement “strategies instruction,” a useful approach to teaching learning strategies. Strategies instruction can be embedded in content-area classes; it can be a part of the teaching-learning process.

Personal behaviors and characteristics in the teaching-learning process indicate the way educators teach (Grasha, 1996) and show that various teaching styles exist. Teachers vary in how they manage their classes, how they interact with their students, and how they view their roles as educators. When classroom teachers show learners how to select and use appropriate strategies, they display their own preferred teaching styles. Thus, teaching styles affect not only the instructional strategies adopted by teachers but also students’ learning styles and abilities. Instead of relying on their preferred teaching style, teachers should understand that one style of instruction may not meet the needs of all students. Students differ in the way they approach the learning process and deal with various learning activities (Callahan, Clark, & Kellough, 2002). One good way to make teachers consider individual learning differences and recognize the need to modify their own teaching style is to make them learn from the student’s perspective. Much research has been devoted to teaching styles and learning strategies in higher education. There is little research; however, concerning the learning strategies of secondary level school students in mathematics.

The conventional method of teaching mathematics has been less successful. Majority of the students turn out to be very miserable and inattentive in mathematics classes. The reason is they could not memorize or recall a concept with ease after being taught a topic. Methods of teaching and their styles of learning on the topics may affect the performance of students. Udeinya and Okabiah (1991) blamed poor performance of students in mathematics on poor methods and approaches to teaching which has reduced the level of motivation. Harbor–Peters (2001) asserted that the issue of poor performance in mathematics examinations was due to the problem of teaching methods. Teaching methods have to make learning easier, faster, more enjoyable and more transferable to the new situations of mathematics learning. However, learning strategies in mathematics are related to the role of numerical acquisition, the connection of strategies to other individual traits of learners such as learning styles, attitude towards learning, motivation, anxiety and other factors and to the impact of strategic instruction. Rahman (2011) states that, culture influences upon learning mathematics. Singh (1985) has attempted to identify the effect of culture on mathematical creativity of two religious groups and found a significant difference between urban and rural, Hindu and Muslims. Thus, students belonging to different social classes differ in their academic achievement (as cited in Rahman, 2011). Hindu, Muslim and Christian students differ in their academic scores. Stevenson and et.al (1986) have asserted that, the cross cultural differences in mathematics performance before kindergarten, early environmental manipulations may have especially strong impact on subsequent achievement (as cited in Rahman, 2011). Similarly, Indra (1991) found the relation of social class, religion, family size and birth order to academic achievements (as cited in Rahman, 2011).

Despite these social, cultural ethnic and environmental factors, learning strategies are the elements of an active knowledge building process. These elements are continuously developed when a person interacts with mathematical objects in context and with other people. Frota (2008) points out that strategies and styles of learning are improved from processes of interaction with the teacher, among classmates, as well as with the classroom environment. Students preferentially take in and process information in different ways: by seeing and hearing, reflection and acting, reasoning logically and intuitively, analyzing and visualizing. In the same manner some instructors lecture, others demonstrate or lead students to self-discovery; some focus on principles and others on application, some emphasize memory and others understanding.

In this way, when mismatches exist between learning strategies of most students in a class and the teaching styles of the teacher, the students may become bored and inattentive in class, do poorly on tests, get discouraged about the courses, the curriculum, and themselves, and in some cases, change to other curricula or drop the courses. As a result, teachers are confronted by low test grades, unresponsive or hostile classes, poor attendance and dropouts.

Moreover, learning strategies also incorporate beliefs and values, and are value-laden, some of them being considered as positive to promote an in-depth learning approach. Schoenfeld (1992) highlights three relevant aspects of metacognition: a person’s knowledge of his/her own processes of thinking; knowledge of control or self-regulation of actions; beliefs and conceptions that can influence the way someone does mathematics. Schoenfeld finds metacongnitions, beliefs and practices as special aspects of mathematical thinking. Motivation, expectation, beliefs affect the goals, learning strategies and learning styles. Understanding about students’ learning strategies and styles could help them know themselves, choose the course they will take, decide the learning methods they will adopt, and follow the suitable strategies they will take to learn mathematics. Hence, being aware of learning strategies is important for teachers whole planning a course and proposing different tasks in order to promote the development of diverse learning strategies.

Understanding students' learning difficulties in relation to their learning strategies and timely feedback plays important role in promoting learning. When students respond to questions on an assignment or examination, they may not get feedback for several days or weeks. By the time they receive feedback, they may have moved on to learning new content. Silverthorn argues: If understanding of a new content is dependent on understanding of the old content, and if there were misunderstanding of the 'old' content that were not addressed immediately when it was presented, then the cumulative effect of misunderstandings compiled with no corrective feedback could put students at risk of underperformance or even failure: (Silverthorn, 2006, p. 136).

Nowadays, much research has been carried out in "learning difficulties" (Qian, 1996, as cited in Wang, Du & Liu, 2009). However, most of the research focused on discussion of psychology of learning, which lacks connection with concrete content in mathematics. Although some scholars mentioned that learning difficulty is a significant topic in the research field (Du, 2003; Tao, 2004, as cited in Wang, Du & Liu, 2009), it is still rare in research that focuses on students' learning strategies in mathematics. In fact, effective strategies to improve struggling students in their mathematics learning process are lacking.

An effective mathematics learning environment is one in which students and teachers interact in ways that allow students to have an opportunity to maximize how much they learn. There are several ways in which students and teachers interact in a learning environment. However, creating an interactive learning environment inside mathematics classroom in which students are engaged in mathematics learning can be challenging. One of the reasons is students may experience discomfort regarding their own level of knowledge in the contents of mathematics; and they can escape away from participating openly in classroom discussions or from responding to teacher's oral questions. The complex negotiation of teacher talk, student talk, and classroom dynamics while remaining on task requires in depth research. Fielder and Henriques (1995) opines: Active learners learn well in situations that enable them to do something physical and reflective learners learn well in situations that provide them with opportunities to think about the information being presented. The more opportunities students have to both participate and reflect in class, the better they will learn new material and the longer they are likely to retain it. (Kolb, 1984; Mclarthy, 1987)

The concepts of the aforesaid authors indicate that learning strategies are particular actions employed by learners to make their learning easier, faster, more joyful, more directed, more effective and more transferable to new situations. Many researchers and theorists have tried to define learning strategies. But there is enough explanation about the relation between students' learning strategies, teachers' teaching strategies and learning difficulties. Therefore, there is an urgent need for conducting research on this issue and find out the reasons and their solutions. Without understanding the learners' strategies and their problems, improvement in mathematics education is difficult. So this research aims to address this difficulty and thereby contribute to the advancement of mathematics education.

The above mentioned practical experiences and theoretical backgrounds have inspired me to investigate the preferred learning strategies of secondary school students in the learning of mathematics in Nepalese context. The terms: ‘learning strategies’, ‘teaching strategies’, ‘teaching style’, ‘learning styles’, ‘learning difficulties’ and ‘learning environment’ are related to the concept of learning strategies. The researcher has discussed the relation of these terms with learning strategies in this study.

Purpose of the Study

The purpose of the study is primarily to investigate the preferred learning strategies of secondary school students in the learning of mathematics. It is envisaged that students guide their learning of mathematics with regard to their preferences on learning strategies. Secondly, the impediments students might encounter while adopting their own preferred learning strategies are identified. Thirdly, the assistances students require in adopting their own learning preferences are determined. When children do not learn as per the way they are taught, the teachers must teach them as per the way they learn (Dunn, 1995). This shows that teachers must teach according to the interest of their students and organize their teaching strategies so as to fit with the learning strategies of their students. This study has sought to identify the preferred learning strategies of secondary school students in Nepal and to examine the prevailing problems that inhibit them to adopt their preferences.

So, this study explores the use of learning strategies by mathematics students in common as well as based on gender, ability group, school location and school types. It even analyzes the teacher’s role and classroom practices in promoting learning strategies. It also explores the factors contributing to the formation and use of learning strategies.

Statement of the Problem

Many students have difficulties in studying mathematics. The performance of students in mathematics in SLC is very poor with average score 27.57 and pass percentage 41.21 (Ghimire, 2010). This shows that low achievement is a major problem in mathematics (Ghimire, 2010). The reason behind this pathetic situation might be the various myths related to mathematics which has created fear, anxiety and consequently dropping out of mathematics. Similarly, content issue in curriculum, evaluation system and the problem in adopting effective learning strategies by the students, and classroom instruction might also have been associated with the poor performance of students in mathematics. It is a great challenge to determine whether the students have learning difficulties or there is teaching difficulty with teachers to harmonize their teaching to students' learning strategies. Teachers' teaching strategies and students' learning strategies may be conflicting which has affected the mathematical achievements of the students. When mismatches exist between learning strategies of students and the teaching strategies of teachers, the students may feel bored and become inattentive in class, do poorly in tests, get discouraged and /or drop the courses. This situation shows the need to investigate the preferred learning strategies of secondary school students in learning mathematics. Teachers can readjust their teaching strategies and design the classroom activities accordingly if they have knowledge about the students' use of learning strategies. Further, teachers need to have the knowledge of learning strategies used by students with different genders, ability groups, school location and school type to readjust their teaching strategies. Even the knowledge of the students' preference and the most effective learning strategies will help teachers to encourage students to select the most effective learning strategies that assist for better achievement. It is also important to study whether Nepalese classroom practices are supportive for the students to promote learning strategies. It also seems necessary to discover the factors contributing to the formation of learning strategies.

There have not been adequate studies on learning strategies of secondary level school students in learning mathematics. Even though some researchers (Charkins et.al, 1985; Griggs & Dunn 1984; Smith & Renzulli, 1984) have been interested in the use of learning strategies and have suggested that students can benefit from effective learning strategies, research has not reported on the literature suggesting that the majority of secondary school students are taught to use various learning strategies or that secondary school teachers' teaching strategies influence their students' use of learning strategy. As Dunn (1995) argues, students should be encouraged to use their preferred learning styles and strategies in order to understand the subject they learn. Similarly, Cano (2005), Burke and Dunn (2002), and Dyer and Osborne (1999) discuss the importance of learning styles and strategies for learners' better achievement.

Many researchers (Griggs & Dunn, 1984; Park, 2001; Smith & Renzulli, 1984; Charkins et.al, 1985 as cited in Zhenhui, 2001) have claimed that the teaching strategies of the mathematics teachers must be designed according to the learning strategies of the students. However, the study about it has not been carried out in Asian context, particularly in the Nepalese context of mathematics students. The culture, context and cognition of Nepalese students are different. Therefore, there is an urgent need to explore the students' learning strategies according to their context, cognition and individual interest, and further make recommendations for teaching strategies which will result into better achievement of mathematics students.

The knowledge of learning strategies is essential for educating or developing the potential of children in different ways according to learners' abilities, learning characteristics and/or needs (Chan, 2001). The above mentioned problems and research gaps encourage the researcher to conduct this study.

Rationale for the Study

Learning strategies are particular actions employed by learners to make their learning easier, faster, more joyful, more directed, more effective and more transferable to new situations. Many researchers and theorists have tried to define learning strategies and teaching styles/ strategies. But they have not provided sufficient suggestions regarding what strategies students apply in learning mathematics. As a major concern, the researcher has not found the answer to the question regarding the types of learning strategies the Nepalese secondary school students in mathematics use to learn mathematics?

No research is found regarding the learning strategies adopted by boys and girls students. No research is carried out to determine differences among various ability groups such as high and low achiever students' use of learning strategies in learning mathematics. Also the researcher has not seen the research related to whether teachers' teaching strategies help to promote Nepalese students' learning strategies or not. Necessities of adequate classroom events to promote learning strategies of Nepalese secondary school mathematics students are not found in literature review. Many researchers and theorists have tried to define learning strategies and teaching styles/strategies but they have not provided any suggestion regarding what the factors are contributing to the formation of learning strategies. Similarly, their attention is not enough to examine why learning difficulties occur in relation to students' learning strategies.

Therefore, there is an urgent need for conducting research on these issues and find out the reasons and their solutions. Without understanding the learners' strategies and their problems, improvement in mathematics education is difficult. Knowing how students adopt their learning strategies may help teachers see their role from different viewpoints and understand the importance of reflecting on as well as adjusting their teaching styles/strategies. So, this research aims to address these problems and thereby contribute to the advancement of mathematics education.

Objectives of the Study

The objectives of the study are as follows:

1. To explore students' learning strategies in mathematics,
2. To analyze the differences in students' learning strategies by gender, ability group, location and school types,
3. To identify the most effective learning strategies for better achievement in mathematics,
4. To examine classroom practices as learning strategy promotion activities,
5. To determine the factors contributing to the formation of learning strategies.

Research Questions

This study aims to answer the following major research questions:

1. What are the learning strategies of students in mathematics?

2. What learning strategies do secondary level school students adopt most to solve mathematical problems?
3. What difference is there between boys and girl students in their preferred learning strategies?
4. What kinds of differences between high achieving and low achieving students are there in adopting their preferred learning strategies?
5. What kinds of differences between urban and rural school students are there in their preferred learning strategies?
6. What kinds of differences between public and private school students are there in their preferred learning strategies?
7. Which learning strategies can be combined most effectively to use for better achievement in Mathematics?
8. How do teachers' teaching strategies help to promote students' learning strategies?
9. How are classroom practices promoting learning strategies?
10. What are the factors contributing to the formation of learning strategies?

Significance of the Study

The study is expected to provide helpful information for educators and policy makers to promote positive student outcomes and productive working environment. It also helps students to become strategic learners, educators to be aware of a student's learning strategy use and have flexible teaching styles. The results of this study can be used to inform secondary school teachers about the different ways in which students approach learning. By gaining awareness of students' strategy use, teachers may realize that it is important to teach various learning strategies according to specific needs.

According to Callahan, Clark and Kellough (2002), teachers must modify their teaching styles and teach a wide repertoire of strategies. One teaching style cannot be used for all students. For learning to take place, teachers need to use various teaching styles and to help students, including those with learning difficulties, develop their own learning strategies and use these strategies effectively and efficiently.

This study tries to throw lights on learning strategies used in studying mathematics. So, mathematics teachers can use this study to assess the learning strategies employed by the students of various classes and levels. Moreover, this study is expected to be significant for students, teachers, syllabus designers, textbook writers, material producers, teacher trainers, learner trainers, mathematicians and those who are directly and/or indirectly involved in teaching/ learning mathematics.

The general objectives of education put mathematics as one of the most essential subjects for everybody since it is relevant to the daily life and is also a tool for science and technology. Thus, the attention paid to mathematics education in the country’s education is encouraging to investigate secondary school students' preferred learning styles and strategies in mathematics classes, which, in turn, is believed to improve mathematics instruction in the country. Mathematics instruction becomes more meaningful and understandable when the preferred learning strategies of students, the challenges they might face and the assistance required for students are addressed in a desirable manner. According to Beck (2001):

> When a student reacts favourably or unfavourably to a lesson, it may be due to the subject matter or the teaching strategy followed by the teacher and whether it matches the learning styles and strategies preferences of the students. (p. 13)

Thus, the significance of this study is to address the problems of learning strategies; to provide feedback to the concerned bodies (notably government and non-governmental institutions, curriculum designers, teacher trainers, teachers, researchers, and students themselves) to help them improve the teaching-learning processes in secondary schools; to reduce learners' bias or prejudice towards mathematics by assisting them to use their own preferred learning strategies; to contribute to further studies that make the learning of mathematics more joyful, participatory and sustainable.

In the light of the above mentioned significances, it becomes necessary to conduct the investigation into the preferred learning strategies of secondary school students when they learn mathematics.

Delimitation of the Study

In Nepal, mathematics is taught as a subject from Kindergarten to higher education either as a compulsory or as an optional subject. The discussion on the learning strategies of different level students is very broad. It is impossible to analyse the learning strategies of all level students. This study is concentrated on secondary level students. It is impossible to study about all secondary level students in Nepal. This study is delimited to grade IX students, for the purpose of uniformity and manageability. These students have relatively sufficient experiences with mathematics learning. So, the study is limited to the mathematics students of 24 schools of three geographical regions of Nepal including urban and rural areas. The results can be contextually generalized to these students and similar others provided the context is similar (Denzin & Lincon, 2005). The questionnaire (MSLQ) developed by Pintrich, Smith and McKeachie (1989) was adapted for the study with similar purpose. Information was collected only from the students; so teachers and guardians are not included in the study.

Operational Definition of Terms

The operational definitions of the terms used in this study are the following:

a. Teaching Strategy: It is a purposefully conceived and determined plan of action. According to Strasser (1964); teaching strategy is generalized plan for a lesson or lessons, and it includes structure, desired learner behavior in terms of the goals of instruction, and an outline of tactics necessary to implement the strategy (as cited in Anil, 2011).

b. Teaching Style: "The overall traits and qualities that a teacher displays in the classroom and that are consistent for various situations can be described as teaching style" (Conti, 1989, p. 3). Teaching style refers to the way various teaching approaches are combined. It involves specific instructional techniques or behaviours. It is also a combination of teaching methods that are related either because they describe similar behaviours or have similar instructional purposes.

c. Learning Strategy: This can be defined as learners' behaviors that are intended to "control and regulate their own cognition" and can be used for "the processing of information and controlling other resources besides their cognition" (Pintrich, Smith, Garcia, & Mckeachie, 1993, pp. 802- 803). It is a way a learner engages in a task including how an individual plans and regulates his/her performance. A learning strategy is a set of one or more procedures that an individual acquires to facilitate the performance on a learning task.

d. Preferred Learning Strategies: In this study, preferred learning strategies need to be perceived as the primary choices and mechanisms in the studies of mathematics at secondary school level for mastering the subject matter.

e. Learning Styles: Searson and Dunn (2001) defined learning style as a biologically and developmentally determined set of personal characteristics that make identical instruction effective for some and non-effective for others. The National Association for Secondary School Principals (NASSP) Task Force defined learning style as "the composite of characteristic, cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment" (Keefe *et al.,* 1986). Similarly, Dunn and Dunn (1993) described learning style as the way that each person begins to concentrate on, process, internalize and retain new and difficult academic information.

f. Learning Difficulties: These are the difficulties of learners in acquiring the knowledge and skills to the normal level expected from the peers of the same age, especially because of mental disability or cognitive disorder.

g. Learning Environment: It refers to the whole range of components and activities within which learning takes place.

h. Secondary Level School Student: A student enrolled in grade IX in Secondary school of Nepal.

i. Ability Group:

    i. High Achiever: The students who secured 80% marks and more in District Level Examinations of grade VIII.

    ii. Low Achiever: The students who secured the marks below 32% in District Level Examinations of grade VIII.

j. School Location:

   i. Urban School: The school located in city, town, or district headquarter.

   ii. Rural School: The school located in the village far from city, town, or district headquarter.

k. School Type:

   i. Public School: The school runs by the government of Nepal.

   ii. Private School: The school runs in the private fund by an individual or group of individuals.

l. Cognitive Strategies:

   i. Rehearsal Strategy: It refers to students' use of strategies to recall and repeat learning material.

   ii. Elaboration Strategy: It includes summarizing information and putting ideas into one's own words.

   iii. Organization Strategy: It concerns students' use of strategies to make connections across learning experiences.

   iv. Critical Thinking Strategy: It refers to how learners question or analyze statements and concepts learned in class.

   v. Metacognition Strategy: It concerns how students set learning goals and monitor/regulate the learning process.

m. Resource Management Strategies:

   i. Time and Study Management Strategy: It refers to the strategies adopted by students to manage their time and learning environment.

ii. Effort Management Strategy: It refers to the students' commitment to achieve their learning goals even when there are difficulties.

iii. Peer Learning Strategy: It includes the strategies adopted by students to work with their friends and classmates.

iv. Help-seeking Strategy: It involves how students seek assistance from their teachers and classmates in the learning process.

CHAPTER II

LITERATURE REVIEW

In this chapter, the researcher has discussed the historical perspectives of learning strategies, nature of mathematics and mathematics education, students' learning strategies, mathematical learning experiences and attitudes, role of teachers and classroom practices, and the gaps of studies on learning strategies in the field of mathematics education in Nepal. The empirical study of learning strategies and the perspectives and focus of learning theories on learning strategies have also been dealt with. This literature review is divided into six main parts. Part I discusses the historical perspectives of learning strategies which describe the basic notions for the inception and need for the study of learning strategies. Part II deals with the nature of mathematics and mathematics education describing the meaning of mathematics and mathematics education and the reasons for the study. Various learning strategies and experiences of students in learning mathematics are discussed in Part III. In Part IV, the role of teachers in assisting students to use their preferred learning strategies is discussed. Gaps of studies on learning strategies in the field of mathematics education in Nepal are discussed in Part V. Part VI deals with the reviews related to theoretical and conceptual framework.

Part I: Historical Perspectives of Learning Strategies

Identifying the learning strategies students prefer to learn mathematics and creating opportunities to use their own preferences are essential for learning and understanding mathematics. Stewart (2002) argued that flexible combinations of learning and teaching styles allow all students to develop effective ways of gaining positive educational outcomes. The existence of various learning strategies among individuals apparently leads to the speculation and interpretation of learning strategies.

Burke and Dunn (2002) looked at the debate held between Stephen Douglas and Abraham Lincoln in 1858 which drew attention throughout USA. They stated:

> The two people were those who sought a U.S. Senate seat from Illinois. After 140 years of their debate, another historic event took place in Freeport which again drew widespread attention throughout the nation. Teachers in the Freeport School District (FSD) began teaching individual learning styles to ensure that all of their students would perform well in school. The teachers insisted that there was no debating issue that students learn differently from one another. The teachers further insisted that when students are taught using approaches and resources that complement their particular learning styles, their achievement increases significantly. (p. 103)

This debate has paved the way for further study on students' preferences to learning styles and strategies in the USA. Pewewardy (2002), in his study of learning styles of American Indian/Alaska Native students, stated that the investigation of learning styles is not without criticism (p. 23). For example, Bland (1975) holds the position that there is no such thing as American Indian/Alaska Native students' learning styles. Kleinfeld and Nelson (1991) contended that studies of teaching methods adapted to American Indian/Alaska Native students called visual learning styles provided virtually no support for the hypothesis that culturally adapted instruction increased achievement. Stellern, Collins, Gutierrez and Peterson (1996) argued that American Indian/Alaska

Native students are not necessarily right hemispheric dominant and therefore there is no need to adapt instruction especially geared to the right brain learners.

Based on the above comments, Pewewardy concluded that research on learning styles is one of the latest fashions in education. Furthermore, by quoting Gould (1996) and Guthrie (1998), Pewewardy (2002) said that long before educators became interested in learning styles research, it was generally assumed by non-Indian researchers that American Indian/Alaska Native children lacked the innate intelligence and ability to succeed in formal school programs.

Part II: The Nature of Mathematics and Mathematics Education

There are a number of philosophical views, beliefs and conceptions on the nature and learning of mathematics. Schoenfeld (1992) states that these philosophical views, beliefs and conceptions have paved the way for different teaching-learning methodologies of mathematics since teaching–learning process is a means through which teachers, learners, curriculum and other variables are organized in a systematic manner to address the needs and benefits of mankind. Supporting this, Cangelosi (1996) says that from pedagogical point of view, there is no definite and better way of teaching mathematics. Cangelosi stipulated cooperative method, project method, mastery learning method, and problem solving method as some of the basic learning strategies to be employed in the learning and teaching of mathematics. However, there are various challenges in employing the above-mentioned learning strategies which seem to emanate from the preparation of mathematics teaching materials, the training of mathematics teachers, and the existing beliefs and conceptions on the nature of mathematics itself.

In principles, the National Council of Teachers of Mathematics ([NCTM], 1991) described that mathematics education requires qualified teachers who guide students to meet the educational goals and objectives and support students, among other goals, to employ their own preferred learning styles and strategies. In addition to this argument, students need to be able to deploy meaningful learning strategies and use an insightful approach to mathematics learning since mathematics is one of the basics for the development of science and technology. Thus, one can easily see that advancement in science and technology has been possible after the proper application and utilization of mathematical knowledge, which in turn helps to curb societal problems. Cangelosi (1996) noted that the use of calculators and computers has avoided the long and tiresome calculations. use of computer made it possible to avail all information in the world on a table within a fraction of seconds. Similarly, Schoenfeld (1992) illustrated that mathematical knowledge is associated with the socio-economic situation of the community and it helps to enhance the development of citizens. Likewise, Pewewardy (2002) stated that mathematics connects one to his or her universe in many ways by incorporating language, culture and daily living practices.

Mathematics education deals with the nature of mathematics and its teaching/learning. Supporting this view, Austin and Howson (1979) portrayed that mathematics education centers upon attempts to understand how mathematics is created, taught and learned most effectively. The NCTM (1991) indicated that the basic elements in mathematics education process include teachers, learners, curriculum and pedagogy of instruction. The integration of these elements is mandatory to create a full-fledged operational result. Austin and Howson (1979) further elaborated that mathematics education can be viewed both as a process of individual construction and that of acculturation into the mathematical meanings and practices of wider society. One can learn from this point that the role of learners is of paramount importance in the learning of mathematics. As noted in the standards (NCTM, 1989), traditionally people view learners as objects, which are to be filled with knowledge from a knowledgeable person, the teacher. Learners are expected to memorize the rules and procedures, formulas and follow the only steps given by their teacher in order to solve other mathematical problems; and there is no way to construct their own mathematical knowledge. Moreover, traditional viewers have their opinion that the basic features of mathematics are expected to be crammed and given back as received by the learners.

On the other hand, constructivists view learners as the architects to construct their own knowledge, to discover the relationships, and to form their own concepts. Cangelosi (1996) supported this view by stating:

> Mathematics will not be meaningful to students unless they develop certain key concepts in their own minds and discover key relationships for themselves. The learners are not considered as white slates on which something is to be written by a knowledgeable person. Learners should be given the opportunity to exercise different learning styles and use different learning strategies. (p. 14)

Part III: Learning Strategies and Experiences

Learning Strategies

Learning strategies are explicit techniques that students use to enhance their own learning. These strategies include listening, guessing or inferring, taking notes, identifying progress and focusing. O'Malley and et al. (1985, pp. 582-84) categorize learning strategy into three types, which are: cognitive, metacognitive and socio-affective. Cognitive strategies include the strategies of repetition, researching, translation, grouping, note taking, deduction, recombination, imagery, direct physical response, auditory representation, conceptualization, elaboration, transfer and inference. On the other hand, metacognitive strategies deal with pre-assessment and pre-planning, on-line planning and evaluation, and post evaluation of language learning activities and of language use events. Such strategies allow learners to control their own cognition by co-coordinating the processes of planning, organizing and evaluating. It encompasses the strategies of directed attention, self-management, advance preparation, self-monitoring, delayed production, self-evaluation and self-reinforcement. And, socio-affective strategy includes the actions which learners choose in order to interact with other learners (e.g. by asking questions, clarifying social roles and relationship or co-operating with others in order to complete the tasks). Moreover, socio-affective strategies serve to regulate emotions, motivation and attitudes (e.g. strategies for reduction of anxiety and for self-encouragement).

Pintrich, Smith and Mckeachie (1989) have divided learning strategies into two categories: cognitive strategies (rehearsal, elaboration, organization, critical thinking and metacognition), and resource management strategies (time and study management, effort management, peer learning and help seeking). However, Mayer (1992) noted that, to cope with the high level of cognitive, metacognitive, affective and resource management demands, students must regulate their learning, develop expertise in how to learn and use that expertise to construct knowledge. Students need to be cognitively, metacognitively and affectively active in the learning process to learn effectively. Oxford and Green

(1996) describe learning strategies as specific behaviors that learners use to improve their own learning. Different researchers have divided learning strategies into different categories. In addition Cangelosi (1996) has pointed out that learning strategies include cognitive, metacognitive, affective and resource management. Simpson (2001) cited Stewart Sykes (1997) and stated that, ‘in every classroom some students will experience learning difficulties due to variety of causes like emotional disorder, hearing impairment, intellectual disability, language disorder and the like’. Thus, students’ levels of learning process are important in determining how effectively they can construct and retain knowledge. Students who learn in meaningful ways tend to have learning that is more effective and sustained. Hence, providing meaningful learning strategies to the learners brings more successful and immediate learning outcomes. To achieve the desired educational outcomes in mathematics, each student needs to be engaged in the activity of learning using his/her own preferred learning strategies in mathematics classes.

Since the students use different strategies for learning mathematics in various contexts, it has direct implication for syllabus designing, material production, teacher training and learner training. Students may not be aware of the strategies and their effect in learning mathematics. Raising awareness among students on what strategies they employ and which ones would be effective for them to learn mathematics, therefore, is very important. The researcher also believed that the study on students’ preferred learning strategies in learning mathematics has not yet been conducted in Nepal. This is what the study is hoped to contribute to the development of mathematics education in Nepal.

Researchers at several major universities are carrying out research on learning strategies. In a study, Oxford et al (1989, pp. 206-207) point out "if learners have gone through a strategy assessment phase, their interest in strategies is likely to be heightened and if you explain how good strategies can make language learning easier; students will be even more interested in participating in strategy training".

Chan (2001) described that the assessment of students' preferences for specific learning styles and strategies is basically to help teachers employ the strategies that are congruent with students' preferences in order to maximize the learning outcomes of Chinese students. Although there are differences to conceptualize the learning strategies of students, it is generally assumed that students learn best when their preferred learning strategies are employed in the process of learning.

Grahman (1997) pointed out that females showed greater strategy use than males for general study strategies, formal rule related practice and conversational input elicitation strategies, while males showed no greater strategy use compared to the females in any way (p. 41). Embi's (1996) findings are similar to that of Graham. Embi worked with the Malayasian secondary school female students who often used significantly more learning strategies than their male peers in typical language learning situation (p. 265). Similarly, Embi (1996) in his research observed that students in large classes used a greater number of strategies than in smaller classes because of trying to cope with the demands and challenges (p. 271). Red (1989, as cited in Oxford 1996) in his study with the Nepalese university students found that the styles used by the students for learning English were making notes and summaries, recopying notes and memorizing texts (p. 53).

Manipulative activities are excellent ways for students to develop self-verbalizing learning strategies. As they use the senses of sight, touch, and hearing, students should be encouraged to talk on their own way through each problem, either with peers or to themselves. They gain an understanding of the “why” of basic facts. The more time students are allowed for manipulation and thereby to talk through mathematics problems, the easier it becomes for students to retrieve that knowledge.

An important way to teach students learning strategies is for teachers to model the strategy. Teachers must show students the thinking process they use to analyze and solve problems and then the way they check whether the answer is reasonable. As students learn these strategies through practice, the teacher models less and students gradually take over the responsibility of determining which strategy to use. Students become more independent learners in this way. The goal is for students to generalize these strategies into other learning situations.

Learning strategies are the actions employed by the students to learn, which enhance their performance. Schumaker and Deshler (2006) define learning strategies as the way a learner engages in task, including how an individual plans and regulates his or her performance. According to Riding and Rayner (1998, p. 80), “a learning strategy is a set of one or more procedures that an individual acquires to facilitate the performance on a learning task.” Riding and Rayner further stated that one may use different strategies to tackle different tasks. According to Pressley et al. (1985):

> Learning strategies are composed of cognitive operations over and above the processes that are natural consequences of carrying out the task, ranging from one such operation to a sequence of interdependent operations. Strategies achieve

> cognitive purposes (e.g., comprehending, memorizing) and are potentially conscious and controllable activities. (p. 4)

Mayer (1988) agreed that learning strategies refer to those student actions that are deliberate and have an effect on how students learn and understand information. Learning strategies are cognitive processes, metacognitive processes, techniques, procedures, or behaviors used to facilitate learning (Ko, 2002). Nisbet and Shucksmith (1986) indicated that individuals usually use learning strategies with a specific purpose in mind but are unlikely to always use them consciously. Students may spontaneously choose learning strategies to help them learn. In other words, students use learning strategies either consciously or unconsciously to assist in learning more effectively or “transfer of new knowledge and skills” (Weinstein, Husman, & Dierking, 2000, p. 727).

Effective learning requires students to take control over of their learning process and know how, when, and where to use various learning strategies. Many researchers have studied what learning strategies are, but the definition of learning strategies is not uniform. In short, learning strategies are the particular actions implied by students to learn which enhance their understanding. The above discussions inferred three different perspectives in analyzing students’ individual behavior- cognitive, metacognitive and socio-affective. The learner inherits the mental map through cognitive perspectives. Metacognition encourages the recognition of the learner’s own proficiency in diverse social context with their tactics and techniques. Socio-affective strategy empowers higher order thinking and makes connection with the values, culture and practices in social setting.

Mathematics Learning Strategies

Mathematics learning strategies are behaviors and thoughts that affect students' motivation induced by external stimuli, or affective state, or the way, in which they select, acquire, organize and integrate new mathematical knowledge idiosyncratically. As Cangelosi (1996) states mathematics learning strategies are specific techniques used to promote and enhance mathematics learning. The use of mathematics learning strategies has emerged as a critical variable in the mathematics learning process. According to Wolters (1999), there are six cognitive and metacognitive learning strategies, which are: rehearsal, elaboration, organization, planning, monitoring and regulation. Rehearsal measures the degree to which students use repetition and memorization to learn school material and elaboration evaluates students' use of strategies in which they connect new material to what they already know. Organization shows students reported use of strategies such as making outlines or diagrams to organize study materials while planning reflects the students' tendency to set goals or think through what they wanted to get done before beginning a task. Monitoring assesses the degree to which students mentally supervise or observe their use of cognitive strategies like self-questioning, while regulation measures how frequently students control or adjust the use of their cognitive strategy to fit in the ongoing task requirements. Wolters further stated that mathematics learning strategies are often conscious steps or behaviours used by mathematics learners to enhance acquisition, storage, retention, recall, and use of new information. Thus, knowing the preferred learning strategies of students in the learning of mathematics helps to conduct effective mathematics instruction.

Constructivism emphasizes the way that an idea is built up in the mind of the learner and on providing appropriate experience of students. Von Glasserfeld (2001) stipulated that creating concepts according to constructivist view is a form of construction of knowledge and this construction involves reflection, i.e. recognition of the connections that can be made by coordinating sensory elements or mental operations. Students should reflect on their own activities**.** So, students should learn mathematics for understanding and teachers should teach mathematics with understanding. The role of teachers should be changed to guidance and facilitation rather than imparting ready-made knowledge.

Moreover, teachers have to employ participatory and problem-centered teaching approaches in the teaching-and-learning of mathematics in which the use of one's preferred learning styles and strategies is allowed. Flavell (1979) also showed that learning should focus on students' empowerment, which is developed by involving students in activities that allow them to construct well-organized bodies of knowledge. Similarly, Graven (2002) further noted that, by its very nature, mathematics education needs conceptual understanding and intensive efforts in the construction and reconstruction of knowledge. Since mathematics education deals with the learning and teaching of mathematics, the researcher needed to investigate the status of learning mathematics at secondary level of Nepalese education. The purpose of secondary education in the view of Cano (2005) is to develop critical thought, problem solving skills and learning to learn. To this, as Cangelosi (1996) stated, the attainment of mathematical problem solving ability is dependent on five interrelated components. These interrelated components are concepts, skills, processes, attitudes and metacognition. The cognitive and metacognitive developments of the learner have greater impact on the learning and teaching of mathematics. To Flavell (1987) and Livingston (1996), metacognition is, the ability to monitor one's own thinking processes in mathematical problem solving, and it enables students to benefit from instruction and influences the use and maintenance of learning strategies. Here, Cano (2005) stated that the metacognitive perspective focuses on the analysis of students' beliefs about knowledge and learning or epistemological beliefs. These processes include constant and conscious monitoring of the strategies and thinking processes used in carrying out a task, seeking alternative ways of performing a task and checking the appropriateness and reasonableness of answers.

Math metacognitive strategies are simply memorable plans or approaches that students use to solve problems. These strategies include the students' *thinking* as well as their *physical actions* (Lenz, Ellis, & Scanlon, 1996). Some of the most common metacognitive strategies come in the form of mnemonics, which are meaningful words where each of the letters in the word stand for a step in a problem-solving process or for important pieces of information about a particular topic of interest. For example, one may remember the names of the Great Lakes through the mnemonic "HOMES:" Huron, Ontario, Michigan, Erie, Superior. Metacognitive strategies can also come in the form of easy to remember phrases or through pictures that are easy to recall. Many of us learned the Order of Operations through the strategy PEMDAS with phrase, "**P**lease **E**xcuse **M**y **D**ear **A**unt **S**ally: Parentheses, Exponents, Multiplication/Division, and Addition/Subtraction.

Two important characteristics of any effective metacognitive strategy are: (i) it must be memorable, and (ii) it must accurately represent the learning task. It also can be helpful for students who have learning problems when they form the strategy that has some meaningful connection with its corresponding learning task. For example, the mnemonic, "DRAW" (D- Discover the sign, R- Read the problem, A- Answer, or draw tallies or circles and check answer, and W- Write the answer) is a mnemonic that provides students with the steps necessary for drawing the solutions to basic computation problems. The word "DRAW" clearly relates to the learning task of drawing tallies and circles to solve these types of problems (Mercer and Mercer, 1998).

Since concepts refer to the basic mathematical knowledge needed to solve problems, the number of concepts possessed and the efficiency with which cognitive relationships are organized measure intelligence. The more concepts one has accumulated in mind, the more one is able to learn because there are more categories to anchor incoming information. Concepts are abstract ideas and definitions. If the student does not know the concept, a teacher has to create a comparative advance organizer, relating the new concept to something already known, and to create an expository advance organizer of a verbal explanation of the main features of the concept in order to establish it as a category in the students' cognitive structure. In addition to having conceptual knowledge, mathematical skills are also crucial to solve mathematical problems. The study of Greeno (1991) has shown that mathematical skills refer to the topic related to manipulative skills that pupils are expected to use when solving mathematical problems. They include estimation and approximation, communication, arithmetic manipulation, algebraic manipulation, mental calculation, use of mathematical tools and handling data.

On the other hand, mathematical processes refer to the thinking and heuristics involved in mathematical problem solving, and attitudes refer to the affective aspects of mathematics learning and these include enjoying mathematics, showing confidence in using mathematics, appreciating the beauty and power of mathematics and persevering in solving a mathematical problem. Thus, the above descriptions on the nature of mathematics were given special emphasis to clearly stipulate investigation on the preferred styles and strategies of students in learning mathematics. In line with the above mentioned points, Freudenthal (1991) stated that learning mathematics should have the characteristics of cognitive growth and not of a process of stacking pieces of knowledge. This view is inconsistent with a more general view that the way in which mankind developed mathematical knowledge is also the way in which individuals should acquire mathematical knowledge. He criticizes that mathematics education should take its point of departure primarily in mathematics as an activity, and not in mathematics as a ready-made-system. For him the core of mathematical activity is mathematizing-organizing from a mathematical perspective - which is considered as reinventing mathematics. He further stated that since students are not expected to invent everything by themselves guided reinvention - which emphasizes on the character of learning process, is essential and selective. Freudenthal considers mathematizing to involve both mathematizing everyday-life subject matter and mathematizing mathematical subject matter. Reinvention demands that students mathematize their own mathematical activity as well. In relation to this, Treffers (1987) discerns horizontal and vertical mathematization. Horizontal mathematization refers to the process of describing a context problem in mathematical terms– to be able to solve it with mathematical means. Vertical mathematization refers to mathematizing one’s own mathematical activity. Through vertical mathematization, the student reaches a higher level of mathematics. It is in the process of progressive mathematics-which comprises both the horizontal and vertical components - from which students construct new mathematics. The researcher used these major conceptual issues during the development of theoretical background and development of instruments of the study.

Mathematics learning strategies can be assessed in a variety of ways, such as diaries, think-aloud procedures, observations, and surveys. Oxford and Green (1996) showed that gifted learners use a wider range of learning strategies in a greater number of situations than other learners. Oxford (1990) further pointed out that many different learning strategies can be used by mathematics students: metacognitive techniques for organizing, focusing, and evaluating one's own learning; affective strategies for handling emotions or attitudes; social strategies for cooperating with others in the learning process; cognitive strategies for linking new information with existing schemata and for analyzing and classifying it; memory strategies for entering new information into memory storage and for retrieving it when needed; and compensation strategies (such as guessing or using gestures) to overcome deficiencies and gaps in one's current mathematical knowledge.

The researcher perceived that students need to be taught to use better strategies to improve their mathematical performance. Similarly, teachers need to assist their students by designing instruction that meets the needs of individuals with different stylistic preferences and by teaching students how to improve their learning strategies. If mathematics teachers use their preferred teaching style and do not adjust to the preferred learning strategies of students, students will not cope with mathematical lessons. In the researcher’s view a mathematics teacher needs to be aware of his/her preferred teaching style and the preferred learning strategies of his/her students. Mathematics teachers need to design learning experiences that could accommodate the needs of students as much as possible in their classroom practice. Teachers need to have the knowledge that guides their students learn in a better way. In the words of Polya (1985):

> The students should acquire as much experience of independent work as possible and if left alone with the problem without any help or with insufficient help, they make no progress at all. If the student is not able to do much, the teacher should leave him at least some illusion of independent work and help the student discreetly in the learning of mathematics. (p. 1)

Some mathematics learning strategies may actually have the effect of subverting the learning of mathematics in mathematics classes. Memorization and imitation of examples may meet the short-term goal of completion, but fail to address the long-term goal of strong acts of mathematical knowledge construction. Production of the right answer may override the more difficult endeavours of constructing the idea and of coordinating its interactions with other qualities of powerful constructions (Cangelosi, 1996). As mentioned above, the primary aim of mathematics education is to enable students to develop their ability in mathematical problem solving. Mathematical problem solving includes using and applying mathematics in practical tasks, in real life problems and with mathematics itself. Thus, the knowledge of the preferred mathematics learning strategies of secondary school students in Nepalese secondary schools is of paramount importance to enable them develop their problem solving ability in mathematics and to assist them learn mathematics with and for understanding.

Many learning strategies are discussed in educational literature-far too many to list here. One of the most famous and possibly most effective learning strategies for problem solving in mathematics is George Polya’s four-step problem-solving process (Van de Walle, 1998), which include: understanding the problem, developing a plan to solve the problem, carrying out the plan, and looking back to be sure the answer solves the problem. These steps apply not only to mathematics and other academic areas but also to life skills. After the strategies have been taught, students may work independently in the class as the teacher moves around the room, observing and monitoring that students are using the strategy appropriately. Students may work in small groups and check each other’s use of strategy.

The difference between learning strategies and mathematics learning strategies lies on the nature of mathematics education itself. That is, the interactive discourse between the mathematics teacher and students in class allows the teacher to determine what students know about patterns or concepts and to plan the teaching strategies. This ongoing monitoring of students’ understanding of mathematics and the use of their own preferred learning strategies allow mathematics education to become more relevant to students.

Mathematics Learning Experiences and Attitudes

Practical observations show that the world is changing from time to time and those who understand and can do mathematics will have significantly enhanced opportunities and options to shape their future. Learning can be more effective when the student is interested in learning. It can be argued that everyone needs to understand mathematics; and mathematics is not designed for few. The NCTM (2000) studies reflected that, all students should have the opportunity and the support necessary to learn significant amount of mathematics with depth and understanding. Students need to learn mathematics with understanding, thus actively building new knowledge from experience based on previous knowledge. Hence, the opportunity to solve mathematical problems in order to acquire the ways of thinking, habits of persistence, curiosity and confidence should be given to students. Solving mathematical problems should not be the only goal of learning mathematics but a major means of learning mathematics. Aggarwal (2002) describes that learning includes experiences gained through the formal and informal processes of education that is either from the environment or from the schooling system. Different scholars gave special emphasis on the prior experiences of learners for the learning of mathematics. This can be shown in the words of Kochhar. As he explained:

> There are three levels of learning experiences that play a major role in the teaching and learning of mathematics. These levels are direct experiences, vicarious experiences and symbolic experiences. Direct experiences in mathematics learning include having immediate sensory contact with the actual object. If the learner goes to the business firm, s/he gains direct experiences, which gives first hand information and which facilitates the learning process. Vicarious experiences include use of models, films, specimens, television, radio, pictures, drawings, etc in terms of the real objects. Symbolic or abstract experiences are offered through verbal symbols–oral or written. They occur at conceptual level. The teacher translates the original item into the symbol and passes to the pupil who then has to translate it back to the original image. Thus as the child advances in age and his store of information increases, symbolic experiences become essential since the child is expected to apply and create his

own knowledge. The degree of emphasis increases at this level (Kochhar, 2001, p. 61).

Supporting Kochhar’s view, Harmer (1983) also has pointed out that direct and vicarious experiences provide a concrete basis for conceptual thinking. Thus, the learning experiences of students have a great impact on the learning and understanding of mathematics.

The relationship between teachers and learners is beneficial in the learning of mathematics. In this connection, Kingsley (1989) has shown that more effective learning becomes more educative when there is more effective learning relation and communication between the teacher and his pupils. According to Grouws and Cebulla (2000), the attitude of teachers and students towards mathematics is highly decisive to make the teaching of mathematics either attractive or to learn mathematics with full interest and enthusiasm. The teacher who has a positive attitude towards mathematics shows that mathematics is understood by employing meaningful methods of teaching. Similarly, if learners have positive attitude towards the learning of mathematics, they use their prior knowledge to construct newer knowledge, fully involve in the learning process to develop relationships and relate mathematics to the contextual situations to solve real life problems.

Moreover, there are certain factors that affect learners’ attitude towards learning mathematics. These factors include the actual classrooms’ environment, the teaching methods employed by teachers, the instructional materials used, and teachers’ mastery of the subject matter, school facilities and their achievement in mathematics. Cangelosi (1996), Callan (1996), and Cooney and Shealy (1991) asserted that teachers' effectiveness in the classroom has been shown to benefit greatly from looking at various developmental stages of students and considering cognitive science and other contributions from educational research. Too often, teachers do not focus on how students learn and the critical importance of these cognitive issues for their teaching. Doolan and Honigsfeld (2000) added that, if we want students to have a deeper knowledge of a mathematical concept so that they can apply the knowledge in new situations, we must offer students numerous opportunities to engage with related knowledge, facts, and examples of the concept.

The success of students is a driving force to be motivated to learn mathematics with understanding and apply mathematics as a problem-solving tool. On the other hand, failure in achievements becomes a restraining force and ultimately it de-motivates students. Sometimes they may hate mathematics. Schools should be smart and attractive in order to improve the attitude of students. The argument of Harmer (1983) showed that the physical conditions of a room have great effect on learning and can influence students learning either positively or negatively. Thus, schools have to be equipped with the necessary facilities in order to improve teaching-learning situation. Instructional materials have a great role in facilitating the teaching and learning process since they provide concrete and observable models for the learner to grasp concepts. Cangelosi (1996) elaborates that teacher's knowledge of pedagogical content increases within the context of a strong knowledge of mathematical content, and their ability to impact student learning also increases. Use of different teaching strategies becomes effective in helping children to learn concepts, discover efficient procedures, reason mathematically, and become better problem solvers. These teaching strategies include having high expectations from all students, collaboration with others, promoting cooperative learning, using technology as a tool, using inquiry based learning, promoting mathematical reasoning, promoting problem solving, reflecting on teaching and learning, integrating assessment and instruction, clustering concepts, integrating content areas, and basing practices on educational research. The teaching strategies teachers employ in mathematics classes have their own contribution in enhancing mathematics learning. In line with this view, Keefe (1979) has pointed out that the teaching strategies that need to be applied by mathematics teachers include use of concrete representations, provision of time for students to play, use of examples and non-examples, introducing and implementing technology, use of contextual and prior knowledge of the learner, and engaging students actively in learning.

When teaching for understanding takes place, children’s knowledge builds up and mathematical ideas take roots and start growing. Supporting this view, Cangelosi (1996) argued that children learn mathematics with understanding when they solve mathematical problems. Teachers have to minimize teaching by telling and facilitating them to learn mathematics with understanding. The setting in which students immediately participate should be organized. Thus, teachers have to teach mathematics for understanding by employing proper teaching experiences, styles and strategies. Similarly, teachers and other partners have to work hand in hand in order to build children's thinking about mathematical ideas.

Learning Strategies and Student Learning

Learners differ in their skill in using learning strategies. In short, students approach learning in different ways. Some students possess a wide range of learning strategies and can use them flexibly; however, some students have trouble in learning because they lack effective learning strategies for completing a task. Riggs and Gil-Garcia (2001, p. 8) stated that effective learners have a better awareness of the strategies that are necessary to help them learn. A study conducted by Wang (2002) showed that skilled learners used more learning strategies and apply these strategies more frequently to facilitate their own learning than done by less-skilled learners. Protheroe and Clarke (2008) concurred that effective learners implement a broad array of learning strategies. In Montague and Dietz's (2009) review of cognitive strategy instruction as related to mathematical problem solving, the researchers indicated that strategic learners could use a variety of learning strategies efficiently and effectively. On the contrary, they found that students with learning disabilities did not have effective learning strategies or might not have been able to employ appropriate learning strategies to solve mathematical problems. These students often chose strategies that impeded their academic performance.

Use of learning strategies makes a difference in student learning. Wadsworth, Husman, Duggan, and Pennlington (2007), in their research on learning strategies applied by students, found that learning strategy use was associated with academic achievement. Their learner population consisted of 89 college students who were asked to complete an inventory of learning strategies. The researchers suggested that students' self-efficacy and use of strategies can affect achievement. The results revealed that students who frequently used learning strategies achieved higher grades than those who used strategies less often. In a study conducted by Holschuh (2000), 518 college students answered a strategy checklist that measured their use of learning strategies in a biology class. The purpose of the study was to examine differences in the use of learning strategies between high-achieving and under-achieving students. Holschuh found that high-achieving learners used a greater number of deep strategies than under-achieving ones. They also used more content-specific learning strategies, which suggest that these students know better how to select the strategies that meet their learning needs. In addition, these high-achieving students were able to give reasons for using certain learning strategies to help them learn science. Tsai and Tsai's (2003) research found that learning strategies play an important role in computer achievement. They studied a group of junior high school students enrolled in two computer classes and discovered that the strategies used by students helped them to understand learning material, choose main ideas and other useful information, and monitor their learning. Specifically, students who were effective users of these learning strategies typically performed better academically. Tsai and Tsai also found that these students were less anxious and more positive about computer learning. This relation between the use of learning strategies, achievements and learning attitude could be implacable in Mathematics learning.

Teacher is one of the crucial actors in helping individual students develop effective learning strategies and become strategic learners. Teachers need to be aware of the strategies adopted by their students. This awareness allows teachers to design and implement learning strategy instruction and helps teachers raise their own awareness of the strategies used by students. By knowing students' use of learning strategies, the teacher can recognize learners' strengths and weaknesses and adjust instruction accordingly. Teachers will be able to teach individual students to use learning strategies appropriately and effectively if they identify and accommodate the strategy use of students in relation to their genders (Liu & Lin, 2010; Ray, Garavalia, & Gredler, 2003) and their learning abilities (Pressley, Goodchild, Fleet, Zajchowski, & Evans, 1989). Increasing teachers' awareness of students' strategy use can lead to successful learning and teaching. It is possible, though, that teachers are not sensitive to student learning or make incorrect assumptions concerning learning strategy use (Arabsolghar & Elkins, 2001; Griffiths & Parr, 2001). If teachers over-estimate or under-estimate students' ability to use learning strategies, they may have problems in identifying learning difficulties experienced by their students, and thus they fail to provide appropriate learning assistance. In turn, this would impede student learning.

Researchers have demonstrated the effectiveness of learning strategy instruction (e.g., Katims & Harmon, 2000; Monroe & Troia, 2006). To provide a strategy instruction that is beneficial for the students from diverse backgrounds, teachers should know the learning strategies applied by learners (Protheroe, 2002). According to Lenz (2006), it is very important for educators to pay attention to strategy use. He suggested that educators needed to ensure that their students could select and apply the effective learning strategies that they were taught in the class. Martin (2005) agreed that it was important to understand what strategies students use in the classroom. As she pointed out, every teacher has had ineffective or less capable students in his or her classrooms. She indicated that teachers could use this information to address students' ineffective use of learning strategies. This information enables teachers to incorporate appropriate teaching and learning strategies into the content area of curriculum.

Part IV: The Role of Teachers in Assisting Students to Use Their Own Preferred Learning Strategies

It can be argued that both teaching and learning are important in enhancing or impeding the learning processes of students. Also, teachers' view on learning strategies of their students is one of the factors that affect the learning of mathematics, and it has a great implication for learning. Well-trained teachers know how to guide the learning of their students in the teaching–learning process. Biggs and Moore (1993) have stressed this idea when they argued that, the more the teacher mastered his/her subject, the better he/she will be able to teach it and the more pupils will learn at the end.

Teacher's role is very important to carry out responsibility in changing and shaping pupils' behaviour in school. In order for teachers to be more effective with diverse group of students, Pewewardy (2002) mentioned that it is crucial for teachers to recognize their own world views and understand the preferences of their students. Canfield (1992) further described that, knowing the kinds of learning styles and strategies that students most prefer may help teachers to develop alternative course structures that provide a better fit between their teaching styles and the learning styles and strategies preference of their students. Pewewardy (2002) and Park (2001) have discussed that matching the teaching styles of teachers with learning styles/strategies is important for reinforcing the learning content, for employing diverse instructional approaches and for maximizing the learning of students. In line with this view, teachers need to allow their students to learn through their senses with the use of multimedia presentations and multi-sensory resources. Park (2001) also has mentioned that teachers could meet the learning needs of all students with multiple opportunities for learning, given the reality that mathematics classes usually consist of diverse learners. Mathematics teachers need to help students to identify their learning strategies and describe their strengths, and to show students how to help themselves to learn through their learning preferences. They need to provide their students with instruction on diverse and specific learning strategies and assist them to become effective strategy users as well as competent and self-directed learners in order to improve their academic performance since learning and academic performance are influenced by numerous cognitive variables. Moreover, as NCTM (1989) studies indicate teachers are expected to understand the emerging standards and views of learning to change their roles and practice accordingly.

Teachers are expected to assist and guide their students but not too much and not too little, so that students shall have a reasonable share of their work. Sound teaching usually begins with questions and the phenomena that are interesting and familiar to students, not with abstractions or the phenomena outside their range of perception, understanding, or knowledge. Students should be engaged actively with concentration on the collection and use of evidence. Historical perspectives should be provided insisting on clear expression. Besides, team approach should be followed and knowing should be separated from finding out. Polya (1985) also mentioned that the task of understanding the emerging standards and students' preferences is not easy and it demands time, practice, devotion and sound principles. A teacher must actively engage students in the learning process, so students construct their own knowledge. In addition to taking into account the different learning strategies of his/her students, a teacher should provide equal opportunity for all students to learn mathematics, regardless of gender or other personal characteristics. Polya (1985) distinctly has elaborated that the teacher should put himself in the students' place and should try to understand what is going on in the students' mind. The teacher who wishes to develop his/her students' ability to solve problems must instill some interest for problems into their minds and give them plenty of opportunities for imitation and practice. If the teacher wishes to develop in his/her students the mental operations which correspond to the questions and suggestions, s/he puts them to the students as often as s/he can do so naturally. Moreover, when a mathematics teacher solves a problem before the class, s/he should dramatize her/his ideas a little and put the same question for herself/himself before helping the students.

The Mathematics teacher has a great opportunity of either killing the interest of the students by filling the allotted time with routine operations, or giving them a taste for independent thinking by setting them the problems proportionate to their knowledge. On the other hand, mathematics teachers need to use teaching aids and technological tools to enhance mathematics teaching and learning. As Kay (1971) has suggested, teaching aids make teachers feel easy, make teaching effective and motivate students' attention to be active learners. It improves students' learning. Additional learning materials like TV, Radio, Calculators and Newspapers are important to increase the learning abilities of the learners. Similarly, Batcher (1971) argues that good environmental experience leads to increased learning ability of students. Wallace and Louden (2003) added that, the teacher is to make use of educational media such as computers to improve the effectiveness of instruction; and in the teaching of computation, teachers should make use of hand-held calculators and computers, appropriate to the occasion, to improve the effectiveness of learning.

Goldenberg et al. (1997) assert that students must learn how to think from a mathematical point of view and that they have to develop a habit of mind to understand mathematics. The development of habit of mind perspective is important since mathematical ways of thinking have valuable applications outside mathematics as well as within it. In this connection, Stellwagen (2001) has stated that the primary role of teacher is to recognize the many potentialities of his/her students and to consciously plan for the balanced development of each individual across each of the learning styles. Mathematics teachers need to teach mathematics to develop understanding, mastery, self-expression and interpersonal awareness in their students. Stellwagen (2001) further pointed:

> Basically teachers need to accomplish the tasks of fostering mathematical literacy of students, enhancing the ability of students thinking mathematically, giving attention on the ability to do and use mathematics intelligently rather than on covering a wide area of mathematical content or on using sophisticated mathematical content, integrating the various branches of mathematics and the role of technological tools in enhancing mathematics learning. (p. 267)

Besides stressing on the role of teachers, Stellwagen has described the vital points to be addressed by mathematics teachers as: (1) how they adjust their teaching styles to account for different learning styles and strategies, (2) how they identify learning styles and strategies, (3) how they know whether they have achieved their desired educational outcome (student learning) or not, (4) how they talk about their students' different learning styles and strategies, (5) how they respond to their students' different learning styles and strategies, and (6) why teachers respond to their students' different learning styles and strategies (teachers responsibility, commitment and confidence).

The role of teachers seems to be immeasurable to improve the learning of mathematics which, in turn, contributes to the development of a nation. Hear et al. (2002) have stated:

> Excellent teachers seem to sense what and how to teach; they know, care, and can reach their students; they are adamant that all students can learn; they are committed to their profession and willing to do what it takes to ensure a student learns, and know what to do. They took responsibility for the learning of their students in their classes and purposefully sought out the best ways to reach them. They did not necessarily teach using their own dominant learning styles and should identify individual learning styles and work with students by actively seeking out the best ways to connect with them. (pp. 143-144)

Students' prior knowledge needs to be given due attention to improve mathematics achievement. Hear *et al.* (2002) by citing Haycock and Robinson (2001) noted that teachers who consistently get results from all groups of students clearly know their subjects and how to teach them. Teachers also know that all students come to school with some prior knowledge on which they can build, and see the range of student abilities, cultures, and races in their classrooms as challenges, not as impediments. When teachers give due assistance to students to use their own preferred learning styles and strategies, students start to feel at ease and learn mathematics in a relaxed manner. In this connection, by citing Dunn (1995), Chan (2001) has described that students have typical ways of taking, processing, internalizing, and retaining information and skills which are generally considered as students' learning styles. Effective learning occurs when teachers design and use appropriate teaching strategies for specific and preferred learning styles and strategies of students. Planning of instruction should be geared to employ different learning styles and strategies of students (Dunn & Dunn, 1993; Dunn 1995; Fischer & Fischer, 1979).

Teachers' teaching strategies need to be geared to match the learning styles and strategies of students. Chan (2001) identified nine teaching strategies and mentioned them as: discussion, drill and recitation, independent study, lecture, peer teaching, programmed instruction, projects, simulations, and teaching games. Chan further pointed out that, since student's learning strategy preferences might be different for different specific groups and across different cultural settings, it is necessary that the preferred learning strategies of students are identified and assessed so that the corresponding change in teaching strategies will allow these students to learn by applying the method of their choice (pp. 36-37). Teachers can guide students as they move through several stages in the process of developing deep, flexible knowledge. Mathematics teachers should revisit the same concept repeatedly over an extended period, in order to encourage their students' thinking about the similarities and differences in the examples. As a result, the mathematics teachers have significant role in creating good atmosphere for the learning of mathematics and to arouse the interest of students to use their own preferred learning strategies in the learning of mathematics. The researcher believes that teachers can play a major role in assisting the students to use their own preferred learning strategies by adjusting their teaching styles and strategies.

In the East, especially in Indian sub-continent, in the ancient time, students used to depend fully on their teachers (Gurus) in learning. In the Vedas, the term 'Acharya' is used for Guru. Guru is considered the greatest treasure of knowledge. In educative process teacher and students are the two components; a teacher provides physical, materialistic and spiritual knowledge to the students. The educative process is teacher centered. Guru satisfies the curiosity and needs of the students. Success of the students' life depends on Guru's teaching and guidance. Students were under the full protection of their Gurus during their learning period. Guru was the spiritual father of his pupils. Gurus used to take care of their pupils in the same manner as a father takes care of his children. Gurus used to pay attention for the comprehensive development of personality of their pupils. If required, Gurus used to serve their pupils by doing medical treatment. A Guru was to give his pupil full attention and with-hold no part of knowledge from him (Ancient Indian Education, n.d.).

In the Vedic period, Shravan or listening, Manan or meditation and Nididhyaana or realization and experience, question and answers, discourse, lecture, discussion and debate were the prevalent teaching methods. These methods can still be used in our classrooms faithfully. During that period, teaching and learning process was oral. Whereby, the students were to memorize the mantras (Vedic Hymns) and Richayas (verses of Rigveda) as they are in order to preserve their original forms. Under the oral methods these prosodies were thoroughly taught and Richayas were based on them. Special emphasis was laid on the various lines of a particular verse, their pronunciation and meanings. In this oral method, correct pronunciation was specially emphasized. For this, instruction in grammar and pronunciation was compulsory for all. Thinking method was another part of the teaching method. This was an attempt made to preserve the Veda mantras (Vedic hymns) and Richayas (Vedic verses). Manan (Reflection) was the higher method of teaching than thinking. Through Manan, the meanings of Vedic mantras were developed and preserved in one's own mind. This method was used to encourage the highly intelligent students by guiding them to make research. Similarly, in ancient days, Manan was a method specially adopted for highly intelligent students. Hearing, thinking and meditation were three aspects of mental education. For full mental development, all these three aspects were considered necessary. Thinking over the heard things and perception through meditation was the accepted methods of mental development. Considered from this perspective, the learning strategies of the students can be said to have been replaced by teaching strategies of the Gurus.

Although the education of this period was dominated by the study of Vedic literature, historical study, stories of heroic lives and discourses on the Puranas also formed part of the study. It was necessary for students to obtain knowledge of metrics. Arithmetic was supplemented by the knowledge of geometry. Students were given knowledge of four Vedas – Rigveda, Yajurveda, Samaveda and Atharvaveda. The subjects of study included the spiritual as well as materialistic knowledge, Vedas, Vedic grammar, arithmetic knowledge of gods, knowledge of the absolute, knowledge of ghosts, astronomy, logic, philosophy, ethics and conduct (Ancient Indian Education, n.d.).

Swadhyaya was another method of learning in ancient period. Swadhyaya literally means study of the self, the main practice is the study of the yogic scriptures but it also interludes Japa (mantra repetition). No any yoga or spiritual book qualifies a proper material of Swadhyaya. Its methods: both Shravan and Manan (listening and contemplation) are treated as important parts of Swadhyaya. Japa is of 2 types: Oral and Mental. The art of self-education, contemplation and study that leads to self-realization is

Swadhyaya. The student studied self and constantly did Japa of the mantra received from a teacher, contemplating the meaning of the mahavakyas through the great sentences of the Upanishads during pre- Vedic and post-Vedic education (Ancient Indian Education, n.d.). The practice of self study or Swadhyaya thus contributes to finding ways of arriving at a solution and internalizes the concepts.

Another strong approach to education is very much guided by Manusmriti. Manusmriti regards learning as the best means of securing welfare, understanding, fame, long life and supreme bliss (1.106). It provides greatest value to knowledge and study as an imperishable store because neither thieves nor foes can take it, nor can it be lost (7.83). Besides this, it considers teaching as a duty of only Brahman (1.88). In this context, there is also provision of Acharya (head teacher) and Upadhyaya (sub-teacher) (5.91). It also prefers study as the compulsory duty of twice-born man to be safe from the condition of a Shudra with his descendants (2.168). Directly and indirectly, this idea creates the concept of compulsory education with punishment but only for twice birth. For the purpose of study, it prescribes serving Guru (teacher), studying the Veda, practicing austerity, acquisition of knowledge, control of organs, and abstention from doing injury (12.83). It shows service oriented and ethically guided learning system. In this context, it needs permission to study and recite Veda (2.116) respecting the teacher (2.117). Similarly, student must diligently serve his teacher in the teacher's house (2.243) providing gift to teacher (2.245). Here, Manu indicates the provision of gift with deep regard for the livelihood of the teacher. There is also fixed duration of the study (3.1) without breaking the rules of studentship (3.2) with the dress of student (4.200) which seems similar to the present formal education. Passing the whole life as a student is considered better way (2.249) as parallel idea of lifelong learning (Buhler, 1886; Pant, 2013).

The above brief reviews on Eastern philosophy and its approach to education clearly show that Gurus were the ultimate and only source for the students to learn. They used to memorize what their Gurus taught them orally as to be appropriate. Likewise, Manan (reflection) was also the prevalent learning strategy. The students learned not only the physical phenomena only but also the spiritual phenomenon as self through Swadhyaya (reflecting the self). Similarly, during the Buddhist period, methods of teaching and learning were discussion, question-answer and religious lectures by the Buddhist monks (Datta & Singh, 1962). However, whether it is Vedic era, Manu or Buddhist era, students attentively listened to their teachers, put their queries to them, and the teachers gave satisfactory answers to their queries. The students took their teachers' teaching as the main mantra and memorized them.

Thus, the West focused more on mind and reason, but the East focused more on soul and experience. The eastern approach was more deductive (formula to example), whereas the Western approach was more inductive (example to formula). However, as media and technology have transformed the world in the form of global village, students now are in a position to learning strategies reflecting on both Western and Eastern approaches. As sufficient studies have not been made on this issue in Nepalese context, many gaps can be explored from the literature. The researcher has used Western taxonomy of learning strategies as developed by Pintrich, Smith and McKeachie (1989) not because the Eastern learning strategies are inadequate and poor but because of the preference given to inductive learning approach.

Part V: Gaps of Studies on Learning Strategies in the field of Mathematics Education in Nepal

As discussed above, the results of the studies related to preferred learning strategies of students conducted by researchers have shown the improvement of mathematics learning at different levels. Connected to this view, Stitti-Gohdes (2001) pointed out that knowing the kinds of learning experiences that students' value may help teachers to develop the alternatives that provide a better fit between their instructional goals and the learning strategy preferences of their students. Moreover, the accommodation of learning strategies in the learning of mathematics has made underachieving students to perform better. In Nepalese context, this investigation of preferred learning strategies of secondary school students in the learning of mathematics basically helps to reveal students' preferred learning strategies needed to be considered during the learning of mathematics; to learn mathematics more effectively in their own ways; to engage students in the process of learning mathematics rather than sitting idle in mathematics classes; to identify the major impediments that hinder the implementation of students' preferred learning strategies during the learning of mathematics; teachers to be flexible in their mathematics instruction rather than employing autocratic teaching styles; teachers to adjust or match their teaching styles according to the students' preferred learning strategies identified from research; teachers to design different alternatives to improve mathematics instruction; to increase students' awareness to initiate their teachers to meet their individual needs whenever possible; curriculum developers to consider particularly the learning preferences of students during the designing of mathematics curriculum; to initiate policy makers to suggest the improvement of mathematics instruction as to meet the preferences of the students in order to produce capable citizens; and to propose for further research in improving mathematics instructions that copes with understanding of students.

Many researchers and theorists (Strasser, 1964, as cited in Anil, 2011; O'Malley & et al., 1985; Pintrich, Smith, & McKeachie, 1989; Oxford & Green, 1996) have tried to define teaching strategies and learning strategies; however, their suggestions are not sufficient in the Nepalese context, culture and cognition. The researcher felt the gaps of studies on the use of learning strategies by Nepalese secondary school students in mathematics, differences in the use of learning strategies by male and female students, the differences among various ability groups such as high and low achiever students' in the use of learning strategies in mathematics. Similarly, gap was seen on the use of learning strategies by urban and rural school students to learn mathematics, the differences in the use of learning strategies by public and private school students to learn mathematics, on the effective combination of learning strategies to learn mathematics. Likewise, studies are lacking on the exploration of whether teachers' teaching strategies help to promote Nepalese students' learning strategies, to what extent the classroom events promote learning strategies of Nepalese secondary school mathematics students, and to explore the factors contributing to the formation of effective learning strategies.

Part I-V gave the general description of the theoretical background on the learning strategies. The attempt was made to describe the historical perspectives of learning strategies. The nature of mathematics was discussed. Identifying the learning strategies students prefer to learn mathematics and creating opportunities for them to use their own preferred strategies was found essential to learn mathematics for understanding and to improve the academic achievement of students. Learning strategies are specific behaviors that learners use to improve their own learning and they include listening, guessing, taking risks, identifying progress and focusing (Oxford and Green, 1996). Mathematics learning strategies are behaviors and thoughts affecting the students' motivation or affective state, or the ways, in which students select, acquire, organize and integrate new mathematical knowledge. Students' levels of learning are important in determining how effectively they can construct and retain knowledge. Students who learn in meaningful ways tend to learn more effectively with everlasting retention. To achieve the desired educational outcomes in mathematics, each student must be engaged in the activity of learning using his/her own preferred learning strategies in mathematics classes. Knowing the preferred learning strategies of students in the learning of mathematics helps to conduct effective mathematics instruction. Flexible combinations of learning strategies and teaching strategies allow students to develop effective ways of gaining positive educational outcomes. Moreover, knowing the kinds of learning strategies that students most prefer may help teachers to develop alternative course structures that provide a better fit between their teaching strategies and the learning strategies preferred by their students (Canfield, 1992).

Studies conducted by different researchers were discussed in previous sections to reflect on the importance of conducting this study in Nepal. Since the purpose of secondary education is the development of critical thought, problem solving skills and enhancing the learning of students, students need to use their preferred learning strategies to learn mathematics in a meaningful way (Cano, 2005, p. 215). Mathematics connects one to his or her universe in many ways by incorporating language, culture and daily living practices (Pewewardy, 2002). One can clearly stipulate that the advancement of science and technology is realized by the proper application and utilization of mathematical knowledge, which in turn helps to curb societal problems. Though students are expected to create their own mathematical knowledge with the guidance of teachers, the National Council of Mathematics Teachers in the USA pointed out that integration of the teachers, learners, curriculum and the pedagogy of instruction are mandatory to create a full-fledged operational result (NCTM, 1991). So, knowing the individual differences in which information is perceived, processed and communicated during the learning of mathematics made this investigation of preferred learning strategies used by students in the learning of mathematics important in Nepalese secondary schools.

Part VI: Theoretical and Conceptual Framework

Difference in the learning strategies brings variation in achievement of the learner. The teachers' teaching strategies and the learners' learning strategies play important role for the achievement. These issues are associated to three broad aspects of learner; i.e. behavior, cognition and knowledge construction. Hence, in this part, the researcher has discussed behaviourist, cognitivist and constructivist learning theories and derived learning strategies based on their focuses. Theoretical and conceptual frameworks have also been developed.

Learning Theories

Learning theory means an attempt to describe how people learn. Many learning theories have been developed by psychologists. However, only three theories were repeatedly mentioned by the researcher; Behaviorist Learning theory, Cognitive Learning theory and Consturtivist Learning theory.

Behaviorist Learning Theory

Behaviourism, most often associated with the work of B. F. Skinner, is the most prominent learning theory. Behaviorism is an orientation to learning emphasizing methodically time-controlled events and constructed environmental conditions intended to bring about particular behavioral responses. Merriam and Caffarella (1999, p. 251) identify three assumptions all behaviorists such as Mager, Skinner, Thorndike, and Watson share about the learning process:

First, observable behavior rather than internal thought processes is the focus of study; in particular, learning is manifested by a change in behavior. Second, the environment shapes behavior; what one learns is determined by the elements in the environment, not by the individual learner. And third, the principles of contiguity (how close in time two events must be for a bond to be formed) and reinforcement (any means of increasing likelihood that an event will be repeated) are central to explaining the learning process.

The first of these assumptions implies that behaviourism has little regard for the cognitive processing of the learner involved in the task. This approach focuses entirely upon learners understanding the “what” through methods like rote memorization, identification, and association. This theory is concerned with illuminating only what learners need to know. The second assumption of behaviorists says that learning is strictly influenced by environmental factors. This view is shown clearly through the early work of Robert Gagne, who was heavily influenced by behaviorists such as Skinner and

Thorndike. Gagne's early research examined positive and negative training transfer. "[Gagne's)] research was done with training subjects on complex motor tasks using multiple trials and observing them for periods of little or no improvement in learning" (Fields, 1996, p. 225). The third assumption of learning presented based on behaviorism stresses repetition and reinforcement (operant conditioning) in order to develop desired habits. B.F. Skinner was a major contributor to operant conditioning focusing on "positive and negative reinforcement schedules, the timing of reinforcements, and avoidance behavior" (Merriam & Caffarella, 1999, p. 252).

A behaviourist strategy in mathematics learning tends to stress the practices that emphasize rote learning and memorization of formulae, single solutions and adherence to procedures and drill. As explained by Kowtrakool (2002), the behaviorist psychologists classified human behavior into two types:

1. Respondent Behavior refers to the behaviors elicited by stimulus. When there is stimulus, the observable response would occur.
2. Operant Behavior is the behavior emitted by humans or animals without specific stimulus. This type of behavior affects the environment.

The theory explaining the first kind of learning or Respondent Behavior is called the Classical Conditioning Theory. Thus, the theory of knowledge explaining the Operant Behavior is called Operant Conditioning Theory.

The assumptions of the Behaviorism are:

1. Every behavior occurs by knowing which is observable.
2. Each kind of behavior is aggregate to various kinds of learning.
3. Reinforcement could cause the occurrence of desired behavior.

Behaviourist educators are committed to the idea of a scientific universe of stimuli and responses in which learning and understanding are regarded as the result of behavioural adaptation (change) stimulated by appropriate re-enforcements (Upadhyay, Pradhan & Dhakal, 2010). This theory holds the position that learning results from an event (stimulus), the reaction to the event (response) and the consequences the response (Burton, Moore & Mayliaro, 2004 as cited in Upadhyay, Pradhan & Dhakal, 2010).

The behaviorist view of learning is described as a change in observable behavior that is a result of an experience. It focuses on certain behaviors rather than the thinking that takes place in the learners' mind. Some identify this learning model as crudely practicing learning as this model lack learner's cognitive and socio-affective practices. In this regard, as cited in Upadhyay, Pradhan and Dhakal (2010; p. 2), Kaufman (1979) identified the behaviorist philosophy as follows:

1. The environment may be unambiguously characterized (identified) in terms of stimuli.
2. Behavior may be unambiguously characterized in terms of responses.
3. A class of stimuli exists which, applied contingently (company) and immediately following a response, increases or decreases the response in some measureable fashion. These stimuli may be treated as re-enforces.
4. Learning may be completely characterized in terms of various possible couplings among stimuli, responses and re-enforcers.
5. Unless there is definite evidence to the contrary, classes of behavior may be assumed to be learned, manipulable by the environment, extinguishable (destroyable) and trainable.

Cognitive Learning Theory

Cognitive learning theory states that learning occurs through mental processes and mental structures that result from the learner's attempt to make sense of the world in maths. If a child is deficient in mathematical skills, he/she needs to work extra hard to make sense to his/her own world. The teacher can aid the child in doing this in several ways. First of all, the teacher and students can work together to develop an understanding of students' experiences in their mathematical difficulties. In doing this, students and the teacher can develop and evaluate the specific areas in which they have difficulties. In addition to this, students will be able to develop an understanding of the mathematical skills that they already know. This will allow students to distinguish between the areas of mathematics that they have already mastered and the ones in which they struggle with. For example, the teacher and a student need to make sure that the student is completely secure with adding and subtracting numbers before he/she can move on in attempting to multiply and divide numbers. This will then allow the teacher and student to have a starting point, where they can attempt to create a new understanding of the mathematical concepts in which student struggles. With these strategies in mind, students and the teacher will hopefully be able to change the way students think about math (mental structures) and allow them to overcome their mathematical deficiency.

Cognitivism carries the notion that "Learning involves the reorganization of experiences in order to make sense of stimuli from the environment. Sometimes this sense comes through flashes of insight" (Merriam & Caffarella, 1999, p. 254). Thus, a cognitivist views the learning process as an internal and active mental process, which develops within a learner, increased mental capacity and skills in order to learn better.

The assumption of cognitivism is that an existing knowledge structure must be present in order to compare and process new information for learning. This existing knowledge structure is referred to as schema. Schema is activated and utilized for the benefit of learning when a learner is “made aware of his background knowledge and exposed to strategies to ‘bridge’ from pre-requisite skills to learning objectives” (Blanton, 1998, p. 172).

Cognitivists believe that sense impression (awareness) is the primary source of information. Learning is a change in mental schemata. It becomes knowledge only when the mind systematizes it. Mental representation of the world plays a central role in individual’s perception, thoughts, and actions. So, cognitivist believes in the intellect as the prime source of knowledge. Cognitive psychologists include the following principles (Upadhyay, Pradhan & Dhakal, 2010; p. 3):

1. Prior knowledge is pre-requisite to effective learning.
2. Learning is helped by meaningful association (learning involves making connection between new and existing knowledge).
3. Learning requires a mix of generalization and examples.
4. Rehearsal is usually necessary for retention.
5. Automaticity is essential for developing higher skills; transfer occurs at subconscious level if one has achieved automaticity.
6. Complete instruction is usually less effective for beginners.

Social Cognitive Learning Theory is a theory developed by Bandura at Stanford University, the United States of America. He believes that most learning is caused by “observational learning” or “imitation” (Bandura, 1986). Furthermore, human beings always interact with their surrounding environment. He explained that learning occurs as a result of interaction between students and their social environment. Both student and environment influence each other. Later on, the theory was known as Social Cognitive Learning Theory, since he found from his experiment that one major cause of observational learning was that students had to correctly encode the information observed into the long-term memories. Moreover, they had to be able to evaluate whether or not their imitation was good and verify it. They needed to control themselves through meta-cognitive structure. He concluded that observational learning is a Cognitive Process. As cited in Kowtrakool (2002), Bandura (1986) states that the Social Cognitive Learning Theory consisted of general principles of teaching by using the Social Cognitive Learning Theory to:

1. Specify the objective for students to act, behave, or write the behavioral objective.
2. Give an example of many actions which might be a real life person, cartoon, film, video tape, television, and different types of media.
3. Provide explanations in alignment with each example.
4. Suggest the observational learning step for students such as by asking them to be interested in the knowledge presented to them, the stimulus needed to pay attention to or select.
5. Provide time for students with the opportunity to express their behavior as the model, in order to see whether the students could imitate it or not. If they could not perform correctly, the teaching technique might be improved, or the students might be improved.

6. Provide reinforcement for students who can imitate correctly, so that they can have motivation to learn and be a model for other students.

Constructivist Learning Theory

Constructivism is a new approach in education that claims humans are better able to understand the information they have constructed by themselves. Constructivism promotes a student free exploration within the given framework or structure. The teacher acts as a facilitator who encourages the student to construct knowledge by working to solve realistic problem. Knowledge cannot be simply passed on from learner to learner, but must be constructed individually by each learner. Jean Piaget (1896-1980) and Lev Vygotsky (1896-1934) are two eminent figures in the development of constructivist theories. Piaget (1970) explains the learning process by schemes (the organization of information on how things work), assimilation (the placing of new information into schemes), and accommodation (transforming existing schemes or creating new ones). The motivation for learning is the predisposition of the learner to adapt to his environment, hence to institute equilibrium between schemes and the environment. Continuous interactions among existing schemes, assimilation, accommodation, and equilibrium create new learning. Piaget explores four sequential stages of the psychological development of the young learner and believes teachers should be cognizant of these stages. During the Sensory-motor Stage, (before the age of 2) sensory experiences and motor activities dominate. Intelligence is intuitive in nature and knowledge; it is acquired through mental representation during the Preoperational Stage (from age 2 to age 7). At the Concrete Operational Stage (from age 7 to age 11), intelligence is logical, conserved, and dependent on concrete references. The Formal

Operational Stage (after 11 years of age) is the stage when abstract thinking starts and the learner starts thinking about probabilities, associations, and analogies. Piaget's developmental theory of learning and constructivism are based on discovery. According to his constructivist theory, in order to provide an ideal learning environment, children should be allowed to construct knowledge that is meaningful for them.

Lev Vygotsky (1978), known for his theory of social constructivism, believes that learning and development is a collaborative activity and that children are cognitively developed in the context of socialization and education. The perceptual, attention, and memory capacities of children are transformed by vital cognitive tools provided by culture, such as history, social context, traditions, language, and religion. For learning to occur, the child first makes contact with the social environment on an interpersonal level and then internalizes this experience. The earlier notions and new experiences influence the child, who then constructs new ideas (p. 56).

Furthermore, Vygotsky (1978) emphasized Zone of Proximal Development (ZPD) defining it as "... the distance between the actual developments of a child as determined by the independent problem solving, and the level of potential development as determined through problem solving under adult guidance or in collaboration with more peers" (p. 56). Vygotsky suggests that cognitive development is limited to a certain range at a particular age. However, with the help of social interaction, such as assistance from a mentor, students can comprehend concepts and schemes that they cannot know on their own.

Constructivist theory consists of the major principle that during the process of learning, the learner has to be active as well as assembling knowledge. Kowtrakool

(2002) states that constructivists view the construction of knowledge involve two theories:

1. Cognitive Constructivism refers to learning theory in Constructivism based on Jean Piaget's (1970) Developmental Theory. According to this theory, students are active as well as constructing their own knowledge. Social interaction causes cognitive dissonance. Therefore, the students have to adapt former knowledge with new information until there is cognitive dissonance or new knowledge.
2. Social Constructivism is a theory based on Vygotsky's Developmental Theory that has the assumption that students construct their own knowledge by social interaction with others (adults or friends) while they participate in activities within Social Context which is an indispensable variable. Social interaction causes the students to construct knowledge through the transformation of previously obtained knowledge gradually being more correct, complex, or extensive.

There are common characteristics of Constructivism as follows:

i. Students or learners construct their intellect in what they learn by themselves.
ii. Learning new things is based on one's prior knowledge as well as new discoveries.
iii. Social interaction is important for learning.
iv. Management of the environment and activities which are similar to one's reality could help one to have significant information.

Boethel and Dimock (2000) outline that constructivist-learning theory emphasizes six assumptions of constructivism (pp. 6-8):

i. Learning is an adaptive activity.

ii. Learning is situated in the context where it occurs.

iii. Knowledge is constructed by the learner.

iv. Experience and prior understanding play a role in learning.

v. There is resistance to change.

vi. Social interaction plays a role in learning.

Examples of constructivist learning are found in experiential learning, self-directed learning and reflective practice. These learning strategies explicitly show that the focus is squarely on the learner's construction of knowledge within a social context.

Bruner (1960) believes that knowledge occurs when students interact with the environment, which leads to the discovery for problem solving. He calls it the Discovery Approach. Some educators prefer to call it "Inquiry learning" and note the discovery approach and inquiry learning separately. In the Discovery approach, teachers coordinate the environment and provide different kinds of information regarding what their students need to learn, the objective of the lesson included questions for example, expecting their students to search for and discover the answers by themselves. In inquiry learning, the objective is training the students to be able to point out what the problem is from the existing information, and search for techniques to solve problems by using the existing information.

Bruner believes that the understandable knowledge occurs when the students collect information from environmental interaction and surveying. Bruner also believes that an individual's perception is a result caused by selection or attention to those things since the students are enthusiastic, knowledge would be obtained by discovery, which is the driving force for environmental surveying behavior as well as learning by discovery. The basic approach of the Discovery Learning Theory included:

1. Learning is a process where students interact with the environment themselves. Changes take place as a consequence of interaction, which occur not only in the students but also in the environment.
2. Each student has different types of experience and background knowledge. Knowledge occurs through the relationship between new discoveries and new experiences and understanding, constructed by the student.
3. Intellectual Development can be clearly observed by students and they were being able to receive various alternative stimuli simultaneously. Besides, Bruner provided the instructional principles as follows:
    a. There are differences between a child and an adult's thinking. When children do something wrong, adults should consider the children's intellectual development at different age levels; therefore, children have thought process different from adults. As a result, teachers and those with the responsibility of education should understand the level of thinking obtained by children at each age, and also keep in mind that their cognitive process is different from adults, known as Intellectual Empathy.
    b. Students' importance should be emphasized by assuming that they are able to manipulate their own learning activities, which is called Self-Regulation. They would initiate and do something independently. Therefore, the teachers or those with the responsibility of teaching or providing training need to

manage the environment and simplify learning by providing the opportunity for students to interact with environment.

c. In teaching, one should begin from the experiences which the students are familiar with or real life experiences and relate them to the future experiences, so that they can understand more easily. For instance, teaching students how to use a map should begin with the province where they live in before studying other provinces or the national map.

Moreover, Bruner also viewed that during instructional management, the teachers should be able to provide experiences in order to help the students to be ready without waiting for them to be ready naturally, which is time consuming. According to Bruner's approach, readiness could be stimulated to occur more rapidly.

In addition, Bruner also recommended that for instructional management, Developmental theory should be considered as a connector between Theory of Learning and Theory of Instruction, which meant that the Developmental Theory would determine the content or knowledge as well as a teaching strategy. In order to select the content or knowledge to teach students, one must consider the developmental level as well as the competency level of the students. We can adapt the content to be relevant to child's capabilities in learning or perceiving through techniques appropriate to their age. Therefore, we should teach children with existing readiness without delay. As stated by Bruner, "Any subject can be taught effectively in some intellectually honest form to any child at any stage of development." In readiness, it refers to the children's ability to learn simple skills first as a foundation for the next difficult skill. Bruner stated: "One teaches readiness or provides opportunities for its nurture; one does not simply wait for it."

Readiness, in these terms, consists of the mastery of those simple skills that permits one to acquire higher skills. Bruner viewed that in educational management, subject content should be continuous. If we know which subject is necessary for children or when it should be used, that content subject should be emergently taught to students whilst they are young, by adjusting the subject content to be appropriate with their competency or perception. Consequently, if adequate technique is employed, we should be able to teach any subject at any age level. According to this perspective, instructional management should be a "spiral curriculum" by organizing the subjects to be continuously connected as well as intensively, complexly, and broadly based on students' experiences. The same content would be studied from Elementary Education to the University Level whether it is Mathematics or Physics (Bruner, 1960).

Mathematics is a problem for many students; and they can work with in small peer groups setting to solve math problems. They get help from peers because they have ideas of how to solve the mathematics problems. A student will be able to construct an understanding that makes sense to him/her. This is how social constructivism can be applied in peer learning. There are three types of constructivist views - Radical constructivists believe that individuals construct forms of understanding that make sense to them. Cognitive constructivists believe that students will construct their own understanding. When students work together, they will test and challenge each other's thinking and ideas. Social constructivists feel that students will construct knowledge through their participation in a social setting. They will learn from peers and share ideas with them. There are several learning strategies that will be useful for students. One of them, cooperative learning allows students to work with their peers in a small group setting. The small group allows students to share their ideas. The group will have to depend on each other to complete a goal. The goal of the lesson is to have the students work together cooperatively. They will share ideas and construct an understanding by communicating with each other.

On the basis of above discussion and review of literatures, the behaviourist, cognitivist and constructivist theories, focus on the following assumptions regarding learning strategies:

Table 1.

Focus of Learning Theories

Theories	Theoretical Assumptions
	Learning Strategies
Behaviourist Theory	Imitation, rote learning, learning without understanding, exercise, rehearsal, rigorous practice
Cognitivist Theory	Changing mental processes and mental structures, repetition, researching, translation, grouping, note taking, deduction, recombination, imagery, conceptualization, mnemonic, thinking, self management, physical actions, auditory representation
Costructivist Theory	Social interaction, management of the environment and activities, discovery approach, inquiry learning, active learner who builds and creates meaning and knowledge, asking questions, learners who reflect and make associations with prior knowledge to reach new understandings, self-regulation, self-encouragement, cooperative learning, critical thinking, peer learning, help seeking, elaboration

Table 1 clearly illustrates that Behaviourist theory assumes teachers teach to develop the skill and behaviours of the learners. They use dialogue, lectures, work based practice and teach the exercise to answer the students' problems. Regarding learning strategies, this theory assumes that students imitate their teachers without understanding. They believe that practice makes a man perfect and do exercise and rehearsal.

Cognitivist theory assumes that teachers have prior knowledge of teaching styles and contents. They illustrate various examples, provide explanations, reinforcement and mediate the students to discover new ways and knowledge. It also assumes that teachers provide enough practices and they play decisive role in reshaping the mental schemata of the students through generalization. Similarly, this theory assumes students use the strategies like replication, researching, note taking, translation, deduction and recombination. Students conceptualize the lessons through imagery, mnemonic, thinking and physical actions.

Similarly, Constructivist theory assumes that teachers use learner centered instruction, create democratic learning environment, offer options and choices for students, do not only dictate them what to do and ensures the students' participation in learning. It has also assumed that they would treat classroom work as a research, they ensure the interaction between teachers and students and share ideas with students. Likewise, the theory assumes that teachers do not use power control method and reject the autocratic method of teaching. They generally give home assignment and class work. Regarding the learning strategies, this theory has assumed that students have social interactions, manage the learning environment themselves and discover new strategies and knowledge in a constructive way. The students are active learners who ask question, do research and reach a new understanding. They seek help, use peer learning, cooperate and provide self-regulation. The constructivist theory expects the readers to be critical and discover new knowledge through social participation.

Kapur (2008) states that under the behaviorist approach the student’s achievement was determined on the basis of memory, as a result of which the meta-cognitive skills such as critical thinking; reasoning ability and problem solving were totally neglected. Constructivism, on the other hand, believes that learning is an active process in which meaning is developed on the basis of experience, and that learning should be situated in realistic situations, should promote social interactions and use authentic learning materials/tasks. In a constructivist class students are encouraged to take the initiative in the process of learning. Students are encouraged to ask questions, interact freely and develop independent thinking. This, in turn, helps them develop critical thinking and problem solving attitude. As a part of this approach, students are asked open-ended and extrapolatory questions and their ideas are given due recognition. Group work and pair work are encouraged because sharing of ideas helps in conceptual clarity and language learning. The constructivist approach is based on the premise that all human beings construct their own knowledge and that given the right opportunity and environment, learners will be able to construct their own knowledge.

The specific learning strategies based on gender, ability group, school type and school location were not found discussed separately. Some researchers (Kaylani, 1996; Oxford & Nyikos, 1989) have said that girl students used memory, cognitive, and social strategies like rehearsal, peer learning and help seeking more than boy students. But they have not talked about the strategies used by the boys. Similarly, Zimmerman (1998) as cited in McCoach & Siegle (2001) has said that high achievers have more self-reflection and metacognition than low achievers- which was discussed qualitatively.

In this study, learner's learning strategies are explored being based on the Behaviourist, Cognitivist and Constructivist learning theories. These theories are combined with the empirical results presented in the following theoretical framework.

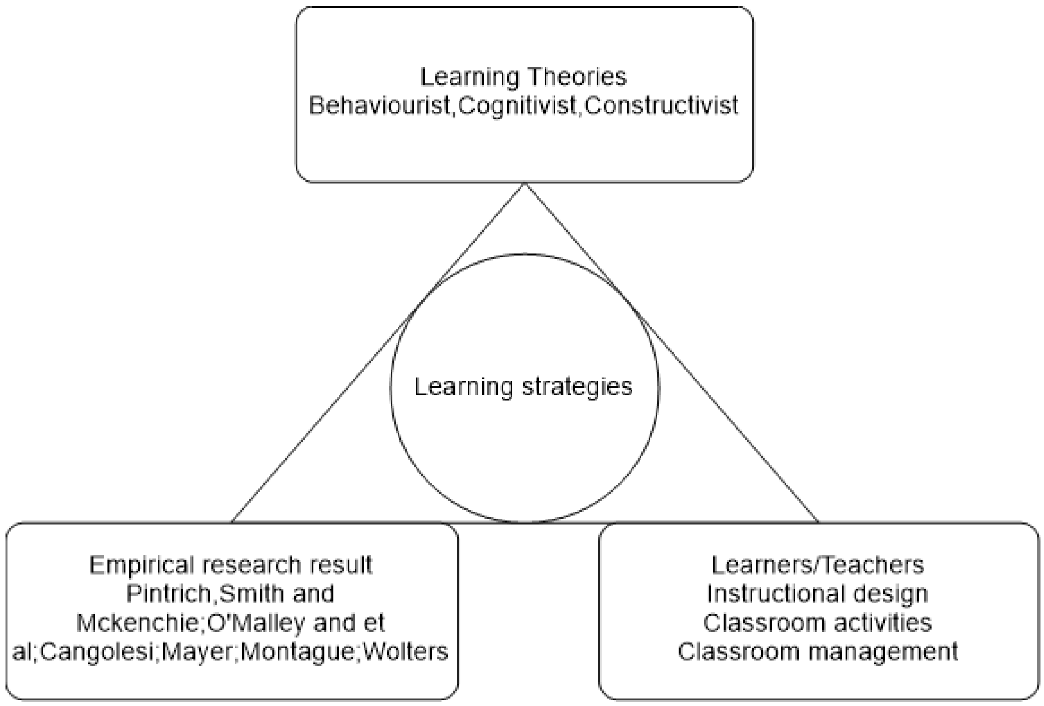

Figure 1. The Theoretical Framework

Behaviourist, cognitivist and constructivist learning theories (Global Theory) have suggested the possible learning strategies (as described in Table 1). Similarly, the empirical researchers' result Pintrich, Smith and Mckeachie, O'Malley and et al, Cangolesi, Mayer, Montague and Wolters have classified the learning strategies (as mentioned in the previous section of this chapter). This study tries to explore the learning strategies used by Nepalese secondary school mathematics students with reference to the learning theories and empirical results. It also discusses how students acquire the particular learning strategies in their classrooms. The study also tries to find out how the teachers' instructional designs help student to develop effective learning strategies.

Conceptual Framework

A conceptual framework explains either graphically or in narrative form the main things or the key factors/variables and their relationships to be studied. The conceptual framework of this study is based on the theoretical framework mentioned above. Behaviorist, Cognitive, and Constructivist learning theories provide the study with the learning approaches which are based on the theoretical framework. In learning management, teachers who manage the learning or teaching, need to understand the approach of that theory in order to make the necessary adjustments for learning in the future. From the above discussed learning theories the researcher has tried to see how these learning theories contribute in designing different learning strategies by the mathematics students.

Teachers, learners, theories, instructional design, classroom activities are the components which explore the learning strategies directly or indirectly in learning mathematics. This concept has been shown in the figure 2 of conceptual framework:

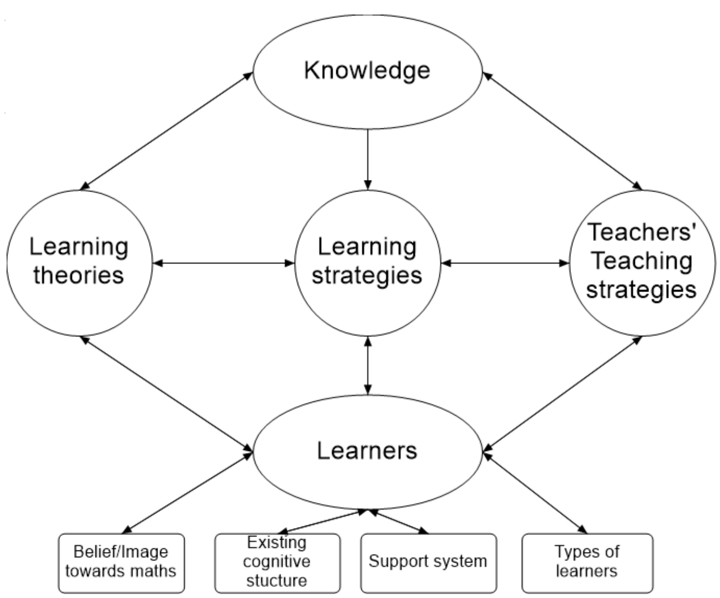

Figure 2. Conceptual Framework

Figure 2 explains that there are two agents- teachers and students who involve in classroom activities where they apply the learning strategies. As the researcher's experiences indicated and the reviewed literature supported, students' beliefs, type of learners, image towards mathematics, support system, existing cognitive structure, social background, previous knowledge also play important role for their selection and use of learning strategies. Similarly, learning strategies are determined by observing belief and practice of students' and teachers' classroom activities like instructional design and classroom management through various tools of quantitative and qualitative methods. Theories also provide guideline to determine learning strategies. This study explores the learning strategies of mathematics students applying B. F. Skinner's behaviourist learning theory, Bandura's social cognitivist learning theory, and constructivist learning theory as suggested by Jean Piaget and Vygotsky as Developmental Learning Theory, and S. Bruner as Discovery Learning Theory being based on the taxonomy (rehearsal, elaboration, organization, critical thinking, metacognition, effort management, time and study management, peer learning, and help seeking) developed by Pintrich, Smith, & Mckeachie (1989) along with the reference of other researchers O'Malley & et. al, Oxford, Cangelosi, Mayer, Montague, and Wolters.

The research digs out the existing knowledge gaps in the field of knowledge world from an academic perspective. To identify knowledge gaps, the researcher applies review of the previous researches. Basically, existing knowledge world has explored learning strategies but the strategies are different between boys and girls, low achievers and high achievers in the context of Nepal, which has not been analysed so far. This research also explores the different learning strategies used by public and private school students in urban and rural settings. In this scenario, the research explores the remaining gaps in existing knowledge world.

On the basis of existing knowledge gaps and theoretical understanding applied in the research, creating the conceptual framework on distinct basis comes as the second implication to the research. All the psychological theories are interested in how human mind works, but they all approach and put emphasis on different things. Behaviourists emphasize on the modification of behavior, Cognitivists seek changing the mental process of the learner and Constructivists emphasize on the construction of knowledge with the interaction between learner and social environment. However, the researcher finds connection between all these theories for developing learning strategies.

The research explores the existing knowledge gaps within the pedagogical implication of theories. Teachers' teaching styles, contribution of theories, classroom activities and instructional design basically empowers the learners to develop their own learning strategies. Learner also develops his/her own learning strategies. Identifying these strategies for the academic purpose seems relevant to fulfill the existing knowledge gaps.

CHAPTER III

RESEARCH METHODOLOGY

This chapter describes how the present study was conducted in course of answering the research questions, particularly explaining the methods, instruments and the way they were used in collecting the data/information while addressing the research questions. It justifies why the selected design, instruments, data collection methods, and analysis was used. This chapter includes the nature of primary and secondary data, process of information collection, research design selected for the study, processing and analysis of data and report writing.

This chapter gives detail description of how documents were reviewed and blended with the field information to see how the knowledge and information gained from the documents have compliance with the field information. The methodology used is explained in the sections: research design, population and sample, sampling procedure, instruments, data collection procedures, secondary data and information, and techniques of analyzing the data.

Research Design

Research design is considered as the blue-print and cornerstone of any study since it facilitates various research operations. In this regard, Kothari (2006) argues that research design helps the researcher for advance planning of the methods to be applied for collecting the relevant data and techniques to be used during analysis. The nature and objectives of the problem to be studied and the means of obtaining information are the most important factors to be considered in order to choose the appropriate research design. Regarding the selection of the research design, Kothari (2006, p. 33) and Brown and Dowling (1998) noted:

> If the major emphasis of the study is on discovery of ideas and insights the appropriate research design is found to be exploratory while if the purpose of the study is on the accurate description of a situation the appropriate research design is descriptive. (p. 37)

The main objective of the study was to explore learning strategies of mathematics students of Nepal. Learning strategy is a way a learner engages in a task including how an individual plans and regulates his/her performance. A learning strategy is a set of one or more procedures (guess and check, problem solving, reflective etc.) that an individual acquires to facilitate the performance on a learning task. Individual ideas, techniques, plans, ways, styles, opinions and judgment are being critical over the learning matters. So, this study had sought out information about the learning strategies of mathematics students. The methods of study were descriptive, interpretive and exploratory with field flavor and the information was based on both the primary and secondary sources. Illustrations of views and opinions of people were mainly based on the primary sources and for the secondary sources various related literatures and reports were reviewed. The constructs to be used in answering the research questions demands both subjective and objective reality and the knowledge of learning strategy use by a student can be constructed on the basis of what s/he is practicing and scaffolding provided from the side of the teacher and the whole learning management system of particular time and space. Therefore mixed method research design is necessary to the present study. In the mixed method, survey, observation and interview methods were used sequentially. The rationale of using mixed method is explained below.

A survey method collects information directly from the people about their ideas, feelings, plans, beliefs, backgrounds and desires as well as the facts that could be observed (Sharma, 2007, p. 97). The present study was related to searching out the learning strategies of mathematics students who were the respondents for the survey. The respondents' retrospective feelings and thoughts were the basic data to be used in answering the questions. What different learning strategies were used by different categories of students in learning mathematics was the matter of concern about retrospective feeling rather than experimenting. In this study, the researcher used survey method to collect the data and used inferential statistics to take the effect (or dependent variable) and to examine the data retrospectively for establishing causes, relationship or associations.

The life experiences of how they were constructed as students and their journey of learning mathematics using their own idiosyncratic strategies of learning were also needed to answer the research questions. The life experiences were brought from the observation and interviews with the students. Therefore, besides survey design, interview and observation of qualitative paradigm were also employed in order to capture genesis of different learning strategies used by mathematics students identifying their classroom practices, views and techniques in solving mathematical problems selecting two schools within the Kathmandu valley. Qualitative information related to the existing classroom practices, images towards mathematics and mathematics teaching and learning were collected to triangulate this information to the data/information obtained by the survey regarding the learning strategies used by the students in mathematics learning. Both quantitative and qualitative treatments were employed to collect the data/information to answer the set research questions. So, integrating both quantitative and qualitative designs (mixed method), with wider range of sources of informants were considered in the study.

This is mainly inferential study because this study has used the high level statistics for quantitative analysis. On the other hand, it is exploratory and explanatory as well as descriptive research design including quantitative and qualitative study (mixed method) in actual classroom setting in which data/information were obtained by interviewing, observing, surveying, diary keeping, and video recording.

Quantitative research is a mode of inquiry often used for deductive research, when the goal is to test theories or hypotheses, gather descriptive information, or examine relationships among variables. Constructs as variables are measured, and numeric data are yielded that can be analyzed statistically. Quantitative data have the potential to yield efficient data collection procedures, to provide measurable evidence, to help to establish (probable) cause and effect, to create the possibility of replication and generalization to a population, to facilitate the comparison of groups, and to provide insight into a breadth of experiences. All these features are necessary for this study.

A salient strength of qualitative research is its focus on the contexts and meaning of human lives and experiences for the purpose of inductive or theory-development driven research. It is a systematic and rigorous form of inquiry that uses methods of data collection such as in-depth interviews, ethnographic observation, and review of documents. Qualitative data help researchers understand processes, especially those that emerge over time, provide detailed information about setting or context, and emphasize the voices of participants through quotes. Qualitative methods facilitate the collection of data when measures do not exist and provide a deeper understanding of concepts. This research needs adequate qualitative description of the learners, classroom settings, interaction between teachers and students, students' story of using different strategies in sequence etc. Besides, the description gives the characteristics of individuals, describes facilities, states the habits of the students and describes the attitude of them. Students both boys and girls were interviewed through the use of open-ended questionnaires for qualitative information related to students' perceptions of their teachers' teaching styles as well as the learning strategies of students. Mathematics classrooms were observed to explore learning strategies of students. This qualitative information was helpful to understand students' attitudes towards mathematics learning. Arguing to the inferences drawn from the quantitative techniques need to be done using qualitative information.

Regarding the methods and types of information, Myers (1997) says that qualitative research methods were developed in social sciences to enable researchers to study social and cultural phenomenon. Qualitative data sources include observation and participant observation (field work) and interviews and questionnaires, documents and tests, and the researches, impressions and reactions (pp. 2-3). Furthermore, "qualitative research is a research that produces findings not arrived at by any means of statistical procedures or other means of quantification, it tells about persons' lives, stories, behaviour, but also about organizational functioning, social movements, or interactional relationships" (Strauss & Corbin, 1990, p.17). Strauss and Corbin (1990) further say that some of the data may be quantified but the analysis is a qualitative one. The qualitative description includes studies related to culture, patterns or processes of social and culture change by encompassing the elements like customs, norms or values of social structure and organization or patterns of human behavior. Qualitative description can also be derived from the historical method or comparative method, which looks into the origin and processes of development of any culture or society or their parts. As this study intended to analyze the learning strategies of students in mathematics, qualitative study was helpful to look into the problem from multi-dimensional perspective. To elaborate further on this method of study, Denzin and Lincoln (1994) say:

> Qualitative research is interdisciplinary, transdisciplinary, and sometimes counter disciplinary field. It crosses cuts the humanities and the social and physical sciences. Qualitative research is many things at the same time. It is multi paradigmatic in focus. They are committed to the interpretive understanding of human experience. At the same time the field is inherently political and shaped by multiple ethical and political positions. (p. 2)

Strauss and Corbin (1990, p. 19) think " the qualitative methods of data gathering and analysis are used due to its validity in giving satisfactory results" and according to them researches coming from various disciplines such as anthropology and phenomenology, advocate for using qualitative methods for this purpose. The authors further say that the reason for using qualitative methods is also to get new and fresh views on issues about which some have already known.

On the above ground the researcher thought that qualitative method was the best method to be integrated with quantitative method for this study. Qualitative method was mostly used in social and behavioral sciences therefore the researcher thought it was necessary to this research because it could be effective to analyze behaviour and perception of the students. Patton (1990) arguing about the advantages of the qualitative research design says that qualitative research brings portrayals of holistic settings and greater attention can be paid to the feeling , perception, setting, interdependencies, complexities, idiosyncrasies, and context. The writer says that 'John Dewey advocated a holistic approach to both teaching and research if one were to reach into and understand the world of the child.'

Qualitative method is not limited to any particular setting or some individuals or someplace depending on some variables. Rather, it can take wider coverage of any issue or a problem by understanding a phenomenon or program as a whole and unifying nature of particular settings. Therefore, this method is most suited for a study related to some issue on education. Thus, qualitative method, by all means, the researcher found to be best fitted for dealing with the issue, and selected this research design. Qualitative information was helpful to identify various learning strategies used by students in mathematics learning.

Mixed Method

Mixed methods research is defined as a research approach or methodology with a focus on research questions that call for real-life contextual understanding, multi-level perspectives, and cultural influences; employing rigorous quantitative research assessing magnitude and frequency of constructs and rigorous qualitative research exploring the meaning and understanding of constructs; utilizing multiple methods (e.g., intervention trials and in-depth interviews); intentionally integrating or combining these methods to draw on the strengths of each; and framing the investigation within philosophical and theoretical positions. Johnson and Onwuegbuzie (2004) have mentioned three stages of mixed method:

i) Induction: Discovery of patterns through tables/figures

ii) Deduction: Testing of patterns

iii) Abduction: Uncovering the best set of explanations in given context for constructing meaning related to findings

In this study, the researcher collected the data and information using various tools and discovered patterns through tables and figures. The patterns were tested using statistical tools, different theories and empirical results. Then the results were explained in context.

Mixed methods researchers often follow diverse philosophical positions. These positions are often referred to as dialectal stances that bridge post-positivist and social constructivist worldviews, pragmatic perspectives, and transformative perspectives (Greene, 2007). For example, researchers who hold different philosophical positions may find mixed methods research to be challenging because of the conflict created by their different beliefs (Greene, 2007). However, mixed methods research also represents an opportunity to transform such conflicts into new knowledge through a dialectical discovery. A pragmatic perspective draws on employing "what works," using diverse approaches, giving primacy to the importance of the research problem and question, and valuing both objective and subjective knowledge (Morgan, 2007). A transformative perspective suggests an orienting framework for a mixed methods study based on creating a more just and democratic society that permeates the entire research process, from the conceptualization of problem to making conclusions, and the use of results

(Mertens, 2009). Creswell (2012) emphasizes, "… mixed methods research has its own philosophical worldview: pragmatism" (p. 537). Thus, the researcher followed the pragmatic perspective in this study giving primacy to the research problem and questions valuing both objective and subjective knowledge so that the results can be used in teaching-learning process.

Optimally, all studies draw upon one or more theoretical frameworks from the social, behavioral, or biological sciences to inform all phases of the study. Mixed methods studies provide opportunities for the integration of a variety of theoretical perspectives.

Mixed methods study begins with the assumption that investigators, in understanding the social and health world, gather evidence based on the nature of the question and theoretical orientation. Social inquiry is targeted toward various sources and many levels that influence a given problem (e.g., policies, organizations, family, individual). Quantitative (mainly deductive) methods are ideal for measuring pervasiveness of "known" phenomena and central patterns of association, including inferences of causality. Qualitative (mainly inductive) methods allow for identification of previously unknown processes, explanations of why and how phenomena occur, and the range of their effects (Pasick et al., 2009). Mixed methods research, then, is more than simply the collection of qualitative data from interviews, or collecting multiple forms of qualitative evidence (e.g., observations and interviews) or multiple types of quantitative evidence (e.g., surveys and diagnostic tests). It involves the intentional collection of both quantitative and qualitative data and the combination of the strengths of each to answer research questions.

In mixed methods studies, investigators intentionally integrate or combine the quantitative and qualitative data rather than isolating one from the other. The basic concept is that integration leads to maximizing the strength of the quantitative and qualitative data and minimizing their weaknesses. This idea of integration separates current views of mixed methods from older perspectives in which investigators collect both forms of data, but keep them separate or casually combined them rather than using systematic integrative procedures. One of the most difficult challenges is how to integrate different forms of data. Three approaches have been discussed in the literature (Creswell & Plano Clark, 2011): merging data, embedding data, and connecting data.

Merging data consists of the work of combining the qualitative data in the form of texts or images with the quantitative data in the form of numeric information. This integration can be done by reporting results together in a discussion section of a study, such as reporting first the quantitative statistical results followed by qualitative quotes or themes that support or refute the quantitative results. It can also be achieved by transforming the given dataset (e.g., counting the occurrence of themes in a qualitative dataset) so that the transformed qualitative results can be compared with the quantitative dataset (Sandelowski, Voils, & Knafl, 2009). This integration can also occur through the use of tables or figures that display both the quantitative and the qualitative results (i.e., data displays).

In embedding data, a dataset of secondary priority is embedded within a larger, primary design. An example is the collection of supplemental qualitative data about how participants are experiencing an intervention during an experimental trial. Alternatively, qualitative data collection may precede an experimental trial to inform development of procedures or follow an experimental trial to help explain the results of the trial.

Connecting data involves analyzing one dataset (e.g., a quantitative survey), and then using the information to inform the subsequent data collection (e.g., interview questions, identification of participants to interview). In this way, integration occurs by connecting the analysis of results of the initial phase with the data collection of the second phase of research (Creswell, 2014). Connecting data is the approach the researcher used in this study with the analysis of quantitative data in the first phase and integrating the collection of the qualitative data in the second phase.

Creswell, Plano Clark, Gutmann, and Hanson (2003) classified mixed methods designs into two major categories: sequential and concurrent. The researcher has used sequential designs in this study. In sequential designs, either the qualitative or quantitative data are collected in an initial stage, followed by the collection of the other data type during a second stage. In contrast, concurrent designs are characterized by the collection of both types of data during the same stage. Within each of these two categories, there can be three specific designs based on: (a) the level of emphasis given to the qualitative and quantitative data (equal or unequal), (b) the process used to analyze and integrate the data, and (c) whether or not the theoretical basis underlying the study methodology is to bring about social change or advocacy (Creswell et al., 2003). In accordance with this typology, the three types of sequential mixed methods designs are: (a) sequential exploratory, (b) sequential explanatory, and (c) sequential transformative. Among them, the researcher has adopted sequential explanatory design which is shown in the figure 3 (Creswell, 2014, p. 209).

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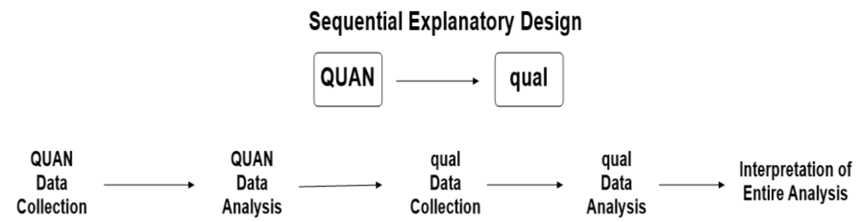


Figure 3. Sequential Explanatory Design

Reasons for the Use of Mixed Method

The research method followed in an investigation must fit the research problem or question. Problems most suitable for mixed methods are those in which the quantitative approach or the qualitative approach, by itself, is inadequate to develop multiple perspectives and a complete understanding about a research problem or question. For example, quantitative outcome measures may be comprehensible using qualitative data. Alternatively, qualitative exploration may usefully occur prior to the development of an adequate instrument for measurement. By including qualitative research in mixed methods, investigators can study new questions and initiatives, complex phenomena, hard-to-measure constructs, and interactions in specific, everyday settings, in addition to experimental settings.

Several purposes captured the major reasons for using mixed methods in research. The researcher sought to view problems from multiple perspectives so as to enhance and enrich the meaning of a singular perspective. The researcher also wanted to contextualize the information, take a macro picture of a system and add information about individuals. The reasons were: to merge quantitative and qualitative data to develop a more complete understanding of a problem; to develop a complementary picture; to compare, validate, or triangulate results; to provide illustrations of context for trends, or to examine processes/experiences along with outcomes (Plano Clark, 2010). Another reason was to have one database built on another. When a quantitative phase follows a qualitative phase, the intent of the investigator is to develop a survey instrument, an intervention, or a program informed by qualitative findings. When the quantitative phase is followed by the qualitative phase, the intent may be to help determine the best participants with whom to follow up or to explain the mechanism behind the quantitative results (Plano Clark, 2010).

As this study was intended to analyze students' use of learning strategies the researcher employed both quantitative and qualitative approaches (mixed method). The researcher has used sequential explanatory design by demonstrating the quantitative data in the tables and qualitative information in the text to authenticate the findings derived from quantitative analysis. Various learning strategies of mathematics students were explored by analyzing and interpreting both quantitative data and qualitative information. The integration was done reporting first the quantitative statistical results followed by qualitative quotes or themes. Quantitative data have been given more emphasis than the qualitative information. A survey method was used to collect information directly from the students about their ideas, feelings, plans, beliefs, backgrounds, techniques and desires as well as the facts that could be observed. The present study was intended to searching out the strategies of students in learning mathematics. Students were the respondents for the survey. Qualitative study was very helpful to look into the problem from multi-dimensional perspective. The respondents' retrospective feelings and thoughts about learning mathematics were the basic information used in the study. So, integrating both quantitative and qualitative designs, wider range of sources of information was considered in the study. Data derived from the survey were both agreed and denied by the qualitative analysis. The agreed data were put in coherence and the conflicting remarks and data were discussed and debated to view problems from multiple perspectives so as to enhance and enrich the meaning of a singular perspective.

Population and Sample

Population is the group of interest of the researcher on which the result of the study can be generalized. “A population is considered to be any group of people that shares a set of common traits such as all students, teachers or farmers etc. Why a researcher would specify a population depends on to whom he or she wishes to extend his or her results” (Black, 1999, p.111). Best and Kahn (1996) define population in these words: “A population is any group of individuals that have one or more characteristics in common that are of interest to the researcher. The population may be all the individuals of a particular type, or a more restricted part of that group” (p. 13).

The result of the study could be extended to the students, teachers, educators, mathematicians, parents and the people who were working in teaching and learning. It would be justifiable that the population of the study consisted of all the mathematics students, mathematics teachers, mathematicians, and mathematics educators. However, the learning strategies are the constructs related to students, and is employed by the students in learning mathematics. So, the population of the study was grade IX students of Nepal. Thus, the study was carried out among the grade IX students. Therefore, 394,513 students of grade IX of Nepal (Department of Education, 2069) were the population of the study.

The representative proportion of population is called the sample. Best and Kahn (1996) define sample as a small proportion of a population selected for observation and analysis. By observing the characteristics of the sample, one can make certain inferences about the characteristics of the population from which it is drawn. In this study, finally 1394 students of Grade IX of 24 selected schools of three geographical regions from urban and rural settings of Nepal including public and private schools were the sample for quantitative study.

The sample size was determined by using the following formula:

$$n = \frac{z^2.p.q.N}{e^2(N-1)+z^2.p.q}$$

Where, z =1.96 for 95% Confidence level

e =0.05, p = 0.5, q = 0.5, N = size of population, n = sample size

The above mentioned formula gave only 384 sample students out of 394,513 students studying in Grade IX as the data provided by Department of Education. Theoretically, 384 is the standard size of sample for the study whereas additional 1010 students were selected as extra students to include the students the researcher had met incidentally during his visit to the sample schools. The survey forms were distributed to all the students met in the school at the time of survey. The other case was that in some schools the number of students was not as proportionate as in predetermined sampling frame. Therefore, to cover this condition that all those received survey forms were used and ultimately the sample students for quantitative study became 1394.

To authenticate the findings derived from quantitative method, 24 students (12 boys and 12 girls including equal number of high achievers and low achievers) selected purposively from two types of schools i. e. public and private, from one of the geographical regions (Hilly region) were the samples for qualitative study. Both schools were from urban setting. For qualitative information related to the students of rural schools, the researcher purposively added 4 students (2 boys and 2 girls) and collected additional information conducting interviews from a rural school of same geographical region. Thus, 28 students from 3 schools were the samples for qualitative study.

Sampling Procedure

The multi-stage sampling procedure was used to establish the highest degree of representativeness of the category of population from different ecological, developmental, urban and rural regions of the country with the representation of different castes and cultures from both public and private schools including high performing and low performing schools in the country. Kothari (2011) asserts “ordinarily multi-stage sampling is applied in big inquiries extending to a considerably large geographical area, say, the entire country.” (p. 66) He further states the advantages of this sampling design in two points “(a) It is easier to administer than most single stage designs mainly because of the fact that sampling frame under multistage sampling is developed in partial units; (b) A large number of units can be sampled for a given cost under multi-stage sampling because of sequential clustering (p. 66).

The following five-stage sampling design was applied in this study, as this study wanted to investigate the learning strategies used by mathematics students across Nepal and wanted to take sample of few schools for the purpose.

Stage I: Stratified random sampling (Geographical regions)

Stage II: Stratified random sampling (Urban and rural areas)

Stage III: Random sampling (Public and Private Schools)

Stage IV: Incidental sampling (boys and girls students)

Stage V: Purposive sampling (High achiever and low achiever students from teachers' school record)

In the first stage, stratified random sampling approach was applied by dividing the whole country into three strata based on its geographical regions: Mountain region, Hilly region and Terai region. According, Rasuwa and Solukhumbu districts were selected from the Mountain region. Ilam, Kathmandu, Dhading, Kaski, Pyuthan, Surkhet and Dadeldhura were selected from Hilly region. Similarly, Jhapa, Rupandehi and Kailali districts were selected from Terai region. In the second stage, urban and rural areas were separated in each of these districts by using stratified random sampling. The urban areas included district headquarters of the country and the municipalities. Then, in the third stage, public and private schools were selected by using random sampling. Thereafter, the schools were visited in the fourth stage, and boys and girls students were selected using incidental sampling method. And at last stage, purposive sampling was used to select high achieving and low achieving students from two types of schools i. e. public and private, from one district in one of the geographical regions (Hilly region). Accordingly, Kathmandu district was selected. Both schools were from urban setting. So, for qualitative information related to the students of rural schools, the researcher purposively added a rural school of Dhading district of same geographical region.

Grade IX students were sampled from the schools in 12 districts mentioned above so as to make representation of geographical, social, economic and ethnic variation existing in the country. Help was sought in meeting the sample schools from the District Education Office (DEO) of the selected sample districts. The researcher approached the sample schools through the persons who were in contact with the researcher. At the time of administering the research instruments for collecting the data, the Head-teacher and the mathematics subject teachers helped the researcher. As the Grade IX students who attended the class were the sample students for the study, those who were present in class were given the Motivated Strategies for Learning Questionnaire (MSLQ) and requested to fill out the questionnaire and return back after completion. All the participants returned the questionnaire after completion. The questionnaires were distributed to 1436 students but all the students did not fill out all the items of the questionnaire and some of the students ticked out two or more than two options in an item. Such questionnaires were excluded from the study. With this procedure, the sample of the students for this study came out with the total of 1394. Among them 977 students were from 17 public schools, and 417 students were from 7 private schools. Likewise, 987 students were from 16 urban schools, and 407 students were from 8 rural schools. Similarly, 652 students were boys and 742 students were girls from different schools. The achievement level was seen in 178 students from 2 schools of Kathmandu district. Among them, 43 high achievers and 44 low achievers were selected as samples of the study. The main purpose of the study was to explore the learning strategies of mathematics students. However, the researcher had to see the relation of learning strategies to the achievement level. Therefore, the achievement was taken only from Kathmandu district for researcher's ease.

In the case of qualitative sampling design, purposive sampling procedure was adopted for the selection of key informants. It was designed in the field rather than by presumption. In order to select the samples from the population, the researcher used purposive sampling method in qualitative study. "In purposive sampling one picks up the cases that are judged as typical on the basis of the needs of the researcher" (Thakur, 1997). Purposive sampling is the way of selecting the research place because “the researcher’s hand picks subjects on the basis of specific characteristics, building up a sample of sufficient sizes when multiple groups are to the selected, but it is difficult to justify the representativeness of the resulting sampling.” (Black 1999, as cited in Dhakal, 2003, p.19)

For qualitative information, the researcher focused on the observation of classroom practices in two selected schools of distinct categories of any one of the three geographical regions. One school was public in nature with Nepali as a medium of instruction. The other one was private in nature with English as a medium of instruction. Both schools were from urban setting of Kathmandu district. For qualitative information related to the students of rural schools, the researcher added 4 students (2 boys and 2 girls) and collected additional information conducting interviews from a rural school of Dhading district to authenticate the findings derived from quantitative methods. Poor people’s children are studying in the public school; however, the rich and middle class people’s children are in private schools. The selected sample public schools represented the nature of general public schools in the country and students were from the families with low socio-economic status, whereas the selected sample private school represents the nature of school in the country which provides services to the students from the rich, high socio-economic status and the elite people. Twelve students including six high achievers (3 boys and 3 girls) and six low achievers (3 boys and 3 girls) from a public school and twelve students including six high achievers (3 boys and 3 girls) and six low achievers (3 boys and 3 girls) from a private school were purposively selected for interview to collect qualitative information in the study. Similarly, 4 students (2 boys and 2 girls with equal number of high achievers and low achievers) from a rural school of Dhading district were also sampled for the qualitative study. Altogether, the sample students for qualitative study were 28. The sampling frame of this qualitative sample was gender, ethnicity and caste, high achievers and low achievers, participation in the classroom, poor and rich students studying in secondary level (Grade IX). These students were interviewed frequently on different themes and issues in course of class observation. The interview was in-depth and thematic.

Data and Information

The researcher collected data and information from two sources: primary source and secondary source. The primary data and information were collected using questionnaire, observation and interview. The secondary data and information about mathematics achievement of the key informants (students) were collected from two case schools from the marks ledger of District Level Exam of their previous grade VIII as provided by the school. Then the students were categorized as high achievers and low achievers in mathematics. Available literatures for the secondary data and information related to the study were reviewed. This literature constituted various books on the related subject.

Instruments

The researcher developed the interest of pursuing the study using questionnaires, observation guidelines and interview guidelines as research instruments. In relation to this idea, Trochim (2004) argues that alternative forms were designed to be equivalent in the types of questions that lead to the outcome. Likewise, Kothari (2006) describes that the collection of primary data for qualitative studies is made possible either through questionnaire or through interviews. The researcher had employed the following four instruments in this study viz. questionnaire, observation guidelines, interview guidelines and researcher's reflective diary.

Questionnaire

Different versions of the Motivated Strategies for Learning Questionnaire (MSLQ) have been widely used in many countries and with students from diverse backgrounds. The 85-item questionnaire (Pintrich, Smith, & McKeachie, 1989) originally designed to measure motivational beliefs and learning strategy use of college students was translated by Wu and Cheng, 1992 (cited in Chang, 2010) for use with elementary and junior high school students in Taiwan. The questionnaire includes motivation scales and learning strategies scales, which can be used together or separately (as cited in Chang, 2010). In the present study, only the learning strategies section was utilized (See Appendix -II).

The learning strategies consisted of cognitive strategies which include rehearsal, elaboration, organization, critical thinking and metacognition, and resource management strategies which include time and study management, effort management, peer learning and help seeking (see appendix IX).

The Taiwanese version of the Motivated Strategies for Learning Questionnaire (Wu & Cherng, 1992) was used to survey the students in the present study to identify the learning strategies of secondary school students (items from the Questionnaire can be found in Appendix I). It was a self-scored instrument which was adapted from the MSLQ developed by Pintrich, et al. (1989), which is described below.

Motivated Strategies for Learning Questionnaire (MSLQ)

The learning strategies section of the MSLQ contains two categories with 43 items. Cognitive Strategies include five scales: Rehearsal (4 items), Elaboration (6 items), Organization (4 items), Critical Thinking (5 items), and Metacognition (10 items). The category of resource management strategies includes four scales: Time and Study Management (5 items), Effort Management (3 items), Peer Learning (3 items), and Help seeking (3 items). Each item represents a statement concerning the use of learning strategy. Students respond to the items using a 7-point Likert-type scale, ranging from 1 (not at all true of me) to 7 (very true of me). Some negative items are reverse-scored. For these items, a score of 7 is transformed to a score of 1; a score of 6 is transformed to a score of 2, and so on. Any scale score is calculated by taking the mean of the responses to all items in the particular scale (Wu & Cherng, 1992).

The original MSLQ is believed to have sufficient reliability and validity (Pintrich & Johnson, 1990). A reliability analysis was also carried out by Pintrich, et al. (1989) to evaluate internal consistency of the scales of MSLQ. The values ranged from 0 .65 for Rehearsal to 0.91 for Task Value. In order to develop a Taiwanese version of MSLQ, Wu and Cherng (1992) conducted a study to establish the internal consistency and test-retest reliability of the translated instrument. They administered the adapted version to 921 elementary and junior high school students in Taiwan. As to the test for internal consistency, the sub-scale reliability coefficients ranged from 0.55 for Extrinsic Goal Orientation to 0.87 for Metacognition. Test-retest reliability was obtained with a sample of 75 students. The value ranged from 0.57 for Rehearsal to 0.87 for Elaboration.

Validity of MSLQ was examined by measuring the inter-correlations among the scales of cognitive strategies and among the scales of resource management strategies. The inter-correlations among the scales were significant ($p < 0.001$) and ranged from 0.43 to 0.74. With respect to the predictive validity of the scales, they were successful in predicting academic achievement. Positive correlation of test scores was found with Rehearsal ($r = 0.18$, $p < 0.01$), Elaboration ($r = 0.20$, $p < 0.01$), Organization ($r = 0.16$, $p < 0.01$), Critical Thinking ($r = 0.21$, $p < 0.01$), Metacognition ($r = 0.20$, $p < 0.01$), Time and Study Management ($r = 0.32$, $p < 0.01$), Effort Management ($r = 0.17$, $p < 0.01$), Peer Learning ($r = 0.17$, $p < 0.01$), and Help seeking ($r = 0.16$, $p < 0.01$).

The Use of Motivated Strategies for Learning Questionnaire

Lynch (2008) administered the Motivated Strategies for Learning Questionnaire (Pintrich & Garcia, 1991) to 320 college students to investigate their learning strategy use in each student's most difficult class and discovered gender differences. The results revealed that female students reported using fewer Critical Thinking strategies than did male students. Nevertheless, females used Rehearsal, Elaboration, Organization, and Metacognitive strategies more frequently than males.

Jacobson and Harris (2008) employed the Motivated Strategies for Learning Questionnaire developed by Pintrich, Smith, Garcia, and McKeachie (1991) to determine if differences existed between traditional and non-traditional college students' use of strategies. The researchers found that non-traditional students exhibited greater use of overall learning strategies, whereas traditional students used Help-seeking strategies most frequently.

In another study, Hamman, Berthelot, Saia, and Crowley (2000) used the questionnaire to determine if strategy instruction influenced strategic learning of students. Out of the nine learning strategies scales, they selected only five scales for use in their study. The sample consisted of 11 middle school teachers and 235 middle school students. Based on their observations, the researchers discovered that teachers encouraged students to use learning strategies by saying things like, “You should probably consider planning some homework time each night to work on your research project” or, “You could think about other words that begin with P, and that might help you remember the characteristics of P-waves” (p. 345). Teachers also offered reasons for using learning strategies, such as “I’d recommend you write out the whole sentence rather than only the numbers—Writing it out will help you remember it better and it will be better when you are studying” (p. 345). The results of the study showed that these students’ use of learning strategies was found positively associated with their teachers’ instruction.

In studying the impact of applying learning strategy in mathematical learning, Shores and Shannon (2007) administered the adapted version of the Motivated Strategies for Learning Questionnaire (Pintrich & De Groot, 1990) to fifth and sixth graders. However, these students’ use of cognitive and self-regulated learning strategies did not contribute to higher test scores. The study failed to support the hypothesis that self-regulated learning will help students improve academic performance in mathematics.

The Motivated Strategies for Learning Questionnaire has been employed in many countries. Eshel and Kohavi (2003) used three scales of the questionnaire modified by

Pintrich and De Groot in 1990 to assess self-regulated strategies of 302 sixth graders in Israel. In Taiwan, Shih (2005) studied the relationship between learning strategy use and achievement goals. Among the participants of this study, 242 6^{th} graders were asked to respond in the Taiwanese version of Pintrich, Smith, Garcia, and McKeachie's (1989) questionnaire. In a study conducted by Kosnin (2007), the Motivated Strategies for Learning Questionnaire was translated into the Malaysian language to measure learning strategies used by engineering undergraduates. Kosnin found that self-regulated learning significantly predicted students' academic achievement. Tang and Neber (2008) researched gifted students' use of strategies to learn chemistry. There were 315 10th- and 12th- graders from China, Germany, and the United States. In order to measure the strategy use of each student, the questionnaire (Pintrich & De Groot, 1990) was translated into Chinese and German. The findings revealed that American students showed more frequent use of self-regulated strategies than Chinese or German learners. In this study, the researcher used this model as the major tool for the collection and quantitative analysis of the data.

Observation Guidelines

The researcher maintained daily notes on class observation of the sampled schools. The observation checklist for students learning strategies developed by Shell Centre for Mathematics Education, University of Nottingham, UK (cited in Upadhyaya et. al, 2010, p. 272) (see Appendix-III) was adopted for the observation of the students to find their learning strategies. However, the observation checklist was not used for statistical analysis, but it was used to maintain researcher's reflective diary. Besides, observation guidelines were prepared. The guidelines included issues of learning strategies used, teacher's instruction, and relation between teachers and students as well as among students during classroom learning, assessment practices, contents coverage and clarity. All the activities done in the class by teachers and students, class management, sitting arrangement, materials used were registered on the note. Besides, the researcher's reflections on the classroom activities were noted down in remark section. The mathematics problems related to the study area were given to the key students through teacher to observe their solving techniques for finding their learning strategies.

Interview Guidelines

Another method of information collection was interview taken with the key informants. Both observations and interviews were carried out simultaneously while observing the class activities. The interview guidelines were prepared for the interview of informants. Werner & Schoeffle (1987) stated:

> Any elicitation of information for an ethnography process from general to the particulars of an individual's knowledge, the interview sequence follows the same progression one usually sequences follows the same profession one usually starts by engaging the consultant in an open-ended interview, posing general, indirect or grand tour question first. Eventually, as the focus narrows, toward specific key terms on topics, question with a narrower range or structural question are asked to elicit greater detail on particular items. All of these are mini- tour questions. (p. 314)

Some information was collected from participant observation but some were out of these tools. For example, the information of previous learning strategies/ practices and current practices were to be collected using interview tools. The open ended questions were asked to the informants on continuous basis up to the end of field period. Playing, grouping, singing and telling stories were the tools applied for interaction with them. The researcher used leisure periods, break times and time after the classes so that within limited period, without disturbance, field study went ahead.

The researcher finds no systematic, formally ordered data if there is no structure in one's interviewing. While the researcher may get a general idea of things through a conversation, more precise and detailed information may be gathered through well constructed interview guides. The open ended interview can be truer than a conversation. It is a type of conversation dedicated to a specific purpose and to specific safeguards of methodology. This study was founded on the open ended interview tools in the informal setting. Two interview guidelines were used for students. Learning strategies particulars in mathematics concepts were the questions to the students. The interview guidelines included the learning strategies classified by learning theories to collect the learning strategies of the students in the learning of mathematics.

Development of interview guidelines. The interview guidelines under research questions were used for students. These guidelines included the learning strategies classified by learning theories to collect the learning strategies of the students in the learning of mathematics. In interview guidelines, problems in learning mathematics, strategies used in learning mathematics, causes of lower scores and higher scores in mathematics, socio-economic and cultural role in the learning of mathematics, teachers' instruction, classroom management, de-motivating cause in learning mathematics, need and role of mathematics realized were the questions to the students. Besides, the researcher developed interview guidelines for learning strategies developed by just modifying the Motivated Strategies for Learning Questionnaire developed by Chen, 2008 (as cited in Chang, 2010).

While modifying the questionnaire into interview guidelines, the researcher consulted with his research supervisor as well as language expert.

Researcher's Reflective Diary

Besides the instruments mentioned above, the researcher used his own reflective diary. The researcher also collected the field data including the points related to issues of learning strategies used, teacher preparation, teaching strategies used, and relation between teachers and students and among students during classroom learning, assessment practices used, content coverage and clarity. All the activities done in the class by teacher and students, class management, sitting arrangement were registered on the note. Besides them, the researcher's reflections on the classroom activities were noted down in the remark section.

Pilot Test of MSLQ

The researcher translated the MSLQ into Nepali version. The learning strategies items to be adapted in this research may not have been necessarily reliable in the Nepalese context. So, it became necessary to pilot it in a small group that had "the same profile with the subjects of the study" (Brown and Dowling, 1998) and that were not part of the study. Thus, the researcher administered the adapted version to 94 grade IX students in Nepal to test reliability (internal consistency) of the translated instrument. The reason lied in the fact that pilot-testing helped to learn where undesired mistakes were made, and it gave an opportunity to modify the questions of the study. Specifically, it avoided ambiguities, assured the simplicity and clarity of communication, and avoided double-barreled questions in the items contained in the questionnaires and interview guide. As Dooley (2004) noted, if the pilot study does not produce sensible results, then the researcher modifies and resets the items until s/he gets proper instrument that can generate what it is supposed to do.

The reliability of the test represents the internal consistency of the test. Before analyzing the data, the beginning step was taken for testing the reliability of the learning strategy items asked for the students in the sample.

The Methods of finding reliability of the test are test-retest, split-half, parallel test, internal consistency etc. The internal consistency is determined from Cronbach alpha. This indicates how well the items are correlated with one another. High reliability indicates that all the items measure the same thing, or general construct. The item total correlation is corrected by Cronbach alpha and hence the corrected item-rest correlation is the method which we use to see the internal consistency of the test. A general traditional principle is that one should reject those instruments where Cronbach alpha value is less than 0.60 (Nunnally & Bernstein, 1994). Nevertheless, the principle is not strict (Knapp & Brown, 1995, 465-469). Even before Cronbach, it was proved that Alpha is the minimum of the reliability. The common range of Cronbach α is 0.65 - 1.00; however, it is rare to get the α value above 0.92. However, the Cronbach α decreases as the number of items or the item total correlation decreases. In this research, even 4 items in a small set of learning strategy were included, and hence, the alpha value could occur even lower than 0.40.

Items of all nine categories were piloted in two schools – Sitaram Higher Secondary School and Rainbow International Boarding Higher Secondary school; in which 94 students had participated. Based on that data, overall internal consistency of the items was 0.850 which was the indication of high reliability. The item-wise item total statistics is given in Appendix VII.

Items 1, 5 and 8 had very low or negative correlation in total. Those items could work in the final research. The above reliability coefficient showed that the consistency could be preserved in the information obtained using this instrument.

Reliability and Validity of the Quantitative Instrument

Joppe (2000) defines reliability as the extent to which results are consistent over time. An accurate representation of the total population under study is referred to as reliability, and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable (p. 1). Embodied in this citation is the idea of replicability or repeatability of results or observations. Kirk and Miller (1986) identify three types of reliability referred to in quantitative research, which relate to: (1) the degree to which a measurement, given repeatedly, remains the same (2) the stability of a measurement over time; and (3) the similarity of measurements within a given time period (pp. 41-42).

The traditional criteria for validity find their roots in a positivist tradition, and to an extent, positivism has been defined by a systematic theory of validity. Within the positivist terminology, validity resided amongst, and was the result and culmination of other empirical conceptions: universal laws, evidence, objectivity, truth, actuality, deduction, reason, fact and mathematical data to name just a few (Winter, 2000). Joppe (2000) provides the following explanation of what validity is in quantitative research:

> Validity determines whether the research truly measures that which it was intended to measure or how truthful the research results are. In other words, does the research instrument allow you to hit "the bull's eye" of your research object? Researchers generally determine validity by asking a series of questions, and will often look for the answers in the research of others. (p. 1)

Wainer and Braun (1998) describe the validity in quantitative research as "construct validity". Construct is the initial concept, notion, question or hypothesis that determines which data is to be gathered and how it is to be gathered. They also assert that quantitative researchers actively cause or affect the interplay between construct and data in order to validate their investigation, usually by the application of a test or other process.

In this sense, the involvement of researchers in the research process would greatly reduce the validity of a test. So far, the definitions of reliability and validity in quantitative research reveal two strands. Firstly, with regard to reliability, whether the result is replicable. Secondly, with regards to validity, whether the means of measurement are accurate and whether they are actually measuring what they are intended to measure. However, the concepts of reliability and validity are viewed differently by qualitative researchers who strongly consider these concepts defined in quantitative terms as inadequate. In other words, these terms as defined in quantitative terms may not be applicable to the qualitative research paradigm. The question of replicability in results does not concern them (Glesne & Peshkin, 1992), but precision

(Winter, 2000), credibility, and transferability (Hoepf, 1997) provide the lenses of evaluating the findings of qualitative research. In this context, the two research approaches or perspectives are essentially different paradigms (Kuhn, 1970).

The researcher ensured the reliability of the questionnaire by applying Cronbach's alpha. To explore nine learning strategies, 43 items were included in the questionnaire. All these items included 7 point Likert scale. Among them, item number 5 was negative in the scale. Hence, it was recoded into positive scale by changing 1 to 7, 2 to 6 and so on. Overall, Cronbach's alpha reliability for internal consistency of all the 43 items in full scale study was 0.888 whereas it was 0.85 in pilot test. Hence, from reliability point of view, the items were reliable enough to use in the research in all. The item rest correlation of all the items used in the nine strategies is given in Appendix VIII. Since item total correlation of the test items is acceptable when it is equal or above 0.20. In general, the item-rest correlation is some decimal point lower than item total correlation. Hence, item rest correlation was acceptable round 0.20 or above.

Almost all the items were correlating good enough to use. However, though item number 1, 5 and 32 had low correlation with the overall responses, it was still better to use because of two reasons. First, all of them correlated positively ($r > 0.12$) and they were part of some of the small set of nine learning strategies. Without them, the sets might have been unsuccessful to explain the particular strategy result.

Reliability of the sets of learning strategies. The nine learning strategies explored in this study were: Rehearsal, Elaboration, Organization, Critical Thinking, Meta Cognition, Time study management, Effort management, Peer learning and Help seeking. However, overall reliability of the test was high enough (0.88), individual consistency of the nine strategies could be assessed to ensure the acceptability of the results.

In all the strategies, items were in the 7-point Likert scale. The learning scale score was calculated by taking the mean of the responses to all items in the particular scale. The minimum possible value of mean was 4 and maximum was 28.

Rehearsal. Rehearsal strategy incorporated only four items. Table 2 shows the scale mean, scale variance, item total correlation (ie, corrected or item rest correlation) and Cronbach's alpha estimated.

Table 2.

Item Total Statistics of the Items of rehearsal

Item Description	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1. When I study the readings for this course, I outline the material to help me organize my thoughts.	15.22	10.545	0.061	0.332
2. When studying for this course, I often try to explain the material to a classmate or friend.	15.9	9.122	0.154	0.243
3. I usually study in a place where I can concentrate on my course work.	15.84	8.595	0.16	0.236
4. When reading for this course, I make up questions to help focus my reading.	17.23	6.621	0.239	0.111

Since the item-total correlation of item number 1 was low in this small set, the total reliability was only 0.30; however, this item was accepted for the total set.

Elaboration: Elaboration strategy incorporated only six items. Table 3 shows the scale mean, scale variance, item total correlation (i.e. corrected or item rest correlation) and Cronbach's alpha estimated.

Table 3.

Item Total Statistics of the Items of Elaboration

Item Description	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
5. I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do.	27.92	22.104	0.158	0.574
6. I often find myself questioning things I hear or read in this course to decide if I find them convincing.	29.08	18.881	0.352	0.493
7. When I study for this class, I practice saying the material to myself over and over.	29.39	18.746	0.261	0.542
8. When I become confused about something I'm reading for this class, I go back and try to figure it out.	28.32	19.404	0.299	0.518
9. When I study for this course, I go through the readings and my class notes and try to find the most important ideas.	28.63	19.371	0.378	0.485
10. I make good use of my study time for this course.	28.5	19.512	0.393	0.481

The corrected item total correlation of each item was within the required range except for item number 5; however, it was still near the acceptable range. The overall Cronbach's alpha reliability of Elaboration was 0.56, at acceptable range in round figure.

Organization. Organization strategy incorporated only four items. Table 4 shows the scale mean, scale variance, item total correlation (i.e. corrected or item rest correlation) and Cronbach's alpha estimated.

Table 4.

Item Total Statistics of the Items of Organization

Item Description	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
11. If course readings are difficult to understand, I change the way I read the material.	15.88	9.819	0.173	0.332
12. I try to work with other students from this class to complete the course assignments.	15.9	11.766	0.135	0.36
13. When studying for this course, I read my class notes and the course readings over and over again.	15.99	11.108	0.246	0.242
14. When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.	15.95	11.672	0.235	0.26

The corrected item total correlation of each item was within the required range except for item number 12; however, it was still near the acceptable range. The overall

Cronbach's alpha reliability of Organization was 0.36, at lower acceptable range in round figure.

Critical thinking. Critical thinking strategy incorporated only five items. Table 5 shows the scale mean, scale variance, item total correlation (i.e. corrected or item rest correlation) and Cronbach's alpha estimated.

Table 5.

Item Total Statistics of the Items of Critical Thinking

Item Description	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
15. I work hard to do well in this class even if I don’t like what we are doing.	18.61	22.907	0.109	0.604
16. I make simple charts, diagrams, or tables to help me organize course material.	19.53	19.052	0.338	0.478
17. When studying for this course, I often set aside time to discuss course material with a group of students from the class.	19.33	18.074	0.387	0.445
18. I treat the course material as a starting point and try to develop my own ideas about it.	19.58	18.925	0.388	0.448
19. When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions.	18.75	19.74	0.355	0.47

The corrected item total correlation of each item was within the required range except for item number 15; however, it was still near the acceptable range. The overall Cronbach's alpha reliability of critical thinking was 0.55, at acceptable range in round figure.

Metacognition. Metacognition strategy incorporated only ten items. Table 6 shows the scale mean, scale variance, item total correlation (i.e. corrected or item rest correlation) and cronbach's alpha estimated.

Table 6.

Item Total Statistics of the Items of Metacognition

Item Description	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
20. Before I study new course material thoroughly, I often skim it to see how it is organized.	47.13	63.845	0.342	0.647
21. I ask myself questions to make sure I understand the material I have been studying in this class.	46.62	64.896	0.344	0.647
22. I try to change the way I study in order to fit the course requirements and the instructor's teaching style.	46.67	67.424	0.277	0.659
23. I ask the instructor to clarify concepts I don't understand well.	46.02	66.193	0.373	0.644
24. I memorize key words to remind me of important concepts in this class.	46.64	63.653	0.437	0.631

25. I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for this course.	46.4	62.758	0.232	0.679
26. I try to relate ideas in this subject to those in other courses whenever possible.	47.51	64.646	0.338	0.648
27. When I read this subject, I make the structure of the important concepts.	47.03	61.845	0.448	0.627
28. When reading for this class, I try to relate the material to what I already know.	46.95	64.73	0.408	0.637
29. I have a regular place set aside for studying.	47.29	63.32	0.254	0.67

The corrected item total correlation of each item was within the required range. The overall Cronbach's alpha reliability of metacognition was 0.67, at acceptable range.

Time and study management. Time and study management strategy incorporated only five items. Table 7 shows the scale mean, scale variance, item total correlation (i.e. corrected or item rest correlation) and cronbach's alpha estimated.

Table 7.

Item Total Statistics of the Items of Time and Study Management

Item Description	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
30. I try to play around with ideas of my own related to what I am learning in this course.	20.62	21.525	0.316	0.457
31. When I study for this course, I write brief summaries of the main ideas from the readings and my class notes.	21.57	19.517	0.282	0.474
32. When I can't understand the material in this course, I ask another student in this class for help.	19.95	20.087	0.172	0.56
33. I try to understand the material in this class by making connections between the readings and the concepts from the lectures	20.55	21.499	0.387	0.43
34. I make sure that I keep up with the weekly readings and assignments for this course.	21.21	18.481	0.368	0.414

The corrected item total correlation of each item was within the required range except for item number 32; however, it was still near the acceptable range. The overall Cronbach's alpha reliability of time and study management was 0.52, at lower acceptable range.

Effort Management. Effort management strategy incorporated only three items. Table 8 shows the scale mean, scale variance, item total correlation (i.e. corrected or item rest correlation) and Cronbach's alpha estimated.

Table 8.

Item Total Statistics of the Items of Effort Management

Item Description	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
35. Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.	11.36	4.593	0.326	0.2
36. I make lists of important items for this course and memorize the lists.	10.95	4.645	0.322	0.209
37. I attend this class regularly.	9.71	7.642	0.152	0.495

The corrected item total correlation of each item was within the required range except for item number 37; however, it was still near the acceptable range. The overall Cronbach's alpha reliability of effort management was 0.43, at lower acceptable range.

Peer learning. Peer learning incorporated only three items. The table 9 shows the scale mean, scale variance, item total correlation (i.e. corrected or item rest correlation) and Cronbach's alpha estimated.

Table 9.

Item Total Statistics of the Items of Peer Learning

Item Description	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
38. Even when course materials are dull and uninteresting, I manage to keep working until I finish.	11.48	7.688	0.214	0.317
39. I try to identify students in this class whom I can ask for help if necessary.	11.1	7.923	0.266	0.249
40. When studying for this course I try to determine which concepts I don't understand well.	11.4	5.049	0.229	0.328

The corrected item total correlation of each item was within the required range. The overall Cronbach's alpha reliability of peer learning was 0.38, at lower acceptable range however, each item of the strategy had very good correlation within the set.

Help seeking. Help seeking incorporated only three items. Table 10 shows the scale mean, scale variance, item total correlation (i.e. corrected or item rest correlation) and Cronbach's alpha estimated.

Table 10.

Item Total Statistics of the Items of Help Seeking

Item Description	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
41. When I study for this class, I set goals for myself in order to direct my activities in each study period.	11.45	4.522	0.314	0.298
42. If I get confused taking notes in class, I make sure I sort it out afterwards.	10.15	6.076	0.256	0.41
43. I try to apply ideas from course readings in other class activities such as lecture and discussion.	11.34	4.505	0.286	0.355

The corrected item total correlation of each item was within the required range. The overall Cronbach's alpha reliability of Help seeking was 0.46, at lower acceptable range; however, each item of the strategy had very good correlation within the set.

Validity of the questionnaire was examined by measuring the inter-correlations among the scales of cognitive strategies and resource management strategies; and correlation of learning strategies with achievement score.

Internal correlation among the scales of cognitive strategies and resource management strategies. The nine learning strategies showed very good reliability. This indirectly indicated that the five learning strategies – rehearsal, elaboration, organization, critical thinking and metacognition- also had correlation in total at significant level. To examine whether those strategies correlated each other, a Pearson's correlation was calculated. Table 11 showed the matrix of learning strategies and their bivariate correlation as an internal correlation based on the mean of response in the 7-point Likert scale in each category.

Table 11.

Internal Correlation among the Scales of Cognitive Strategies

Learning Strategy		Mean Rehearsal	Mean Elaboration	Mean Organization	Mean Critical Thinking	Mean Meta Cognition
Mean Rehearsal	Pearson Correlation	1	0.396**	0.318**	0.326**	0.361**
	Sig. (2-tailed)		0	0	0	0
	N	1394	1394	1393	1393	1394
Mean Elaboration	Pearson Correlation	0.396**	1	0.496**	0.383**	0.443**
	Sig. (2-tailed)	0		0	0	0
	N	1394	1394	1393	1393	1394
Mean Organization	Pearson Correlation	0.318**	0.496**	1	0.430**	0.425**
	Sig. (2-tailed)	0	0		0	0
	N	1393	1393	1393	1393	1393
Mean Critical Thinking	Pearson Correlation	0.326**	0.383**	0.430**	1	0.482**
	Sig. (2-tailed)	0	0	0		0
	N	1393	1393	1393	1393	1393
Mean Meta Cognition	Pearson Correlation	0.361**	0.443**	0.425**	0.482**	1
	Sig. (2-tailed)	0	0	0	0	
	N	1394	1394	1393	1393	1394

**Correlation is significant at the 0.01 level (2-tailed)

The Pearson's correlation between any two learning strategies of the category “cognitive strategies” was very good (r = 0.30 – 0.50). It indicated that every category was good enough to use the learning strategy of the students in Mathematics. The correlation was statistically significant at $p < 0.001$.

Table 12.

Internal Correlation among the Scales of Resource Management Strategies

Learning strategy		Mean_Time_Study_Mgmt	Mean_Effort_Mgmt	Mean_Peer_Learning	Mean_Help_Seeking
Mean Time_Study_Mgmt	Pearson Correlation	1	.510**	.418**	.408**
	Sig. (2-tailed)		0	0	0
	N	1393	1393	1392	1392
Mean_Effort_Mgmt	Pearson Correlation	.510**	1	.431**	.389**
	Sig. (2-tailed)	0		0	0
	N	1393	1393	1392	1392
Mean_Peer_Learning	Pearson Correlation	.418**	.431**	1	.398**
	Sig. (2-tailed)	0	0		0
	N	1392	1392	1392	1392
Mean_Help_Seeking	Pearson Correlation	.408**	.389**	.398**	1
	Sig. (2-tailed)	0	0	0	
	N	1392	1392	1392	1392

** Correlation is significant at the 0.01 level (2-tailed)

The Pearson's correlation between any two learning strategies of the category “resource management strategies” was very good (r = 0.38 – 0.50). It indicated that every category was good enough to use the learning strategy of the students in Mathematics. The correlation was statistically significant at $p < 0.001$.

Correlation of test score with the scales. As a dependent variable, the achievement score of 178 students of randomly selected schools from Kathmandu valley (viz. Excelsor Boarding School from Private schools and Geetamata School from Community schools) was taken. The score was based on the District Level Examination when sample students were in grade VIII. The responses in learning strategies were taken just after they passed grade VIII. The researcher's claim was that the learning strategy had strict connection with their achievement score. It was possible to find the difference in learning strategy of the high achiever and the low achiever.

Responses of the students in 7-point Likert scale were summed and the mean of each category was calculated to find the correlation of each strategy with the achievement score. Table 13 showed the correlation of the learning strategy and achievement score.

Table 13.

Correlation between Learning Strategy and Achievement Score

Correlations	Students Grade 8 final examination score
Mean_Elaboration	.254**
Mean_Peer_Learning	.192*
Mean_Time_Study_Mgmt	.152*
Mean_MetaCognition	0.128
Mean_Rehearsal	0.058
Mean_Help_Seeking	0.006
Mean_Effort_Mgmt	-0.013
Mean_CriticalThinking	-0.028
Mean_Organization	-.189*

** Correlation was significant at the 0.01 level (2-tailed).

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

Dataset showed that the students' responses positively correlated in elaboration (r = 0.254), peer learning (0.192), time and study management (0.152), and metacognition (0.128). An interesting fact was that organization correlated negatively (r = -0.189) with the learning achievement, which indicated that low achiever students used organization in many cases but not the high achiever students and hence negative (see the topic: difference in learning strategy of low achiever and high achiever).

The result of the above test showed that the questionnaires were reliable and valid. Validity of the questionnaire was established also after consultation with the supervisors, research experts, educators, some school teachers, language teachers, their acceptance and rejection of the Nepali version of the items/constructs.

Reliability and Validity of the Qualitative Instrument

Qualitative research uses a naturalistic approach that seeks to understand phenomena in context-specific settings, such as "real world setting [where] the researcher does not attempt to manipulate the phenomenon of interest" (Patton, 2001, p. 39). Strauss and Corbin (1990), broadly define, qualitative research as "any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification" (p. 17) and similarly, the kind of research that produces findings arrived from real-world settings where the "phenomenon of interest unfolds naturally" (Patton, 2001, p. 39). Unlike quantitative researchers who seek causal determination, prediction, and generalization of findings, qualitative researchers seek instead illumination, understanding, and extrapolation to similar situations (Hoepfl, 1997).

Qualitative analysis results in a different type of knowledge than does quantitative inquiry because one party argues from the underlying philosophical nature of each paradigm, enjoying detailed interviewing and the other focuses on the apparent compatibility of the research methods, “enjoying the rewards of both numbers and words” (Glesne & Peshkin, 1992, p. 8). This means the methods like interviews and observations are dominant in the naturalist (interpretive) paradigm and supplementary in the positive paradigm, where the use of survey serves in opposite order.

Although it has been claimed (Winter, 2000) that quantitative researchers attempt to disassociate themselves as much as possible from the research process, qualitative researchers have come to embrace their involvement and role within the research. Patton (2001) supports the notion of researcher's involvement and immersion into research by discussing that the real world is subject to change; and therefore, a qualitative researcher should be present during the changes to record an event after and before the occurrence of change.

However, both qualitative and quantitative researchers need to test and demonstrate that their studies are credible. While the credibility in quantitative research depends on instrument construction, in qualitative research, “the researcher is the instrument" (Patton, 2001, p. 14). Thus, it seems when quantitative researchers speak of research validity and reliability, they are usually referring to a research that is credible while the credibility of a qualitative research depends on the ability and effort of the researcher. Although reliability and validity are treated separately in quantitative studies, these terms are not viewed separately in qualitative research. Instead, the terms which encompass both- such as credibility, transferability, and trustworthiness are used.

Validity and reliability are the most essential factors in designing research instrument. Instrument without validity cannot give authentic information for the study.

The most essential kind of validity is the content or constructs validity of the research tools. Content validity implies whether the instrument judges/measures what it is intended to measure. Construct validity says whether the constructs are adequate or not. To understand the meaning of reliability and validity, it is necessary to present the various definitions of reliability and validity given by many qualitative researchers from different perspectives. Although the term ‘reliability’ is a concept used for testing or evaluating quantitative research, the idea is most often used in all kinds of research. If we see the idea of testing as a way of information elicitation, then the most important test of any qualitative study is its quality.

A good qualitative study can help us “understand a situation that would otherwise be enigmatic or confusing” (Eisner, 1991, p. 58). This relates to the concept of a good quality research when reliability is a concept to evaluate quality in quantitative study with a “purpose of explaining” while quality concept in qualitative study has the purpose of “generating understanding” (Stenbacka, 2001, p. 551). The difference in purposes of evaluating the quality of studies in quantitative and qualitative research is one of the reasons that the concept of reliability is irrelevant in qualitative research.

According to Stenbacka, (2001), “the concept of reliability is even misleading in qualitative research. If a qualitative study is discussed with reliability as a criterion, the consequence is rather that the study is not good” (p. 552). On the other hand, Patton (2001) states that validity and reliability are two factors which any qualitative researcher should be concerned about while designing a study, analyzing results and judging the quality of the study. This corresponds to the question, “How can an inquirer persuade his or her audiences that the research findings of an inquiry are worth paying attention to?"

(Lincoln & Guba, 1985, p. 290) To answer the question, Healy and Perry (2000) assert that the quality of a study in each paradigm should be judged in terms of the paradigm itself. For example, while the terms “reliability” and “validity” are essential criterion for quality in quantitative paradigms, in qualitative paradigms the terms credibility, neutrality or confirmability, consistency or dependability and applicability or transferability are to be the essential criteria for quality (Lincoln & Guba, 1985).

To be more specific with the term of reliability in qualitative research, Lincoln and Guba (1985, p. 300) use “dependability”, which closely corresponds to the notion of “reliability” in quantitative research. They further emphasize “inquiry audit” (p. 317) as a measure which might enhance the dependability of qualitative research. This can be used to examine both the process and product of the research for consistency (Hoepfl, 1997). In the same vein, Clont (1992) and Seale (1999) endorse the concept of dependability with the concept of consistency or reliability in qualitative research. Consistency will be achieved in data when the steps of research are verified through examination of raw data, data reduction products, and process notes (Campbell, 1996).

Similarly, the researcher was conscious on ‘triple crisis’ of Denzin &Lincoln (1985) who argue: ‘triple crisis of representation, legitimization and praxis confronts qualitative researchers in the human disciplines which involves a serious rethinking of such term as validity, generalizability and reliability (p. 19). To be free from this, as Denzin &Lincoln proposed to be involved in more action, participatory, and activist oriented local and small scale theories fitted to specific situation, the researcher had tried to be more specific, local and action oriented participatory for data collection and interpretation.

To ensure reliability in qualitative research, examination of trustworthiness is crucial. Seale (1999), while establishing good quality studies through reliability and validity in qualitative research, states that the “trustworthiness of a research report lies at the heart of issues conventionally discussed as validity and reliability” (p. 266). When judging (testing) qualitative work, Strauss and Corbin (1990) suggest that the "usual canons of ‘good science’…require redefinition in order to fit the realities of qualitative research" (p. 250). In contrast, Stenbacka (2001) argues that since reliability issue concerns measurements, then it has no relevance in qualitative research. She adds the issue of reliability is an irrelevant matter in the judgment of quality of qualitative research. Therefore, if it is used then the “consequence is rather that the study is no good” (p. 552). To widen the spectrum of conceptualization of reliability and revealing the congruence of reliability and validity in qualitative research, Lincoln and Guba (1985) state: "Since there can be no validity without reliability, a demonstration of the former [validity] is sufficient to establish the latter [reliability;]" (p. 316). Patton (2001) with regards to the researcher's ability and skill in any qualitative research also states that reliability is a consequence of validity in a study.

The concept of validity is described by a wide range of terms in qualitative studies. This concept is not a single, fixed or universal concept, but “rather a contingent construct, inescapably grounded in the processes and intentions of particular research methodologies and projects” (Winter, 2000, p. 1). Although some qualitative researchers have argued that the term “validity” is not applicable to qualitative research, but at the same time, they have realised the need for some kind of qualifying check or measure for their research. For example, Creswell & Miller (2000) suggest that validity is affected by the researcher's perception of validity in the study and his/her choice of paradigm assumption. As a result, many researchers have developed their own concepts of validity and have often generated or adopted what they consider to be more appropriate terms, such as, quality, rigor and trustworthiness (Davies & Dodd, 2002; Lincoln & Guba, 1985; Mishler, 2000; Seale, 1999; Stenbacka, 2001).

The discussion of quality in qualitative research initiated from the concerns about validity and reliability in quantitative tradition which "involved substituting new term for words such as "validity" and "reliability" to reflect interpretivist [qualitative] conceptions" (Seale, 1999, p. 465). The issue of validity in qualitative research has not been disregarded by Stenbacka (2001) as she has for the issue of reliability in qualitative research. Instead, she argues that the concept of validity should be redefined for qualitative researches. Stenbacka (2001) describes the notion of reliability as one of the quality concepts in qualitative research which is "to be solved in order to claim a study as part of proper research" (p. 551).

In searching for the meaning of rigor in research, Davies and Dodd (2002) find that the term "rigor" in research appears with reference to the discussion about reliability and validity. Davies and Dodd (2002) argue that the application of the notion of rigor in qualitative research should differ from those in quantitative research by "accepting that there is a quantitative bias in the concept of rigor, we now move on to develop our reconception of rigor by exploring subjectivity, reflexivity, and the social interaction of interviewing" (p. 281).

Lincoln and Guba (1985) argue that sustaining the trustworthiness of a research report depends on the issues, quantitatively, discussed as validity and reliability. The idea of discovering truth through measures of reliability and validity is replaced by the idea of trustworthiness (Mishler, 2000), which is “defensible” (Johnson 1997, p. 282) and establishing confidence in the findings (Lincoln & Guba, 1985). If the issues of reliability, validity, trustworthiness, quality and rigor are meant differentiating a 'good' from 'bad' research, then testing and increasing reliability, validity, trustworthiness, quality and rigor will be important in any research paradigm.

If the validity or trustworthiness can be maximized or tested, then more “credible and defensible result” (Johnson, 1997, p. 283) may lead to generalizability which is one of the concepts suggested by Stenbacka (2001) as the structure for both doing and documenting high quality qualitative research. Therefore, the quality of a research is related to generalizability of its result and thereby to the testing and increasing the validity or trustworthiness of the research. In contrast, Maxwell (1992) observes that the degree to which an account is believed to be generalizable is a factor that clearly distinguishes quantitative and qualitative research approaches.

Although the ability to generalize findings to wider groups and circumstances is one of the most common tests of validity for quantitative research, Patton (2001) states generalizability as one of the criteria for quality case studies depending on the case selected and studied. In this sense, validity in quantitative research is very specific to the test to which it is applied – whereas triangulation methods are used in qualitative research. Triangulation is typically a strategy (test) for improving the validity and reliability of research or evaluation of findings.

Based on this assumption, the researcher collected data from both quantitative and qualitative methods. The collected data and information were triangulated with the use of different instruments in different times. Re-interviews were also taken to triangulate and authenticate the data. In this way, trustworthiness was maintained in research. Therefore, the researcher claimed that the instruments were reliable and valid in the context of this study.

Patton (2001) advocates the use of triangulation by saying “triangulation strengthens a study by combining methods. This can mean using several kinds of methods or data, including using both quantitative and qualitative approaches” (p. 247). However, the idea of combining methods has been challenged by Barbour (1998). She argues that mixing paradigms can be possible but mixing methods within one paradigm, such as qualitative research, is problematic since each method within the qualitative paradigm has its own assumption in “terms of theoretical frameworks we bring to bear on our research” (p. 353).

Even though triangulation is used in quantitative paradigm for confirmation and generalization of a research, Barbour (1998) does not disregard the notion of triangulation in qualitative paradigm and she states the need to define triangulation from a qualitative research’s perspective in each paradigm. For example, in using triangulation of several data sources in quantitative research, any exception may lead to a disconfirmation of the hypothesis whereas exceptions in qualitative research are dealt to modify the theories and are fruitful.

The researcher tried to avoid threats to the validity of the research methods and conclusion drawn from the analysis of observation and interview data. In this process, the researcher followed Maxwell (1996) who indicated that validity refers to 'the correctness or credibility of a description, conclusion, explanation, interpretation, or other sort of account'(p. 109). For interviews, it is likely that 'what the informant says is always influenced by the interviewer and the interview situation, a validity threat named 'reactivity' (ibid.). To avoid this, the researcher conducted a pilot interview as mentioned before to avoid 'lead questions' or ambiguous items. During the transcription process, the researcher tried to describe data by reporting participants' responses ‘verbatim’.

In this view, Healy and Perry (2000) explicate on judging validity and reliability within the realism paradigm which relies on multiple perceptions about a single reality. They argue for the involvement of triangulation of several data sources and their interpretations with those multiple perceptions in the realism paradigm.

On the backstop of the theoretical understanding as discussed, the researcher maintained the reliability and validity of the instruments. Both reliability and validity were determined after the consultation with the supervisors, research experts, educators, some school teachers, language teachers, their acceptance and rejection of the Nepali version of the items/constructs included in the interview and observation guidelines.

The observation guidelines were used to observe some mathematics classes of the school where the pilot test was carried out before starting the collection of information. Similarly, the interview guidelines were administered among a few students to find out whether they would be appropriate sequencing and coverage of the issues to be raised. The corrected items and constructs were included in the final instrument. For the reliability and validity of researcher’s reflective diary, the researcher chose appropriate time for observation and interviews, and compared the points in the diaries with the information found during observation and students’ responses in the interviews where the researcher found similar information. The researcher even consulted the related subject teachers and the informants to finalize the researcher’s reflective diary.

Data/ Information Collection Procedure

In the first phase of data/ information collection, various strategies used by the Nepalese students of mathematics were examined. Three different methods were used in data/information collection- questionnaire survey, close observation and open-ended interview. The researcher collected all the information himself. The researcher visited each selected school for the survey. The researcher described his research work to the Head teacher of each school visited. Permission from the Head teachers was gained but it would not be sufficient for applying the research tools in the classroom among students. Building of a good rapport with the Head teachers and particularly with the subject teachers and students was necessary. On request, the Head teachers arranged a meeting with the mathematics teachers of the schools. Researcher explained to them the study design, and the data to be collected for the study. After this interaction, the researcher was allowed to enter the classroom and the subject teacher informed his/her students about the presence of the researcher and asked the students for their cooperation in the researcher’s works. Then, giving the data collection instrument ‘Motivated Strategies for Learning Questionnaire’ to the respondent students, the study was introduced and the things included in the questionnaire were explained. Similarly, the instructions regarding what they had to do as respondent were also clarified. After demonstrating how to respond the questionnaire, students were set free to respond to the questionnaire. The filled out questionnaire were collected from the students.

In the second phase, mathematics students were interviewed for primary data and information required for the study. The primary data were collected from open-ended interview, close observation and observation of activities from two secondary schools.

Among the various methods of qualitative research in-depth open ended interview and close observation were used for which guidelines including open ended questions as mentioned above under research questions were used to collect information from the students and mathematics teachers. Mathematics classes were observed by the researcher himself. The mathematics problems related to the study given by their mathematics teachers were observed to find their solving techniques for finding their learning strategies. Students were interviewed through the use of the interview guidelines. Qualitative information related to classroom practices, images about teaching and learning of mathematics were taken from the two schools using ethnographic method. Two schools were selected as case schools representing the two school systems- public and private. After visiting six schools and talking about the need for staying long period of time in the school, four schools accepted to participate in the research. Out of the four schools, two were selected. Permission was taken from the Head Teachers but it was not sufficient for collecting classroom related information. School teachers were the other significant persons for gaining access to data/information. Though the researcher had got permission from Head Teachers of the two schools to be there for one year in this study, it could not be possible to get help and support from the subject teacher and the students. Building of a good rapport with school family and particularly with the subject teachers and students was necessary. On request, the Head Teachers arranged the meeting with subject teachers. The researcher explained to them the study design, required information to be collected and ethical questions that the researcher had to follow in the meeting with the teachers. After this interaction, teachers allowed the researcher to sit in their classes as an observer and they informed their students about the intermittent presence of the researcher in the class. The researcher spent one year staying two days in a week in the two schools observing the classes; interviewing the students in the concerned themes and issues. Particularly, the researcher himself observed 30 classes (15 classes in per school) using observation checklist. The researcher spent 2 months (1 month in each school) for the observation using observation guidelines. As researcher observed the classes, he noted down each and every activity done in the class in a note-book. Each day evening the researcher summarized the observation notes in a text.

After building good rapports with teacher and the students with several days' class observations, the researcher began interviewing the students. The interviews with the students were taken after two months of being there in the school and being familiar to the students focusing on their meaning of schooling and learning mathematics, teaching style of their teachers, the problems faced and felt by the students in learning of mathematics. Interviews were taken individually and recorded in a video camera as well as in an audio-recorder. The re-interviews were also taken and recorded to obtain the missing information and triangulate them with the information obtained from initial interviews and class observation. The researcher gathered information about their family background, ethnicity, attitudes, environment through informal talks and other different sources. The researcher even conducted informal talks with the mathematics teachers to understand their teaching strategies, their perception towards students' learning strategies, mathematics curriculum, use of teaching materials and students' behaviours.

Ethical Consideration

The researcher has not used language that might be offensive to any institution, religion, caste, gender, culture, group, individual, and the like. The language which students had used during observation and interview has been moderated considering ethical matter. Similarly, the researcher has not mentioned the names of the participant students. During observation and interview, the subject teachers as well as the students had requested the researcher not to mention their names because they might face problem in the future. So, their request for anonymity was considered in this thesis.

Processing and Analysis of Data and Information

All the data, information and opinions gathered from both the primary and secondary sources were processed, analysed and interpreted to prepare the study report. The study was both quantitative and qualitative type so mostly descriptive, inferential and exploratory methods were used for analysis and interpretation.

The questionnaires were administered for the mathematics students to find out their reflections about the learning strategies in mathematics classroom. The questionnaires were surveyed to analyze and verify the different categories of learning strategies existing among the students learning mathematics in Nepalese schools. Open ended questions for interview were designed to collect information related to boys and girls of different groups regarding their strategies in learning mathematics.

Before analyzing the data to answer the research questions of the study, the raw data were prepared and organized for analysis. An individual student’s responses derived from survey using the seven point Likert scale were encoded in the SPSS software (Version 20). All students’ individual scores on each item of the nine strategies (scales) in the Motivated Strategies for Learning Questionnaire were obtained by calculating the mean of item scores in each strategy. The strategy with the highest mean score indicated a student's most frequently used learning strategy. The qualitative method consists three kinds of data collection: in-depth, open ended interviews, direct observation and written documents (Patton, 1990; p. 12). Each of the three kinds of data collection consists of various activities such as direct quotations about the experiences of people, opinions, feelings, knowledge, people's behaviour, actions, interpersonal interactions, organizational processes, experts, quotations from documents, program records, memoranda and correspondence, personal diaries and open ended writes responses to questionnaires and surveys (Ibid).

Mathematics classes were observed to explore various learning strategies adopted in classroom learning. Problem solving tasks were given to the students by their teachers to explore their learning strategies in learning mathematics. The researcher observed their activities to explore the use of learning strategies. Similarly the mathematics students were interviewed which was recorded and their responses were transcribed. Likewise, personal experience, observation during the study period, various books, seminar, workshop papers, multilateral reports, internet information relevant to the study were also reviewed, analyzed and used for understanding the problem and drawing reflection on all the gathered information.

In this study, the collected quantitative and qualitative data were merged to develop a more complete understanding of a problem; to develop a complementary picture; to compare, validate, or triangulate results; to provide illustrations of context for trends, or to examine processes/experiences along with outcomes. Sequential method was followed for the integration of data and information in which qualitative data analysis followed the quantitative data analysis.

Quantitative data were analyzed on the comparisons of use of nine learning strategies, differences in choice of learning strategies by girls and boys, rural and urban school students, public and private school students, high achiever and low achiever, most effective learning strategy; and then the analysis of learning strategies to identify the combined strategies that can be used by the students to achieve the high achievement are estimated using quantitative analysis. For the comparison, in most of the cases, chi-square test was done. The Chi-square test procedure tabulates a variable into categories and computes a chi-square statistic. This goodness-of-fit test compares the observed and expected frequencies in each category to test that all categories contain the same proportion of values, or to test that each category contains a user-specified proportion of values (IBM Corporation, 1989-2011). The collected quantitative data were analyzed and interpreted by using appropriate inferential statistics (χ^2 test, ANOVA, Univariate General Linear Model analysis). The learning strategies of students were investigated by examining the frequency with which each strategy was used. A Chi-Square test was employed to see if any strategies were used significantly more than others. The relationship between learning strategies of students and gender was examined by using Crosstabs with a Chi-Square test to assess the frequency of strategies students use the most and to determine whether there was a significant difference in the most frequently used strategies between boys and girl students.

Similarly, the relationship between learning strategies of students and different ability groups, school location and school types was examined by using Crosstabs with a

Chi-Square test to assess the frequency of strategies students use the most and to determine whether there was a significant difference in the most frequently used strategies between high achiever and low achiever students; urban and rural school students; and public and private school students. Chi-square test was appropriate for the analysis because the researcher's aim was to see the goodness of fit. Also the ordinal scale attracts the Chi-square test statistics. Besides, Univariate General Linear Model analysis was used for comparison of the mean. The GLM Univariate procedure allows to model the value of a dependent scale variable based on its relationship to categorical and scale predictors. The GLM Univariate procedure provides regression analysis and analysis of variance for one dependent variable by one or more factors and/or variables. The factor variables divide the population into groups. Using this General Linear Model procedure, the null hypotheses about the effects of other variables on the means of various groupings of a single dependent variable can be tested. Interactions between factors as well as the effects of individual factors can be investigated, some of which may be random. In addition, the effects of covariates and covariate interactions with factors can be included. For regression analysis, the independent (predictor) variables were specified as covariates.

Both balanced and unbalanced models can be tested. A design is balanced if each cell in the model contains the same number of cases. In addition to testing hypotheses, GLM Univariate produces estimates of parameters (IBM Corporation, 1989-2011). Commonly used priori contrasts are available to perform hypothesis testing. Additionally, after an overall F test has shown significance, post hoc tests can be used to evaluate differences among specific means. Estimated marginal means give estimates of predicted mean values for the cells in the model, and profile plots (interaction plots) of these means allow to easily visualize some of the relationships. To see the most effective learning strategy in relation to the achievement, ANOVA, Univariate General Linear Model that gives the result of regression analysis, was used.

Both quantitative and qualitative methods were used to study the learning strategies of mathematics students, most used learning strategies, preferred learning strategies used by boys and girl students, learning strategies used by high achieving and low achieving students, learning strategies used by urban and rural students, learning strategies used by public and private school students, and combination of learning strategies for better achievement in mathematics. However, only qualitative method was used to study the role of teachers' teaching strategies in promoting students' learning strategies, role of classroom practices for promoting learning strategies, and contributing factors to the formation of learning strategies. The collected qualitative information from observation and interviews were encoded, and similar information was kept in one basket. So, there were different information baskets. Qualitative data were analyzed using coding process. Codes were categorical and thematic. The analyzed data were interpreted using different theoretical perspectives as explained in the theoretical framework of the study. The information were critically analyzed substantiating with theory as discussed above and the results of the previous studies, considering whether the generated data were matched with already existed knowledge or not. The quantitative data were interpreted from diagrams and tables. The qualitative information was interpreted from the texts, narrations and reflective points with the help of learning theories and empirical results.

Then the integration was made in sequential order; first quantitative analysis and interpretation followed by qualitative analysis and interpretation. During integration, coherent issues were agreed and conflicting issues were discussed and debated.

So, the planning for the chapter “Analysis and Interpretation” is given in the schematic chart which describes in detail how the analysis was performed in the study.

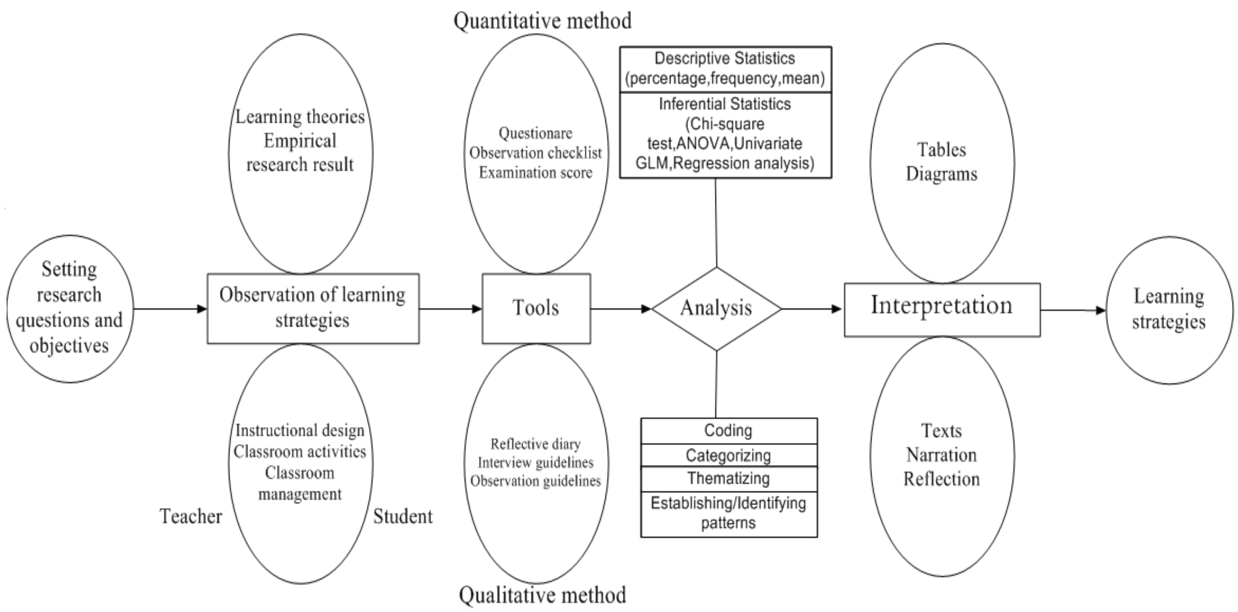


Figure 4. Schematic Chart for Analyzing Learning Strategies

CHAPTER IV

ANALYSIS AND INTERPRETATION

This chapter is focused on the analysis of the data collected so far. Both quantitative and qualitative data were collected. Quantitative data were analysed using Statistical Program for Social Science (SPSS version 20). Both descriptive and inferential statistics were used while analyzing the data. The statistical tools such as percentage, mean, standard deviation, Pearson correlation, Chi-square test, ANOVA were used for quantitative analysis. The comparisons of nine learning strategies, differences in students' choice of learning strategies by gender, rural and urban school students, public and private school students, high achieving and low achieving students, were compared using the mean of the Likert scales used in MSLQ. The significant difference between and among groups was tested using Chi-square test and ANOVA.

Qualitative information was collected for answering the research questions related to students' image towards learning strategies, existing school conditions and classroom practices. Qualitative data were analysed using coding process. Codes were both categorical and thematic. The interpretation of analysed data was done using different theoretical perspectives as explained in the theoretical framework of the study. The details of analysis framework and techniques employed in the study are discussed in chapter III. This chapter is organized in three sections. Section I discusses about the learning strategies used by mathematics students. Section II analyzes the role of teachers and classroom practices for the promotion of learning strategies, and Section III deals with the factors contributing to the formation of learning strategies.

Section I: Learning Strategies

Learning strategies of mathematics students, most used learning strategies of mathematics students, preferred learning strategies by gender, learning strategies by high achieving and low achieving mathematics students, learning strategies used by urban and rural school mathematics students, learning strategies used by public and private school mathematics students, and effective learning strategies in mathematics for the best achievement were analysed and interpreted in this section.

Learning Strategies of Mathematics Students

Among nine learning strategies (rehearsal, elaboration, organization, critical thinking, metacognition, effort management, time and study management, peer learning and help seeking), students used more than one strategy in almost one-third of the cases. The survey revealed that secondary level school students used various learning strategies to solve mathematical problems. Whenever the students selected more than one strategy, a random number was generated in MS-Excel. Based on the random numbers, the strategy corresponding to the highest random number was taken as the most preferred learning strategy of the particular student. A new variable was developed "SELECTED_learning_Strategy" which contained only one strategy for one student.

Based on the selected learning strategy, frequency was counted. The counted frequency was plotted in the bar-chart which is shown in the figure 5.

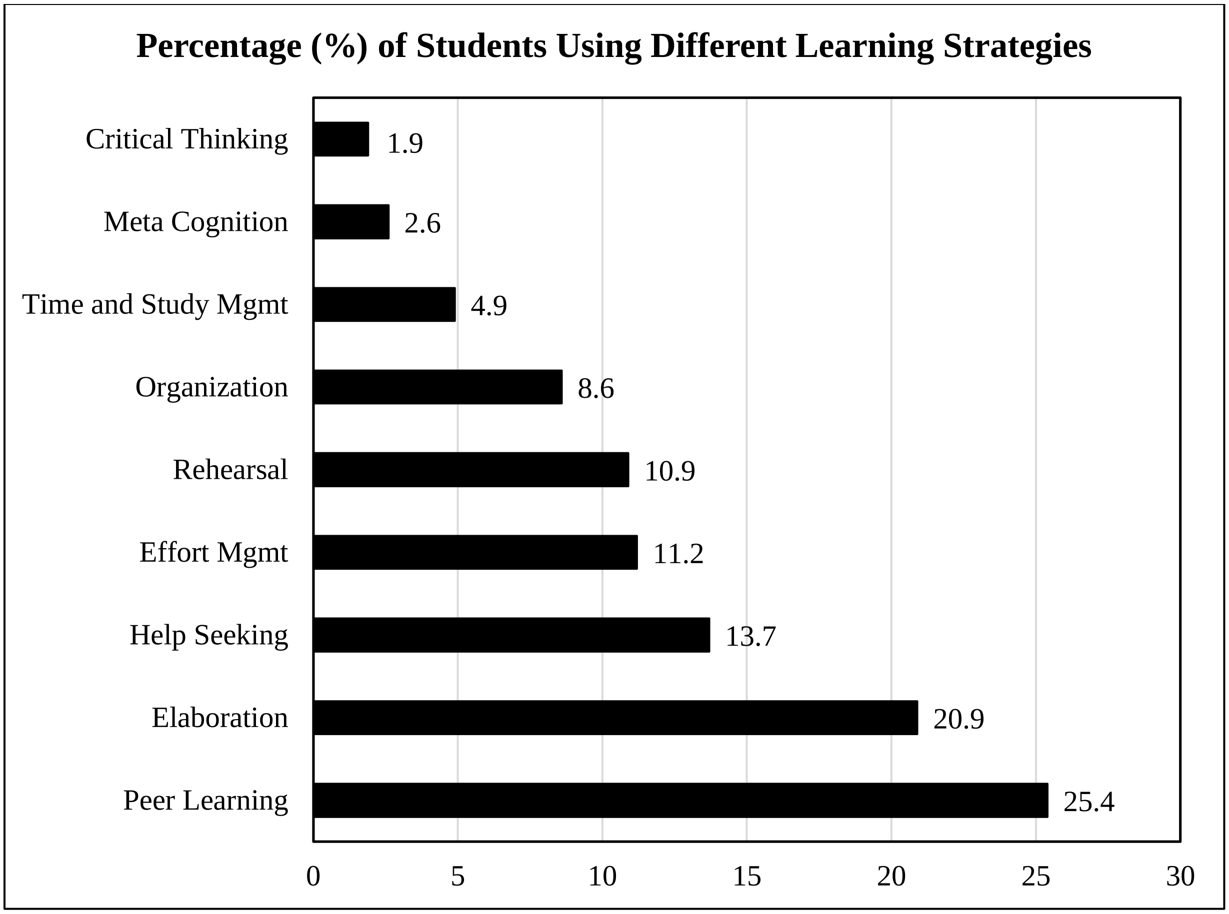


Figure 5. Learning Strategy Mostly Used by All Students

Figure 5 showed that out of the 1394 students, 25.4 percent students used peer learning strategy in their study. Besides this, elaboration, help seeking, effort management, rehearsal were used by 20.9%, 13.7%, 11.2%, 10.9% students respectively. Some other strategies were also in use; however, they were preferred by few students. They include: organization (8.6%), time and study management (4.9%), metacognition (2.6%) and critical thinking (1.9%).

Students preferentially took in and processed information in different ways: by seeing and hearing, reflecting and acting, reasoning logically and intuitively, analyzing and visualizing steadily. Teaching methods were also varied, for example: some instructors lecture, others demonstrate or lead students to self-discovery; some focus on principles and others on applications; some emphasize memory and others on understanding.

When mismatches occurred between the learning strategies of students in a class and the teaching strategies of teachers, the students were found bored and inattentive in class, performed poorly in tests, got discouraged about the courses and themselves, and in some cases dropped out of school. Contrary to this finding, when the teacher had connected his/her teaching style with the students' interest and their learning strategies, teaching-learning was found effective.

Effective learning requires students to take control over of their learning process and to know how, when and where to use various learning strategies. Teachers need to be aware of the strategies adopted by their students. This awareness allows teachers to design and implement learning strategy instruction and helps them raise their own awareness of strategies used by students. The teacher is a crucial actor in helping individuals develop effective learning strategies and become strategic learners. By knowing students' use of learning strategies, teachers can recognize learners' strengths and weaknesses and then adjust their instruction accordingly. For this reason, Martin (2005) agreed that understanding what strategies students used in classroom was important.

The observation and interview were based on the learning strategies categorized by Pintrich, Smith & McKeachie, (1989), which are cognitive strategies (rehearsal, elaboration, organization, critical thinking, metacognition) and resource management strategies (effort management, time and study management, peer learning and help seeking). Also the strategies categorized by O' Mally (1985), which are: cognitive strategies (repetition, researching, translation, grouping, note taking, deduction, recombination, imagery, direct physical response, auditory representation, conceptualization, elaboration, transfer, inference and problem solving), metacognitive strategies (thinking, mnemonic, physical actions, attention, self mangagement, preparation, self monitoring, self evaluation and self reinforcement.) and socioaffective strategies (asking questions) were considered in the study. Though all the strategies were not considered in the study, some of the learning strategies developed by O' Malley were also considered.

Cognitive strategies assert that students learn through changes and mental process as well as mental structures that result from the learner's attempt to make sense of the mathematical world. It includes repetition, note taking rehearsal, elaboration, organization, critical thinking etc. By the cognitive strategies, students develop an understanding in their mathematical difficulties. During observation the researcher found students trying to solve problems on their own taking references of their previous lessons. The teacher solved the exemplary problems on white board and students copied them when they understood the particular problems with teacher's help. They used understanding to solve problems. They were even found attempting to solve the problems by studying the worked out examples from the book. One of the students asserted, "Sometimes I practise myself looking examples from the book before teacher teaches the unit". Students claimed in the interview that they solved problems with the ideas they studied in previous class also. One of the students claimed, "Sometimes I solve the problems with the ideas I studied in previous class". Students were found trying to solve mathematical problems in a different way. "I try to solve problems in a new way that is different from the way done by the teacher”, responded one of the students studying in grade IX.

Mathematics was learnt through more practice. During observation and interview, students were found taking practice as a must. They often practised in class and at home. At home they practised what their teacher had taught in class. A high achiever girl claimed, “At home I often practise what teacher teaches at school”. The teachers also asked the students to practise or have rehearsal repeatedly. Similarly, students took notes from their teachers and friends. Often they were found copying the problems solved by the teachers on board. And if some were absent in class, they copied notes from their friends the next day. The above observation and interview showed that students used cognitive strategies like practicing, thinking, rehearsal, note taking etc in learning mathematics.

When the researcher was in observation, one of the high achievers solved the problem of exercise himself by looking example from the book before the teacher started to teach. But other students did not do so. It was the effort management of the student. The student used his metacognition. He thought that he can solve the problem from the study of example given in the book. The student used the same technique as given in examples to solve similar problems given in the exercise. The high achiever used his brain and developed his own learning strategies. The same expression was found in the interview with high achiever. The high achiever student said, “Sometimes I practise myself looking worked out examples from the book to do homework at home before the teacher teaches the lesson.”

The above observations and the opinions of the students supported that the high achiever students followed the strategy of effort management and their metacognition to some extent. The high achiever students also said that sometimes they solved the problems with the idea they studied in previous class. In class observation the researcher found that both the high achievers and low achievers used to ask their friends at first. Whenever they were confused they first asked their friends, and in the case of lacking clarity they asked the teacher. They were learning from peers as well as seeking help from others. The students were not static. The students hesitated to ask questions with teacher. They felt ashamed and feared to ask with teacher whereas they felt comfort to ask with their own friends. One of the low achievers studying in a private school admitted, “I feel comfort to ask my friends first and then to my teacher.” Similarly, the students learned also from their family members and relatives apart from friends and teachers. A high achieving student from a public school claimed: “If I don’t understand, I first ask my friends, and then my teacher. At home, I ask my father.”

The above statement of the student showed that they used socio-affective strategies (asking questions) in terms of O’Malley’s categories. In words of Chang (2010), it was help seeking strategy- i.e. resource management strategy. In the word of Piaget (1970), it was social cognitive learning strategy. The students mostly got help from their teachers and friends at school and from their family members at home. Students even got help from their tuition teacher. Mostly the low achievers sought greater help than the high achievers as their understandings in the class differ.

Students increased their understanding and learnt through socio-affective strategies as claimed by O’Malley and socio-cognitive by Piaget. When the students worked together, they tested and challenged each other's thinking. Social constructivists feel that students construct knowledge through their involvement in social setting. They learn from peers and share ideas with them. Cooperative learning allows students to work with their peers in a small group setting. The small group helps students to share their ideas. The group completes the goal helping each other. During observation, the researcher also found students discussing in group for solving problems. In another case, students discussed and shared ideas generally with co-sitters and sometimes with other friends of the class. In the interview, one of the students said, "When I'm confused I ask my friends. I even teach my friends". He stated that they discuss with their friends. Another student claimed during face to face with the researcher, "I share with friends and sometimes we have debate also regarding the way of solving problems." This showed the students' sharing strategy in learning. In the interview, the students also opined that they copied notes from their friends if they were absent or confused. They even copied from friends while doing homework and class work. One of the interviewees asserted, "I copy notes from friends if I'm absent in class." The above narratives and the observation made by the researcher showed that students use resource management strategy for which O'Mally calls socio-affective or socio cognitive strategy to learn mathematics.

Metacognitive strategies were also used by the students in learning mathematics. Math metacognitive strategies are simply memorable plans or approaches that students use to solve problems. These strategies include the students' thinking as well as their physical actions (Lenz, Ellis, & Scanlon, 1996). Some of the most common metacognitive strategies come in the form of mnemonic, which are meaningful words where the letters in the word each stand for a step in a problem-solving process or for important pieces of information about a particular topic of interest.

In a class observation, one of the teachers was teaching the lesson "simplify" in algebraic expression. The teacher described the rule for simplification as: B- Brackets, O-Of, D- Division, M- Multiplication, A- Addition, S- Subtraction. The teacher pronounced the rule as BODMAS. Then the students started to read BODMAS and pointed to their friend *badmas*. Next day in the same lesson, students started to read the rule BODMAS and applied to solve the problems. That was one example of mnemonic (metacognitive) strategy found in class observation. In interview with students, I asked them about the rule of simplification. The students stated the rule of BODMAS and interpreted, which O'Malley has called "metacognitive strategy". This was the example of a memorable plan they used. Similarly, students learned the order of simplification through the strategy phrase "<u>P</u>lease <u>E</u>xcuse <u>M</u>y <u>D</u>ear <u>A</u>unt <u>S</u>ally" where Parentheses, Exponents, Multiplication/Division, Addition/Subtraction are the steps in order. The use of mnemonic method is also asserted by one of the high achieving students as follows:

> Sometimes I use short cut method to remember, like when I was in grade VIII, I felt confused to remember cosA= 1/secA and cotA= 1/tanA. I memorized it that cos has 's' at last so it equals 1/sec, being 'sec' starting with 's' and cot has 't' at last so it equals to 1/tan, being 'tan' starting with 't'.

Specially the researcher found that the students' learning from mnemonic strategy is explicit in the following remarks made by one of the respondents, " To remember the formula, I sometimes make catchy sentence, for example, to remember sinA= p/h, cosA= b/h and tanA = p/b, I remember the sentence " <u>S</u>ome <u>p</u>eople <u>h</u>ave <u>c</u>urly <u>b</u>rown <u>h</u>air turned permanently black." From my observation and through interview also, I clearly found students using metacognitive strategies in mathematics learning.

Students did not passively receive and process information. They were active participants in the learning process, constructing meaning in ways shaped by their own prior knowledge and new experiences. They were prone to exploring how the skills they had learned could be related to other context, or determining how the information might be applied in other contexts. Students undoubtedly use the skills they had learned in one context to understand or solve problems in another context. In observation, the researcher clearly saw the students using the elaboration strategy in mathematics class. They were seen summarizing the problem solved by the teacher on the board and used the method that the teacher used to solve another similar problem. One of the interviewees asserted, "I look carefully on the board when our teacher solves the problems, try to understand it, and I solve other similar problems following similar steps." Likewise, worked out examples were also well studied and the skills from such examples were used by the students. While in observation, the researcher found students solving problems prior to their teacher looking upon the worked out examples given in their course books. In the interview also, the remark of students studying in the private school admitted this point: "I sometimes solve the exercise looking upon the worked out examples before our teacher teaches. Worked out examples are very helpful." Similarly, the students admitted that they organized and used the knowledge that they had gained in the previous class to learn mathematics. A student studying in grade IX in a public school answered- "I use my skills learnt in previous grade especially VII and VIII, to solve many mathematical problems in grade IX. Unitary method, Simplification, Geometrical knowledge is mostly used." Students develop the elaborated technique widely to use mathematical knowledge in other subjects also. Many students, in the interview, openly admitted that they used mathematical knowledge in other subjects like Science, Environment, Population and Health (EPH), Social Studies, etc. One of the respondents responded, "Mathematical knowledge can be used in other subjects like Science, Social, EPH and Population to solve statistical problems."

Students learned in many ways by seeing and hearing, reflecting and acting, reasoning logically and intuitively, memorizing and visualizing, elaborating and repeating. Students did not only receive what the teacher teaches; instead, they used various learning strategies. Rehearsal (recalling and repeating learning material) was the strategy commonly used by many students. They practised what their teachers had taught them to recall the learning materials so that they could achieve good marks in the examination. They applied rehearsal in the form of classwork, homework, exam practices and solving model questions. During class observation, the researcher observed the teachers giving class work and homework, and checking the exercises done by the students. They even asked the students to practise model questions or the previous exam questions. The students even solved problems from practice books. In such various ways students were using rehearsal strategy to learn mathematics. Similar answers were given by the students during interview also regarding the practicing. One of the high achievers studying in the private school said, "I always practise solving important problems in the evening at home after I complete homework." Similarly, a girl of grade IX from a public school said, "I practise much to learn mathematics. I practise every Saturday." "I practise previous exam questions and model questions", admitted another low-achieving boy of the private school. Likewise, a girl admitted, “Reading only in class only does not help learning mathematics. Before exams, I often practise all the exercises from books and some important questions from practice books.” The above mentioned narratives and responses clearly stated that rehearsal was one of the widely used strategies by the secondary school mathematics students.

For practising mathematics, students generally chose quiet, peaceful environment. They preferred to learn mathematics in a silent environment which lacked disturbances either to listen to the detail presentations of their teachers or to make private trials for solving problems. When the students found proper environment to learn mathematics, this had great impact on their achievement. Pewewardy (2002) agrees it. He argues that one’s surroundings or field-independence and field-dependence affect how one learns rather than what he/she learns. Students intuitively used time and study management strategy in learning mathematics. In observation also, the researcher found seat arrangement quite interesting. The students managed their seats together according to their learning achievement– i.e. high achievers preferred to sit with another high-achiever and the low achievers with the low achievers. The students managed more hours to practise mathematics than other subjects. In the interview, a student answered, “I practise mathematics daily for one hour at home.” Concerning the environment they preferred to study in peaceful environment. One of the interviewees claimed, “I study geometrical proof in peaceful place to concentrate. I can’t study in noisy place.” These narratives show that students used time and study management as effective learning strategy.

Effective learning required students to take control over the strategies they used to learn. Conscious use of learning strategies made a difference in student learning. In fact, learning occured through changes and mental processes and mental structures that resulted from the learners' attempt to make sense of the world. Students' critical thinking which helped them to make conscious use of learning strategies promoted them to assure their academic achievement. Students, obviously, thought critically to understand mathematical problems; and critical thinking promoted their mathematical assessing level, in turn. Thus, critical thinking was one of the important strategies students used to learn mathematics. They asked their mathematics teachers about the validity of the formula and the methods to solve particular problems. In observation, the researcher saw students asking teacher to prove how the particular formula was derived. The teacher showed it to them. Similarly, the students also used alternative methods to solve the mathematical problems, and they showed the solutions to their teachers for checking. The students even discussed each other about the alternative methods and the validity of the formula. In the interview also, many students claimed that they used alternative methods to solve the problems. One of the respondents said, "I solve all the questions from the exercises and check them whether I have done correctly or not. If one is wrong I try to solve it using alternative method." He again admitted, "When the teacher gives us formula, I try to understand how the particular formula is derived, and I even try to understand why the particular formula is used in the particular place, what happens if it is vice-versa." Students used critical thinking as mathematics learning strategy. Another student from a public school responded, "If my thinking and the teacher's process match; I understand easily." A girl replied, "When my thinking and teacher's explanations are similar, I understand clearly. And if I have no idea at all about the particular problem before the teacher teaches, and I feel the teacher's explanation is very true, I understand."

By using critical thinking they determined whether they had understood the problems. Likewise, they were conscious about the importance of mental participation in learning mathematics. A respondent responded, “We should be physically and mentally present in the class.” This showed that mere physical presence did not assure learning, we should be mentally active i.e. critical too. Student’s questioning to the teacher and themselves was also the evidence of their use of critical thinking. During observation, the researcher found students asking questions actively to their teacher until they understand fully. The students even compared the teacher’s teaching and the book. An interviewee admitted, “I compare my teacher’s process of solving problems and the one given in the books. If the process becomes different, I ask the teacher why it is so.” Students critically asked questions to themselves also about their confusion. One of the students studying in grade IX of public school said, “I ask questions to myself like how it happened, how this and that came, why isn’t it different, etc”. These narratives and responses clearly illustrated that students used critical thinking as an effective learning strategy.

Most Used Learning Strategies by Mathematics Students

The null hypothesis assumed by the research question was – all the learning strategies were equally used by the students or all nine strategies were used in equal proportion by the students. The chi-square test for goodness of fit was carried out to test the null hypothesis. Table 14 shows the calculation of the test.

Table 14.

Chi-square Test for Goodness of Fit of Nine Learning Strategies

Learning Strategy	Observed	Expected (Total/9)	Residual [(O-E)^2]	Residual/E	χ^2	*p*
Peer_Learning	354	154.89	39645.23	255.96	639.1607	8.9E-
Elaboration	291	154.89	18526.23	119.61		133
Help_Seeking	191	154.89	1304.01	8.42		=
Effort_Mgmt	156	154.89	1.23	0.01		(8.9
Rehearsal	152	154.89	8.35	0.05		× 10^{-}
Organization	120	154.89	1217.24	7.86		133)
Time_Study_Mgmt	68	154.89	7549.68	48.74		
MetaCognition	36	154.89	14134.57	91.26		
CriticalThinking	26	154.89	16612.35	107.25		

The dataset showed that the null hypothesis was rejected at $p < 0.001$ level and concluded that learning strategies were not used in equal proportion. Students used specific learning strategies rather than all nine strategies equally. Based on the observed and expected frequency, students used all the nine learning strategies in Nepal. However, their use of learning strategy could be seen clearly in three categories: the most used learning strategies were peer learning, elaboration, help seeking and effort management. Likewise, rehearsal and organization were moderately used, and least used strategies were time and study management, metacognition and critical thinking.

Learning was an interactive process; there were many strategies that could be used to gain the desired knowledge from the mathematics courses. The students went through many actions independently or collectively during the learning process. The actions of the varied students produced varied strategies to learn. Students learned many things from their peers, teachers, books, relatives and so on those were easily available to them. Similar expressions were given by the students in interview with the researcher. One of the respondents claimed, “I learn mathematical skills from my teacher, friends and relatives, and I make good use of books, practice books, model questions and internet.” He again claimed, “The worked out examples are very much helpful and necessary for me. I practise to solve the exercises before my teacher teaches new lessons.”

Thus the researcher found students using all the nine learning strategies– peer learning, elaboration, help seeking, effort management, rehearsal, organization, time and study management, metacognition, and critical thinking in one way or the other. However, they mostly preferred to use peer learning, elaboration and help seeking. The researcher interviewed twenty eight students. None of them denied the use of these three strategies. Nonetheless, other six strategies were also used; but by less number of students. Some or the others missed one or more other strategies. “If I don’t understand a problem, I ask my friends” was the common reply of almost all the interviewees. Students do not only ask others, they teach their friends too. A girl studying in grade IX in a private school asserted, “If any friends cannot solve mathematics problems, I often teach them, I know more when I teach them.” In the observation also, the researcher found, similar situation in the class. The students used to discuss each other to solve the problems given by their teachers. Whenever anyone was in confusion, he/she immediately turned to his/her friends. The friends, who were turned, were taught without the feeling of irritation. Thus, the researcher found that peer learning is used mostly and effectively by the students to learn mathematics.

Every student learned in a unique way, so the strategies they used were, however, different. The second mostly used learning strategy the researcher found was elaboration. Students learned, summarized, compared and related the skills and ideas they had learned in the previous class and in other subject also. The researcher found students relating the past mathematical knowledge to present one. One of the interviewees said, “Many things we had studied in the previous grades also help us to solve Mathematics problem.” The other aspect was that they even related mathematical knowledge in their everyday life also. A respondent said in an interview, “We should not study only to pass but to be able to use the knowledge in our real life.” Similarly, the students took notes, listed the important formulas and practised more to the important questions. “When our teacher indicates the important problems, I tick and write them important. Then I practise them time and again”, said one of the respondents in an interview. The students even admitted that they “make list and chart of the important concepts and practise them more.” Studying the worked out examples and solving the problems in their own way was the elaborative technique which students widely used. Many students said in interview that they solved the problems given in exercises referring to the worked out examples given in the books. The researcher found that elaboration was another mostly used strategy by the students while learning mathematics.

Help seeking was the next widely used strategy by the students to learn mathematics. The students asked their teachers, relatives and family members about the difficult problems. An interviewee of the private school responded, “I ask my teacher about the difficult concepts that I don’t understand.” Teachers played important role to provide help to the students guiding them in their difficulties. At home also, students took help from their father, mother, brother or sister, and other members. One of the students of the public school the researcher had chosen said, “In class I ask my teacher, and at home my sister helps me in solving difficult problems.” A boy studying in the same public school had the father who was a mathematics teacher. He said, “I learn many things from my father, in addition to my teacher.” Another one had mother to teach at home. “I ask my mother at home, my father is often out.” In the class observation also the researcher himself saw students asking many questions to their teacher, and the teacher solving problems sometimes on board and sometimes in students’ notebook.

As mentioned earlier, the students learned in unique way, however, some strategies overlapped consciously or unconsciously. Some used one strategy prominently while others used other strategies efficiently. However, some were the strategies which were used properly by majority of students. The researcher found, in his observation and interview that, peer learning, elaboration and help seeking were the most widely and effectively used learning strategies by the secondary level mathematics students.

Preferred Learning Strategies by Gender

The null hypothesis assumed by the research question was – Both boys and girls used all nine strategies in equal proportion. The chi-square test for goodness of fit was carried out to test the null hypothesis. Table 15 shows the comparison of the frequently used learning strategies of boys and girls in number.

Table 15.

Frequency of the Most Used Learning Strategies by Gender

	Gender		Total
Selected Strategies	Boys	Girls	
Rehearsal	67	85	152
Elaboration	151	140	291
Organization	54	66	120
Critical Thinking	17	9	26
Meta Cognition	14	22	36
Time and Study Mgmt	35	33	68
Effort_Mgmt	93	63	156
Peer_Learning	140	214	354
Help_Seeking	81	110	191
Total	652	742	1394

Table 15 showed that most of the female students used peer learning whereas male students used elaboration.

Frequency was arranged in descending order to make the comparison clearer. The ordered percentage of boys and girls was plotted in the bar graph in figure 6 below:

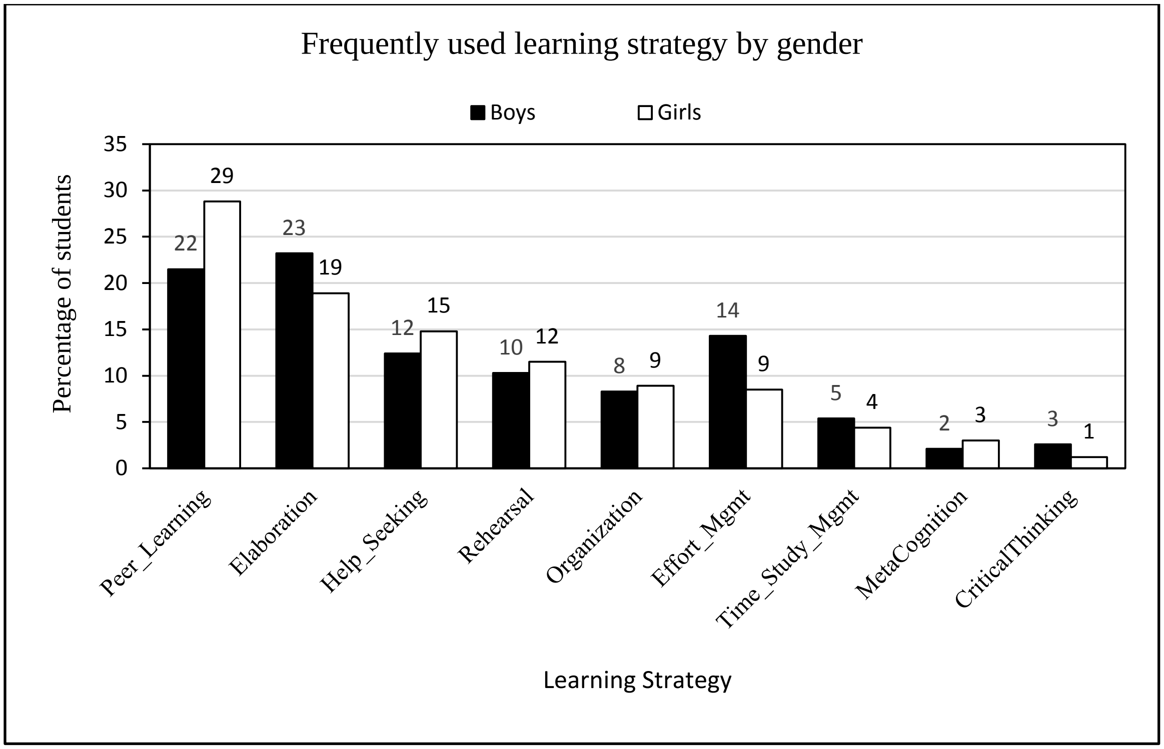


Figure 6. Comparison of Frequently used Learning Strategies by Gender

Figure 6 showed that most of the girls used peer learning in their study whereas most of the boys used elaboration in their learning.

To answer whether boys and girls were in proportion in each category i.e. whether the sex was independent in selecting the learning strategy, result of chi-square test for goodness of fit is shown in table 16 and 17.

Table 16.

The Observed and Expected Frequencies of Boys and Girls in Each Category

(Selected_Strategy * Gender Cross-tabulation)

Selected Strategy		**Gender**		**Total**
		Boys	**Girls**	
Rehearsal	Observed	67	85	152
	Expected	71.1	80.9	152
Elaboration	Observed	151	140	291
	Expected	136.1	154.9	291
Organization	Observed	54	66	120
	Expected	56.1	63.9	120
Critical Thinking	Observed	17	9	26
	Expected	12.2	13.8	26
MetaCognition	Observed	14	22	36
	Expected	16.8	19.2	36
Time_Study_Mgmt	Observed	35	33	68
	Expected	31.8	36.2	68
Effort_Mgmt	Observed	93	63	156
	Expected	73	83	156
Peer_Learning	Observed	140	214	354
	Expected	165.6	188.4	354
Help_Seeking	Observed	81	110	191
	Expected	89.3	101.7	191
Total	Observed	652	742	1394
	Expected	652	742	1394

Table 17.

The Chi-square Test Result

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	27.993[a]	8	**0.0**

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count was 12.2.

The chi-square test showed that the learning strategies used by boys and girls were significantly different at $p < 0.001$ and concluded that boys and girls used different learning strategies. However, all kinds of strategies were used by some percentage of students.

Many researches and discussions (American Association of University Women [AAUW], 1992; Mangione, 1995; Mark and Hanson, 1992; Mael,1998; Marino, Ames, Johnson, & Bodey, 1997; Mathews, Binkley, & Crisp, 1997; Reinen & Plomp, 1994; Rogers, 1995; Silverman & Pritchard, 1993; Sofia, 1998, as cited in Valentine, 1998) had gone into investigating gender differences in students at all grades, levels of learning and achievement in mathematics. A major concern was that women were under-represented in the professional areas associated with these disciplines. This under-representation was evidenced as soon as females began choosing classes in the school years (Silverman and Pritchard, 1993 as cited in Valentine, 1998). Girls began to feel uncomfortable and became disinterested in math early in the educational process. Unfortunately, one of the main reasons for this disinterest was that girls were not encouraged to achieve in these areas and were not given the same opportunities to learn as the male students (AAUW, 1992 as cited in Valentine, 1998). As a consequence, girls thought and learned differently as well as interacted with equipment differently from boys. This was a major key to understand how best to educate girls in mathematics in order to encourage their continuation in this area as career field. Students' motivation, their positive self-related beliefs as well as their emotions also affected their use of learning strategies. There were good grounds for this: high quality learning was time and effort intensive. It involved control of the learning process as well as the explicit checking of relations between previously acquired knowledge and new information, formulation of hypotheses about possible connections and the testing of these hypotheses against the background of the new material. Learners were willing to invest such effort only if they had a strong interest in a subject, which determined the effective ways of selection of learning strategies. The development of learning strategies was dependent not only on the existence of cognitive and metacognitive information processing abilities, but also on the readiness of individuals to define their own goal. A repertoire of strategies combined with other attributes that fostered learning developed gradually from the activities aimed at building a scaffolding structure of learning, which were taken as students' self-regulated learning strategies. In a qualitative study of elementary mathematics classes, Grieb (1982) has also reported a similar point stresing that girls tend to memorize algorithms and specific solutions to problems, whereas boys tend to evaluate and use more complex problem solutions. In addition, Fennema and Peterson (1985) argued that girls do not develop the type of autonomous learning strategies needed for complex problem solving in mathematics. These researchers point out that boys are more likely than girls to assume control for their learning and to evaluate different problem solutions. Girls, on the other hand, tend to show greater avoidance of problem-solving situations, take fewer risks, memorize problem solutions, and request for more assistance than do boys.

There were marked differences between males and females in their interest and enjoyment of mathematics as well as in their self-related beliefs, emotions and learning strategies related to mathematics. With respect to students' use of learning strategies, males consistently reported using elaboration strategies more often than females, whereas females reported using peer learning. A girl studying in a private school reported in the interview, “If I do not understand I ask my friends, especially girls because boys become angry soon. I feel comfortable with girls.” The narrative showed that girls learned from their peers, especially female peers. The same girl again claimed, “While asking questions I feel comfortable with my friends than with the teacher.” Similar view was expressed by a girl from the public school. She said, “I ask my friend Sharmila, she teaches me.” In class observation also, the researcher found mostly girls talking each other regarding problem solving. Peer learning was the strategy, whereby the girls mostly preferred to learn mathematics than any other strategies. However, boys, though they used peer learning, preferred to use elaboration mostly to learn mathematics. The researcher found boys summarizing, taking notes, making charts and lists of the important concepts. They tried to solve problems in their own ways. In the interview also they consistently reported to have used elaboration strategies. A boy of grade IX reported, “I often make the chart of formulas and stick on the wall of my room. I daily look at the chart even in leisure time.” Likewise, another boy said, “I sometimes study the worked out examples and try to solve the problems before the teacher teaches new exercises.” He even reported, “I try to solve problems using alternative method also.”

Similarly, more girls reported using help seeking than boys, whereas more boys used effort management than girls. Girls, whenever confusion aroused, asked their teachers, family members and relatives, however they were poorer in effort management than boys. A girl asserted similarly, “My father also helps me at home as he is also a math teacher.” She even said, “If I don’t understand in the class, I can’t solve the problems, and if I solve by any means, answer becomes wrong.” However, a boy respondent said, “I don’t understand what the teacher teaches; I look into reference materials to understand. I first try to understand from guide, and then solve problems myself. Sometimes I use alternative methods to solve the problems.” These narratives showed that girls preferred help seeking, whereas boys were more likely to take risk and used their own effort in solving mathematics problems. Boys felt shame to ask their teacher. Rather, they tried themselves, even if they could not solve by themselves. One of the respondents said, “I’m afraid of asking the teacher, because he will humiliate me saying ‘why didn’t you understand, while others did?” A girl from the public school admitted, “I often ask many questions to the teacher.”

However, girls were more likely to do much practice than boys. In this respect, girls preferred rehearsal strategy whereas more boys preferred critical thinking. Female students did a lot of practice, but thought less critically. Girls used less logical faculty whereas boys did less practice, so boys sometimes went to the extent of using different method to solve the problems. However, girls were more likely to be teacher dependent. One of the interviewee girls admitted, “I don’t use alternative method, I follow the way my teacher had taught me.” In the similar case, a boy claimed to have used alternative method to solve the exercise. He claimed, “Sometimes I compare my teacher’s lecture and books and try to solve the problems myself looking worked out examples.” This showed that boys tended to be independent while girls tended to be the teacher’s followers.

The above mentioned narratives and responses clearly showed that both boys and girls used all nine strategies, but girls were more likely to use peer learning, help seeking and rehearsal strategies than boys; whereas boys were more likely to use elaboration, effort management and critical thinking strategies than girls.

Learning Strategies Used by High Achieving and Low Achieving Mathematics Students

The null hypothesis assumed by the research question was: Both high achieving students and low achieving students used all nine strategies in equal proportion. Chi-square test for goodness of fit was carried out to test the null hypothesis. High achiever students used multiple strategies in their learning. They were close to their teachers and asked the unclear matters to the teachers. Low achievers were mostly academically poor students; they generally did not like to be close to the teacher and parents to seek help. But, this was not true in all the cases. In this study, researcher was interested to ask fourth research question regarding the differences in the use of learning strategies by the high achieving and low achieving students. The assumption was that high achievers and low achievers used different learning strategies.

From the sample of 178 students, data was divided into quartiles. The lowest quartile (Q1) was marked as 1 and the fourth quartile (Q4) was marked as 4 and all other were recorded to missing value. Then the Univariate General Linear Model was used, which compared the two or more groups of the data. The low achiever's mean score was 31.4% and high achiever's mean score was 83.6%. Based on those two group frequency, a cross tabulation generated percentage of the number of students in both categories, as plotted in the bar graph in figure 7.

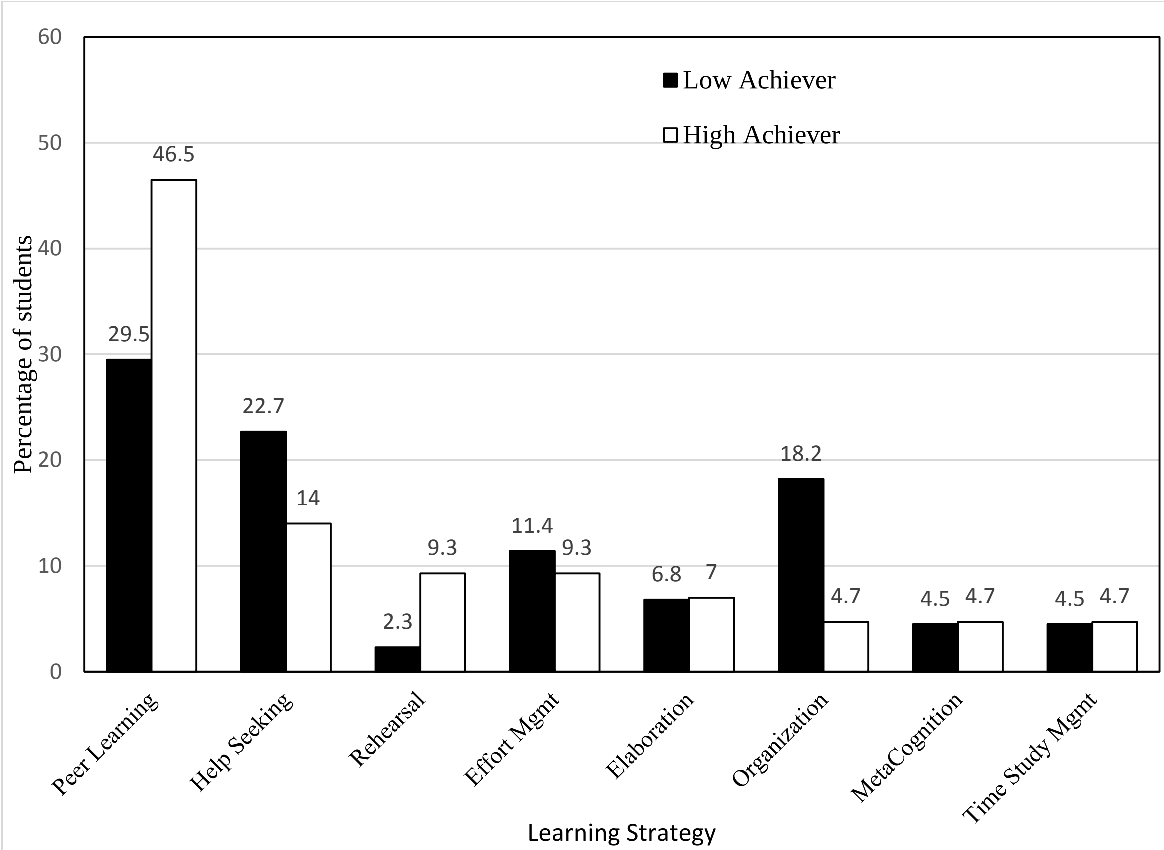


Figure 7. Percentage of Preferred Learning Strategy by High Achiever and Low Achiever Students

Very high percentage of high achiever students (46.5%) used peer-learning as their main learning strategy. Although, the percentage of students was lower, most of the lowest achiever students used peer learning as their learning strategy (29.5%). Among the high achievers, 14% students used help seeking, 9.3% effort management,, 7% elaboration; and very few of them used the remaining strategies. Among the low achievers, help seeking (22.7%), organization (18.2%) and effort management (11.4%) were other commonly used strategies. The correlation of organization was negative (r = -0.18) with the test score (see table 13 , correlation between the scales and test score); this could be explained by big percentage (18.2%) of the low achieving students used organization as their learning strategy.

Table 18.

Observed and Expected Counts of High Achieving and Low Achieving Students

Selected_Strategy * Low achiever =1 High achiever =4 Cross tabulation

		Frequency		Total
Selected_Strategy		Low achiever	High Achiever	
Rehearsal	Observed Count	1	4	5
	Expected Count	2.5	2.5	5
Elaboration	Observed Count	3	3	6
	Expected Count	3	3	6
Organization	Observed Count	8	2	10
	Expected Count	5.1	4.9	10
MetaCognition	Observed Count	2	2	4
	Expected Count	2	2	4
Time_Study_Mgmt	Observed Count	2	2	4
	Expected Count	2	2	4
Effort_Mgmt	Observed Count	5	4	9
	Expected Count	4.6	4.4	9
Peer_Learning	Observed Count	13	20	33
	Expected Count	16.7	16.3	33
Help_Seeking	Observed Count	10	6	16
	Expected Count	8.1	7.9	16
Total	Count	44	43	87

Table 19.

Chi-square Test Result

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.986[a]	7	0.334

a. 11 cells (68.8%) have expected count less than 5. The minimum expected count is 1.98.

Table 18 and 19 showed that the chi-square test was not significant ($p > 0.05$) and hence the learning strategies of high achievers and low achievers did not differ significantly. Both high achievers and low achievers used peer learning most, however more high achievers used this strategy than the low achievers. In addition, they used help seeking and organization as well.

In conclusion, data set did not show significant difference between high achievers and low achievers in the choice of learning strategy. However, high achievers used peer-learning as their main learning strategy– as they studied with the friends, discussed with the friends and solved the mathematical problems independently. Low achievers used three strategies: peer learning, help seeking and organization in almost equal proportion. Organization was the least frequently used learning strategy among high achievers but it was the third highest used learning strategy of low achievers. High percentage (18.2) of the low achievers using this learning strategy indicated that it was not effective learning strategy in Nepal. Moreover, none of the high achiever or low achiever used critical thinking. It implied that critical thinking was either not used by the students and teachers or not required in their study, it was the matter of further study.

Learning strategies are the elements of an active knowledge building process. These elements are continuously developed when a person interacts with objects (mathematical objects in the situation here) and with other people. Students can use different learning strategies and have different learning goals and values. Valuing learning and believing in the importance of the task increases the students' achievement, orientation and motivation. When students value the goals associated with learning activities and use cognitive meta-cognitive and socio-affective learning strategies, they are likely to be high achievers. If not, low achievers. Low achievers have low academic self-perception, lower self-motivation and self-regulation and less goal directed behavior. They have "negative attitude towards school and teachers than high achievers" (Reis & McCoach, 2000, as cited in McCoach & Siegle, 2001). Low achievers are the students who lack self-confidence. Factors commonly associated with low achievers includes low academic self-concept (Schunk, 1998; Supple, 1990; Whitmore, 1980 as cited in McCoach & Siegle, 2001), low self-motivation (Weiner, 1992 as cited in McCoach & Siegle, 2001) , low goal-valuation (Mccall, Evahn & Krazer, 1992 as cited in McCoach & Siegle, 2001) and negative attitude towards school and teachers (Colangelo, Kerr, Christensen & Maxey, 1993; Ford,1996; Rimm, 1995; as cited in McCoach & Siegle, 2001).

The low achievers lack self-regulation, but the high achievers have extreme self-regulation. Self-regulation comprises three major stages: "Forethought, volitional control and self-reflection" (Zimmerman, 1998 as cited in McCoach & Siegle, 2001). Similarly, self-regulation comprises the process by which students are "metacognitively, motivationally and behaviourly active participants in their own learning" (Zimmerman, 1994, as cited in McCoach & Siegle, 2001).

As the observation showed, high achievers were the students who remembered the answer, worked hard to achieve and generated advance ideas. They were interested, receptive, humorous and pleasing. Therefore, they were never bored, responded with interest and opinions and performed at the top of the group. These students learned with ease, enjoyed the company of peers, grasped the meaning and completed assignments on time. Likewise, they were accurate and complete, highly alert and observant. They gathered information from various sources and used "self-regulation and control" (Zimmerman, 1994, as cited in McCoach & Siegle, 2001).

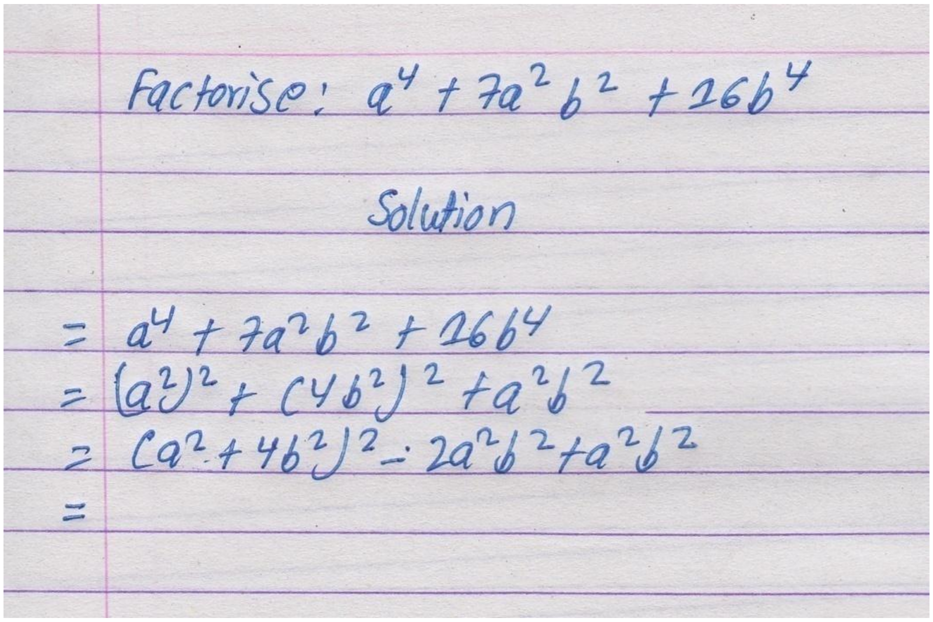
As the high achievers and low achievers were the persons with different attitude, motivation and self-regulation, their learning achievement also differed greatly. The first and foremost difference in their strategies was interaction. High achievers were more interactive than low-achievers. The reasons for being less interactive were feeling embarrassed, feeling frustrated at their interactions, not being acknowledged by the teachers, lacking confidence, concerned about being wrong, getting teased by other students, just not waiting to be involved, being uncertain of the answer and not wanting to be the only person initiating an interaction (Willson, 1999). Of the above mentioned reasons, the two most common were: being uncertain of the answer and feeling embarrassed being teased by other students. Lacking confidence was at the second level and all these were the result of lack of self-esteem and negative self-conception formed from other students, or being unsuccessful in classroom tasks; and efficiency tests had caused associated feelings of shame and failure.

During observation, the researcher commonly saw the high-achievers interacting with teachers involved in and asking questions as well as answering. They seemed cheerful and felt close with their teachers. However, the low-achievers who were termed as ‘weak’ hardly asked any question. They felt ashamed that their friends might tease them saying ‘ignorant’. A respondent girl form grade IX accepted, “I feel ashamed to ask questions with teacher and friends. They “later tease me, saying ‘Kehi pani najanne’ (knowing nothing)”. Such comments were common at school. Another student asserted, “I want to ask madam but I feel shy.” The boy’s narrative clearly showed that the low-achievers had low self-esteem, and they did not interact with the teachers and friends. However, there might have been another reason also; they at least, must have known something about the topic to interact about it, also to ask a question. So, they did not ask. This condition increased their ignorance; and at last they became low-achievers because they lacked the concept of lessons.

While checking the attendance register, the researcher found generally low achieving students were absent two or three days a month; or some were 5 to 7 days also. However, high achieving students were regular in the class. Low achievers, in comparison to high achievers, were generally more absent in the class. They either had sickness or laziness. Even if they were present, they came without homework or any other assignments. But the high achievers were regular with their homework. These conditions increased the gaps between them. Then so called ‘weak’ ones became weaker and the ‘talented’ ones more talent. Furthermore, the low achievers developed inability to speak and they were shy. They rarely asked their friends and teacher for help. If they did not understand the lesson also, they accepted it as their destiny, and used their effort only but never opened to the teachers and friends. However, the high achievers were outspoken, and asked many questions to their teachers. When the researchers asked ‘how often do you ask questions to your teacher?’ one of the low achievers replied, “I usually want to put my feelings forward, but often I feel shy and do not express my opinions and ask a question thinking it might be a mistake”. Here, hesitation played vital role to make them backward. However, a high-achiever’s response was different. He said, “If I don’t understand myself, I ask my teacher. He solves the problems on whiteboard and I understand looking at it”. The low achievers said that not understanding or having less understanding was their faculty. A girl respondent accepted, “I feel ashamed to tell my faults to the teachers”. The above narratives showed that the low achievers remained weak as they did not understand the lesson. A low achiever boy revealed similar truth when he said, “I copy the problems solved by the teacher on board, but I don’t understand. Still I don’t ask the teacher and friends; I think sir becomes angry and I feel shame with friends.” The low achievers mostly became absent and deprived of their lessons; however, the high achievers were regular in school. They had interest in other fields like sports, music and movies. A respondent low achiever boy said, “I became absent in grade IX about 5 or 6 days a month because I often fell sick.” He again added, “I like to play football, watch TV, listen to the music and watch movies.” When they did not ask questions to the teachers, remained many days absent from school and had interest in other fields than learning, their confusion increased and they secure low position in the tests.

The difference also lied in the note taking also between high-achievers and low-achievers. The high achievers kept note. It helped them as a reference material to solve problems and to practice in the examinations. They were benefitted that whenever they were confused at any point they got to see the notes and practiced themselves. One of the high achiever boys said “I keep notes after madam checks my homeworks and class works, and at the time of exam, I practise looking at the notes.” Nonetheless, the low-achievers hardly kept any notes during their lessons. They lacked the practice materials. They needed the guidance from others, for which they were also not open. As a result they did not get references for self guidance. At the exam time, either they did not practise or they had malpractise, and became low- achievers. One of the low-achievers said, “I don’t take notes, I practise from book in the exam time.” And when they practised from book, they focused on the answer, and they made mistakes in the steps of solving the particular problem.

However, the high achievers practised mathematics repeatedly and remained up to date. But the low- achievers feared from mathematics and did not practise well. During observation, the researcher found the high achieving students were up to date with homework, did class work enthusiastically and showed to the teacher regularly. But the low achievers searched for the kick back to escape from doing homeworks. They even did not show their class work to the teacher. In the question ‘Why didn’t you do the work your teacher had given to you in the class?’ their common reply was: “I cann’t solve the problems even if I try hard. So, it doesn’t make any difference for doing or not doing.” The other low achiever girl tried to solve the problem but she did wrong. The researcher observed her doing as follows: The question was from factorization.



Factorise: $a^4 + 7a^2b^2 + 16b^4$

Solution

$= a^4 + 7a^2b^2 + 16b^4$

$= (a^2)^2 + (4b^2)^2 + a^2b^2$

$= (a^2 + 4b^2)^2 - 2a^2b^2 + a^2b^2$

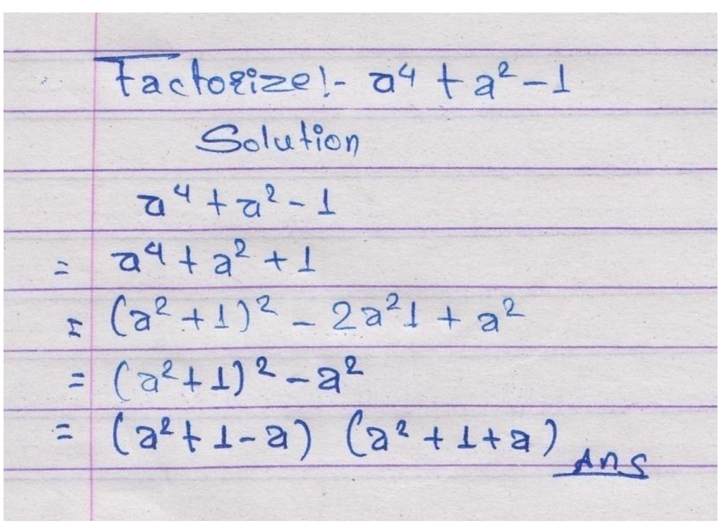
$=$

The mistake was that she forgot to put $4b^2$ in place of b^2. She remembered the formula but made mistake putting the elements in the formula.

However, the high achiever boy solved it properly. In another case, the high achiever corrected the question and solved the problems. The problem was again from factorization.

Factorise: $a^4 + a^2 - 1$

The particular boy said that it should be '$a^4 + a^2 + 1$ and solved the problem as follows:



Factorize:- $a^4 + a^2 - 1$

Solution

$a^4 + a^2 - 1$

$= a^4 + a^2 + 1$

$= (a^2 + 1)^2 - 2a^2 1 + a^2$

$= (a^2 + 1)^2 - a^2$

$= (a^2 + 1 - a)(a^2 + 1 + a)$ Ans

They felt difficult in remembering formulas/ trick also. During observation, the researcher found the low achievers becoming absent in the seats. Next day, the researcher asked them the cause of becoming absent. They replied, “I think I fail in mathematics; so, I don’t like to participate.” Some of them feared from the mistake also. Their replied was “Mathematics is difficult; I fear with it that I may fail”. “Mathematics is a difficult subject” was a common response of most of them. Therefore, they expressed that ‘tuition’ is must to pass mathematics. “I want my school organize tuition class for mathematics”, asserted one of the low achievers in the interview with the researcher. But all of them do not have access to tuition also because of family background. So, they remained passive whereas the high-achievers were mathematically active and cheerful. They felt mathematics as an enjoyable subject, they enjoyed with mathematical formulas and / tricks; however the low achievers feared from it. This resulted in great difference in their achievements.

There were great differences in the attitude and participation of mathematics learning between high achievers and low achievers. However, regarding the learning strategies, there was no significant difference. High achievers were more likely to use peer learning, help seeking and rehearsal strategies compared to other strategies. Similarly, the low achievers also used peer learning, though less than high achievers, help seeking and organization. Both high achievers and low achievers used eight learning strategies, critical thinking was not found in both kinds of students. Elaboration, metacognition and time and study management were less used by both high achievers and low achievers. As regards rehearsal, the high achievers were seen far above the low achievers, and in organization low achievers were seen ahead. However, the difference was due to the differences in attitude, perception and participation.

Table 20.

Attitude, Perception and Score of High and Low Achievers

Ability Group	Attitude	Perception	Average score
High Achievers	Cheerful/enjoy mathematics, Outspoken, Practise, Regular, Note taking, complete classwork/homework	Mathematics is interesting	83.6
Low Achievers	Fear mathematics, Feel ashamed, Give up problems, Absent/irregular, No note, search kickbacks to escape class work/homework	Mathematics is difficult	31.4

Table 20 showed that high achievers differed greatly in terms of their attitude and perception; so in their achievement. The high achievers were cheerful and enjoyed mathematics. They were outspoken, practiced mathematics, regular in the class and did class work and homework regularly and showed to their teachers. For them mathematics was an interesting subject. These positive attitude and perceptions helped them score high (83.6%). On the other hand, the low achievers always feared from mathematics. They felt ashamed to ask friends, teachers and relatives, so they gave up when the problem rose. They were regularly absent in the class and sought kickbacks to escape class work and homework. They perceived mathematics as a difficult subject. Therefore, their negative attitude and perception made them score 31.4%.

To sum up, both high achievers and low achievers used all strategies, though the degree of use differed. As the researcher had tested the achievement level of 178 students for the study of this research question, being a small sample the conclusion came that there is no significant difference in the preferred learning strategies between high achievers and low achievers. But from observation of the mathematics class and interview taken from the key respondents, the researcher came to the conclusion that there was difference in the attitudes, behaviours and participation about learning mathematics between high achievers and low achievers.

Learning Strategies Used by Urban and Rural School Mathematics Students

The null hypothesis assumed by the research question was: Both urban school students and rural school students used all nine strategies in equal proportion. The chi-square test for goodness of fit was carried out to test the null hypothesis. Students of different location might have different physical facilities and methods of teaching. Consequently the learning strategies could also be different because of those resources, teaching methods and environment. The National Assessment of Student Achievement taken in 2011 (result published in 2013) of grade VIII students stated that though the results were somehow better in cities than in the rural area, the difference was not remarkably high. From equity viewpoint, this was a positive thing (Acharya, Metsämuuronen, & Koirala, 2013). In the same kind of research, National Assessment of Student Achievement 2012 of grade V students reported a remarkable rise in performance within the urban schools in the last 14 years (Acharya & Metsämuuronen, 2014). This report section compared the achievement of the rural students and urban students in the year 1999 and 2012 (adopted from table 3.1.8 Situation in 2012 in comparison to the

1999 datasets). Based on those reports, it could be assumed that there was significant difference in learning strategy between the rural students and urban students.

Percentage of students who selected different learning strategies based on location (rural and urban) is plotted in the following figure taking the idea that if the school was in district headquarter or municipality it was named - Urban and if not – Rural.

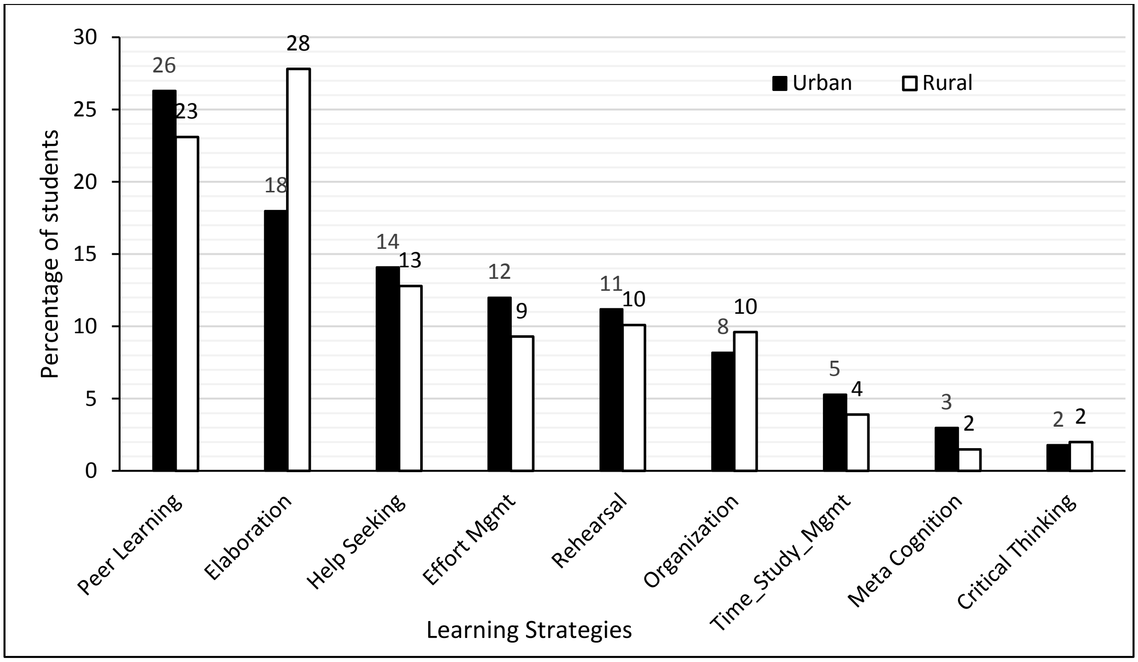


Figure 8. Learning Strategies Percentage of Students in Urban and Rural Locations

From figure 8, it is clear that most of the urban students used peer learning whereas rural students used elaboration. Second highest learning strategy of urban students was elaboration whereas that of rural students was peer learning. However, students from both of the locations mostly used peer learning and elaboration.

To identify whether there was difference, chi-square test was carried out. During the process, a table of observed count and expected count is given in table 21.

Table 21.

Observed and Expected Counts of Urban and Rural School Students

District Headquarter/Municipality (Yes - 1, No - 2) Cross tabulation

Selected Strategy		District Headquarter/Municipality		
		Yes	No	Total
Rehearsal	Observed Count	111	41	152
	Expected Count	107.6	44.4	152
Elaboration	Observed Count	178	113	291
	Expected Count	206	85	291
Organization	Observed Count	81	39	120
	Expected Count	85	35	120
CriticalThinking	Observed Count	18	8	26
	Expected Count	18.4	7.6	26
MetaCognition	Observed Count	30	6	36
	Expected Count	25.5	10.5	36
Time_Study_Mgmt	Observed Count	52	16	68
	Expected Count	48.1	19.9	68
Effort_Mgmt	Observed Count	118	38	156
	Expected Count	110.5	45.5	156
Peer_Learning	Observed Count	260	94	354
	Expected Count	250.6	103.4	354
Help_Seeking	Observed Count	139	52	191
	Expected Count	135.2	55.8	191
Total	Observed Count	987	407	1394
	Expected Count	987	407	1394

Table 22.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.208a	8	0.007
No. of Valid Cases	1394		

Table 22 showed that learning strategy between the rural students and urban students differs significantly. Learning strategies of high school students varied among individual students and groups of students. Indeed, individuality in learning existed in today's classrooms. However, patterns of repetitive and consistent learning behavior in the classroom were also observed. For example, certain students became actively involved in verbalizing thoughts, while others preferred hands-on experiences. Remaining students passively absorbed their environment. Such patterned behaviors were characteristic of basic strategies of learning. A learning strategy is defined as "the way each person absorbs and retains information and/or skills". Each learner possesses an individual learning strategy, which is a preferential mode of learning. Learning strategy may be described in many ways, such as individual personality is characterized by psychologists into "personality characteristics" (Cox, Sproles & Sproles, 1988).

The researcher’s observation and experiences showed that many children in rural setting lived in poverty and their opportunities for learning and life experiences were limited. Rural schools needed to rely on technology to provide students with additional learning opportunities and teachers with necessary professional development. Technology could enable students to access a wider range of curricular contents than was available at the school. Rural schools were often limited in the range of classes they could offer, in access to educational resources that might enhance students’ learning in their particular areas of interest, and in the ability to provide remedial support to struggling students (Redding & Walberg, 2012). Researcher’s introspection even showed that lack of technology had disabled innovations and provided enriched classroom instructions to students in rural schools. Similarly, rural communities tended to rely strong on farming, and students needed to learn the most current skills and practices to be competitive. But they had difficulties to make themselves up-to-date. Moreover, rural schools had difficulty recruiting and retaining new teachers because of location. The teachers teaching in rural schools also lacked technological skills, and they had not kept themselves up-to-date. Likewise, some families in rural communities did not see the value of education. So the students were forced to engage in activities other than concentration on their study. They could not concentrate only on their study, which had caused problems in their learning strategies and achievement. On the other hand,, the schools in urban setting had a greater and easier access to technologies which kept themselves up-to-date in the skills and experiences. Students had easy access to education, and access to wider range of reference materials. They could concentrate on their study. Their attitudes and beliefs had a strong impact on their performance in a particular subject area. The parents of urban setting also had positive attitude towards education. These factors played important roles in developing learning strategies.

The researcher observed that the rate of absence of teachers and students was higher in rural schools than in urban schools. In rural setting, mathematics teachers used teaching materials less than the teachers in the urban setting schools. The classrooms were quieter in urban schools than in rural schools. Teachers encouraged cooperative learning. Therefore, the students of urban schools were more likely to use peer learning as the major strategy to learn mathematics. The researcher observed significant differences in the classroom environments between the urban and rural schools. The urban classrooms were set to be somehow more conducive to learning than the classrooms in rural schools. The teachers in the urban schools seemed to be faced with maintaining on-task behavior situation during class time. These factors had contributed to the students for being more attentive in their study.

The design of mathematics curriculum also had played influencing role for the development of learning strategies and achievement in mathematics. The present curriculum of mathematics was elite favoured and feasible for understanding to the students of urban areas who could get sufficient family support and school provided learning opportunities (Sharma, 2007). This curriculum was not the discourse of the rural students, but thought out on the basis of learning opportunities available in urban elite culture, which was not suitable for the poor rural students. As the course itself was designed to meet the need of urban students, they were more likely to develop more positive attitude towards mathematics whereas the poor rural students developed distrust for mathematics. As a result, urban students used more learning strategies; however, the rural students depended on limited learning strategies. Though some rural students were seen using all nine learning strategies, they used elaboration, peer learning and help seeking mostly in respective order, whereas the urban students used peer learning, elaboration, help seeking and effort management highly in respective order. Thus, significant variations were noted between students in urban and rural schools in learning mathematics.

Concerning the mathematics learning strategies, urban students preferred peer learning than other strategies. “I copy the homework from friends if I can’t do myself. I learn from them too”, said one of the urban school students in interview. In the observation also, urban students were seen solving problems asking with friends. They used to copy homework and class works also. They were more willing to seek help too.

They were likely to ask questions with their teachers, family members and relatives. An interviewee admitted openly, “If I don’t understand, at first, I ask my friends. If I’m still confused, I ask my teacher. At home my sister teaches me to solve difficult problems.” Similarly, they were more likely to use effort management also. They sometimes tried to solve the problems by themselves also. “I generally go through the lessons before the teacher teaches. Sometimes I try to solve using different method also”, claimed a student from an urban school. Elaboration was also another noted strategy the urban school students used in learning mathematics. The researcher saw students keeping notes while teachers solved problems on board. They even reported making lists and charts. They were also seen summarizing the mathematics concepts and ideas which they had studied in previous classes. “I look at the board while teacher solves the problems, try to understand it; and solve similar problems myself following the method the teacher has used,” one of the high achieving urban school students replied in interview. She even said, “Sometimes I relate the ideas I had studied in class VII and VIII to solve some problems, and solve before our teacher teaches us.” To sum up, the urban school students were likely to use peer learning, elaboration, help seeking and effort management respectively. Fewer students were likely to use other strategies.

Concerning the mathematics learning strategies used by rural students, they were more likely to use elaboration. They mostly depended on the elaboration strategy to learn mathematics. They mostly depended on books and notes for their learning resource. They made the note when the teacher taught and solved problems looking upon the notes. One of the respondents of rural school said, “I solve problems before exams looking the notes which I made during our sir had taught us.” Another respondent admitted, “I get help from the examples worked out in the books while solving problems." Rural school students also used peer learning to some extent, however, the urban school students were more likely to use this strategy. One of the girls from rural school said, "I ask my friends, especially girls, when I don't understand any problem." While comparing, the rural school students preferred elaboration whereas the urban school students preferred peer learning. While comparing all nine strategies, urban school students excelled to use almost all the strategies except for elaboration and organization in which rural students excelled.

Learning Strategies Used by Public and Private School Mathematics Students

The null hypothesis assumed by the research question was: Both public school students and private school students used all nine strategies in equal proportion. The chi-square test for goodness of fit was carried out to test the null hypothesis. The achievement of private school students was higher than that of public schools, which was shown by the huge study carried out by Ministry of Education, Education Review Office in 2011. The gap between the students of public (community) schools and private (institutional) schools was very high (Acharya, Metsämuuronen, & Koirala, 2013). The report explains many variables that explain the variation; but it does not explain the effect of learning strategies followed by the students of such schools. This study claimed that despite the physical facilities, socio-economic factors, teachers and parents there were some differences learning strategies to get the different result.

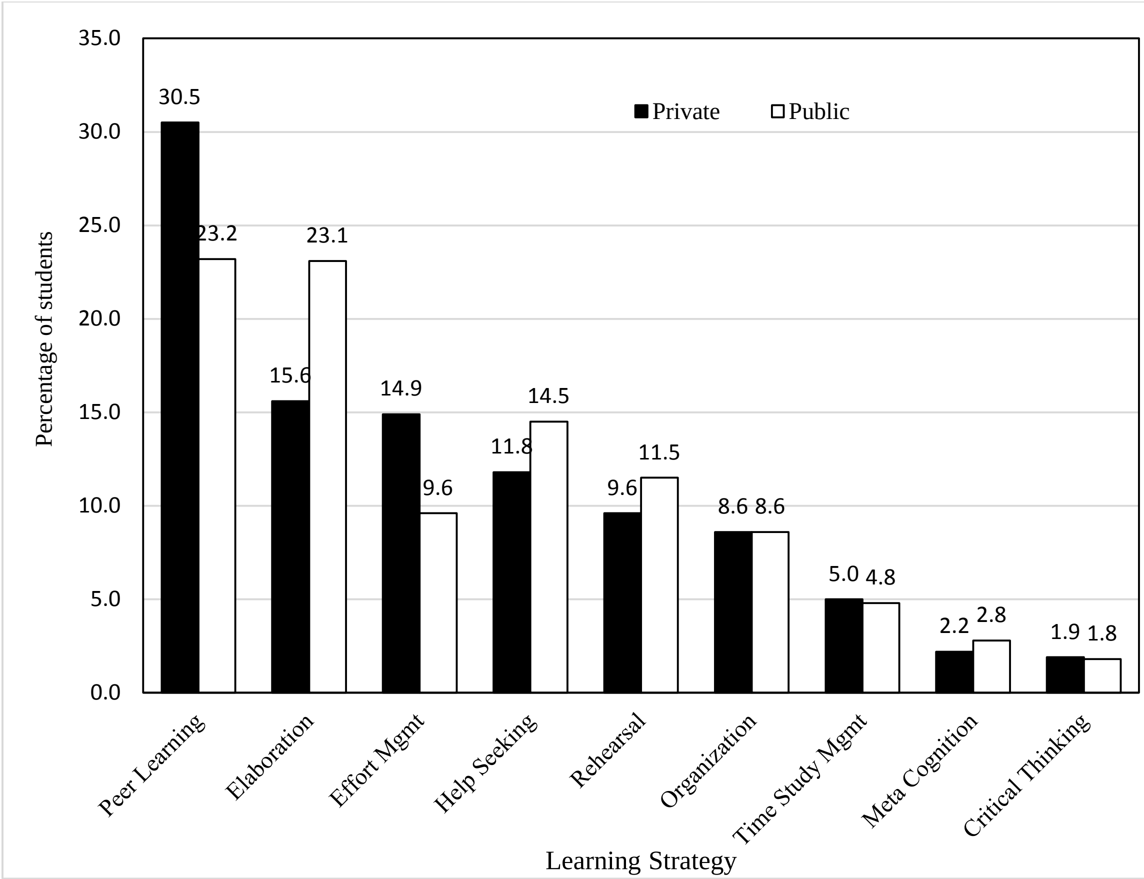


Figure 9. Plot of Learning Strategies against Percentage of Students in Private and Public Schools

From figure 9, peer learning was the most frequently used learning strategy by the students in both public and private schools. Public school students equally used elaboration as a learning strategy.

Table 23 shows the frequency and percentage of students from public and private schools that followed the different learning strategies in mathematics learning.

Table 23.

Observed and Expected Counts of Learning Strategies used by Public and Private School Students

Selected Strategy		School Type		Total
		Public	Private	
Rehearsal	Observed Count	112	40	152
	Expected Count*	107	46	152
Elaboration	Observed Count	226	65	291
	Expected Count	204	87	291
Organization	Observed Count	84	36	120
	Expected Count	84	36	120
CriticalThinking	Observed Count	18	8	26
	Expected Count	18	8	26
MetaCognition	Observed Count	27	9	36
	Expected Count	25	11	36
Time_Study_Mgmt	Observed Count	47	21	68
	Expected Count	48	20	68
Effort_Mgmt	Observed Count	94	62	156
	Expected Count	109	47	156
Peer_Learning	Observed Count	227	127	354
	Expected Count	248	106	354
Help_Seeking	Observed Count	142	49	191
	Expected Count	134	57	191
Total		977	417	1394

The chi-square test for goodness of fit showed the following test result.

Table 24.

Chi-squared Test

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.206[a]	8	0.002
N of Valid Cases	1394		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.78.

The result was statistically significant (at $p < 0.05$) and concluded that the learning strategy between the students of public schools and private schools differed in many ways; however, mostly used strategies were common in both types of schools.

In 1982 a group of authors (Coleman, Hoffer and Kilgore, 1982) published their finding that private schools in the United States were more effective than public schools in helping students acquire cognitive skills. This study, which coincided with a government initiative to channel a portion of public subsidies to private schools, caused lively debate in both scholarly and popular circles (Murnane, 1985; Hanushek, 1986). The proposed initiative is based on the premise that increased (that is, "fairer") competition between public and private schools will foster efficiency. A similar issue is beginning to confront many developing countries. Tightened fiscal constraints have limited the increases in educational budgets necessary to expand access to highly subsidized and publicly provided education (World Bank, 1986). Moreover, many analysts and policymakers were concerned that education was being inadequately and inefficiently provided by the public sector. An obvious alternative was to allow a greater role for private schools. However, relatively little was known about the present role of private schools in developing countries like Nepal. However, private schools accounted for a significant proportion of primary and secondary enrollment.

The observed public schools were founded and run by the government whereas private schools were run by the individuals in their own investments. The students of public schools were from rural areas and from poorer family background. Public schools admitted all types of students. But private schools were selective on who they admitted to their schools. Students had to pay for their schooling although many private schools allowed full or partial scholarships to admitted students who showed financial need. Because the admission process was selective, the students who attended a private school were more likely to be homogenous than those at a public school. Similarly, the public schools were directly managed by the government. Therefore, teachers adopted the strategies to escape from taking more liabilities. Classroom management was poor in public schools. But in private schools classroom management was done effectively.

Classroom management was a significant part of an effective teaching/learning process. Due to an effective classroom management, students flourished in a positive class climate and a compassionate environment. From a student's perspective, effective classroom management provided them the opportunities to socialize themselves while learning. In Nepal, classroom and sitting management was done in both private and public schools. But behavioural problems were not addressed in public schools, whereas this aspect was addressed in private school. Classroom management was a critical part of effective instruction. Effective classroom management beginning with efficient lesson planning preparation helped teachers to teach and students to learn. Students thrive in a positive class climate and an environment in which they felt safe, cared for and involved. From a student's perspective, effective classroom management provided students with opportunities to socialize while learning interesting content. From a teacher's perspective, effective classroom management involved preventive discipline and interesting instruction (Lang & Hebert, 1995).

Effective teaching and learning cannot take place in a poorly managed classroom. If students are disorderly and disrespectful and no apparent rules and procedures guide behavior, chaos becomes the norm. Well-managed classrooms provide an environment in which teaching and learning can flourish (Ahmad, n.d.). Many research studies have concluded that a conducive classroom environment promotes students' academic achievement (Ahmad, n.d.).

Classroom management strategies are a crucial part of teachers' success in creating a safe and effective learning environment for students. The purpose of education is to provide a safe and friendly environment in order for learning to take place. Therefore, teachers should know how to use and apply strategies that will help students to learn (Ahmad, n.d.). Classroom management refers to all the things that a teacher does to organize students, space, time and materials to foster students' involvement and co-operation in all classroom activities. It is an ability of the teacher to cooperatively manage classroom activities by motivating students to develop effective learning strategies. As the public schools lack effective classroom management and private schools incorporate even the behavioural aspects of students, they are more likely to develop and use more learning strategies than public school students.

Students' perception towards teaching and Learning mathematics, their attitude towards mathematics and its learning, classroom management and student participation were important factors for the development of students' learning strategies. Twelve students from public schools and twelve from private school of Kathmandu and 4 students from a rural school of Dhading district were interviewed regarding their needs, feeling, difficulty in learning and the strategies they used in learning mathematics. Public school students in the interview said that mathematics was the difficult subject. This version was from the students who participated less in classroom activities, back-sitters in the classroom, and those who tried to keep themselves out from the eyes of the teachers in the class. There were low achievers in private school also. However, they were encouraged by their teachers to be participated in learning processes. Thus, private school teachers tried to minimize the anxieties of the students regarding mathematics. They created positive attitude among students. So, they were found active in learning more than their counterparts in the public school. The researcher found that private school teachers encouraged active participation of the students. Group discussions were conducted, and sufficient teaching materials were used by the teachers, however, these factors were totally lacking in the public school observed by the researcher. These behaviours made private school students more attentive, while public school students tried to escape mathematics class. In the interview, one of the public school students said, "I feel as if I should not study maths." Similarly, private school teachers were in easy reach to the students, but students could not easily ask about their problems to their teachers in public school. There was intimacy between students and teachers whereas it lacked in public school. If students wanted to ask their teacher, the public school teacher called them in the office. The students feared as well as felt nervous, so they gave up. One of the respondents asserted, "I want teachers teach separately to the weak students, but I haven't got that opportunity. Teachers ask me to go to the office and ask, but I feel nervous there, I become more confused." Likewise, most of the guardians of the students of public school were uneducated, but private school guardians were mostly from educated background. So, public school students rarely got chance to ask their family members for help; however, private school students had higher chance to get help. “There is no one to teach me at home.” admitted a public school student in the interview. But, “my sister teaches me at home” was the remark of a private school student.

The above mentioned environment at school and at home had played role to use learning strategies in mathematics. Private school students were more likely to use peer learning and effort management strategies. As the co-operative environment was created in the private school, they were naturally likely to use peer learning as the most preferred strategy. However, the students of public school also used more peer learning than other strategies. But in the comparison between public and private schools, the latter excelled the former. Similarly, public school students were more likely to use elaboration strategies than private school students. The public school students kept notes, and used it as the ultimate means to refer during their practice. They lacked other materials. One of the public school students said, “I keep notes while the teacher teaches, and solve the other problems looking upon the same notes and practice solving other problems. I even remember the skills I had studied in the previous classes.” Public school students also used effort management to a greater extent than private school students. As they lack other means, referring to the notes and practicing is their strategy to learn and pass mathematics. Though the public school students’ guardians were uneducated and teachers were less cooperative, they were more likely to help seeking than private school students. “Teacher indicates the important questions, which I tick and write ‘V. Imp’”, said a public school student. Another student from the same school said, “I feel the teacher should care weak students more." They had the expectation for help. In some cases, they got help. In some cases, they did not. Private school students were lagging behind in using elaboration, help seeking and rehearsal compared to the public school students. But public school students were back in peer learning, effort management and critical thinking. The attitude and environment, perception, average score and distinct learning strategies are summarized in table 25.

Table 25.
Attitude and Environment, Perception, Average Score and Learning Strategies of Public and Private School Students

School Type	Attitude and Environment	Perception	Average Score	Learning Strategies
Public	Poor classroom management, lack of teaching/learning materials, inclusive in students admission, uneducated guardians, poor family background, no intimacy with teachers, non cooperative environment, lack of individual care	Mathematics is difficult subject. "I wish I shouldn't study maths."	44.05	Elaboration, help seeking, rehearsal
Private	Effective classroom management, sufficient teaching/learning materials, selective in students environment, educated guardians, financially sound, teachers' encouragement, cooperative environment, individual care	Mathematics is an important subject. "We need maths for our further study."	65.48	Peer learning, effort management, critical thinking

The above narrations, responses and table 25 clearly showed that though both public and private school students used all nine strategies to some extent, public school students excelled in some strategy and private school students excelled in others. However, the various contextual factors made significant differences in learning strategies between public and private school students.

Effective Learning Strategies in Mathematics for Better Achievement

The analysis carried out in the previous sub-topics was based on only one randomly selected learning strategy in each case. One-third of the students had used more than one strategy. There were very few students who used 3, 4 or 5 strategies. Those numbers of strategies used are given in table 26:

Table 26:

Use of Multiple Learning Strategies and Achievement

(Dependent Variable: Students' Score)

Number of strategies used (Multiple_strategy_Used)	N	Mean	Std. Deviation
1	138	52.8043	19.89529
2	32	57.2188	21.93794
3 or more	8	62.75	28.80352
Total	178	54.0449	20.73449

The dataset showed that students who used only one strategy achieved low; and when various strategies were used, achievement increased. Those students who used only one strategy achieved only 52.8% marks, but those who used two scored 57.2% and those who used three or more scored 62.75% marks. This indicated that students should use more than one learning strategy to achieve higher marks in the examination. However, difference in mean score was not statistically significant (p = 0.267). The significant test result is shown in the table 27.

Table 27.

ANOVA result from Univariate GLM to Compare the Means

Dependent Variable: Student Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1140.954a	2	570.477	1.332	0.267	0.015
Intercept	182576.2	1	182576.2	426.269	0	0.709
Multiple_strategy_Used	1140.954	2	570.477	1.332	**0.267**	0.015
Error	74954.69	175	428.312			
Total	596008	178				
Corrected Total	76095.64	177				

a R Squared = .015 (Adjusted R Squared = .004)

Comparison made in table 26 and 27 showed that employing more than one strategy can increase the achievement of students in total. It was not clear which of the strategies should be combined to get better results. Hence, a further analysis was carried out.

Learning strategy depended on the nature of students, nature of subject matter and the way how teacher teaches the students. Besides, there could be various internal and external factors that affected students’ selection of learning strategies.

Table 28.

Comparison of Learning Strategy and Corresponding Mean of the Achievement

Selected_Strategy	N	Mean	SD	CV	% of students
Rehearsal	9	65	23.3	36.1	5
Time_Study_Mgmt	8	59	23.7	40.4	4
Peer_Learning	63	58	21.1	36.7	35
Elaboration	16	54	18.1	33.5	9
Help_Seeking	38	52	20.3	39.3	21
Effort_Mgmt	17	51	22.2	43.5	10
MetaCognition	7	50	22.9	45.7	4
CriticalThinking	5	48	8.6	17.9	3
Organization	15	44	18.0	41.3	8
Total	178	54	20.7	38.4	100

To answer the question “What kind of strategy combination contributes best result on average?” the following steps were followed.

Table 28 showed that rehearsal, time and study management and peer learning yielded the best result. To identify the effect of those variables, from original selection of the students’ sum (Most effective strategies were added from selection_max). The sum was up to 3. Similarly, the sum of remaining six strategies was found up to 4, however sum 4 was found only in one case (n = 1). So, only one student was discarded in the plot to make both categories up to sum 3. Now, the number of cases to compare became 177.

The plot against the sum and the corresponding mean is given in the figure 10.

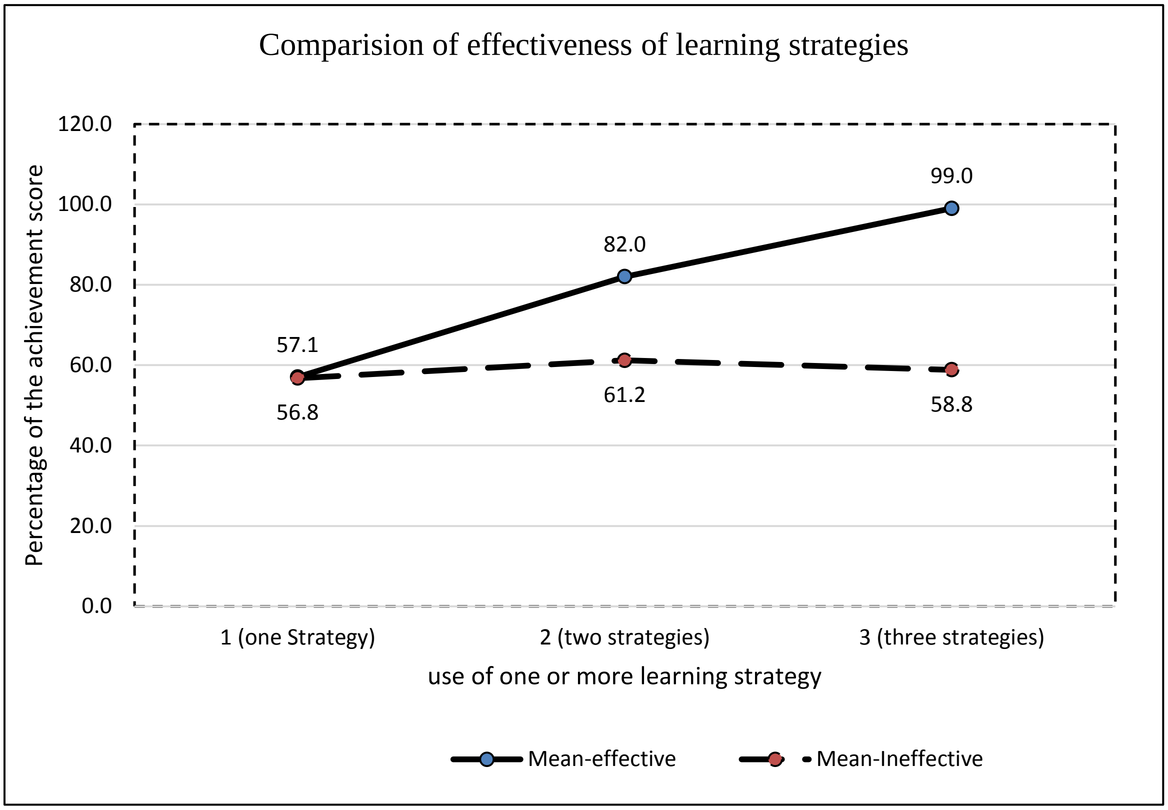


Figure 10. Number of used Learning Strategy and Achievement Score

The category "effective" (rehearsal, time and study management and peer learning) showed that, as the learning strategies were used in combination, the result was better. When they used one, two or three strategies, the mean scores were 57.1, 82.0 and 99.0 respectively. But only one of them used more than two strategies. The result was significant, which is shown in the table 29.

Table 29.

Univariate GLM Output Table Showing the Effect of Selecting Multiple Strategies

Tests of Between-Subjects Effects; Dependent Variable: Student Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3480.143a	2	1740.071	3.919	0.023	0.079
Intercept	42159.08	1	42159.08	94.958	0	0.508
Effective_strategy	3480.143	2	1740.071	3.919	**0.023**	0.079
Error	40845.6	92	443.974			
Total	367162	95				
Corrected Total	44325.75	94				

a R Squared = .079 (Adjusted R Squared = .058)

Table 29 showed that effective learning strategies caused difference in achievement significantly ($p < 0.05$). And difference between achievement of using effective strategies and ineffective strategies was 7.9% (partial eta square = 0.079). The category “ineffective” (remaining 6 strategies) showed that as learning strategies were used in combination, the result could be better. Table 30 shows the ANOVA test result of ineffective learning strategies.

Table 30.

ANOVA Test Result from Univariate GLM

Tests of Between-Subjects Effects; Dependent Variable: Student Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1164.625a	3	388.208	0.818	0.487	0.026
Intercept	56780.47	1	56780.47	119.715	0	0.568
Less_Effective_strategy	1164.625	3	388.208	0.818	**0.487**	0.026
Error	43161.12	91	474.298			
Total	367162	95				
Corrected Total	44325.75	94				

a R Squared = .026 (Adjusted R Squared = -.006)

Table 30 shows that using more than one strategies of ineffective category does not make the significant difference ($p = 0.487 > 0.05$).

It was important to see the extent what extent combined effect of "effective" category of learning strategies increased the learning achievement of the students. For this, a new dummy variable was created by recoding the data for three most effective learning strategies (rehearsal, time and study management and peer learning = 1), and other remaining six strategies were supposed as 0. The new variable was dichotomized to identify the effect of most effective learning strategies. Pearson's correlation of the new dummy variable with the student score was $r = 0.19 \sim 0.20$, which is valid range of the correlation. This correlation was almost equal to the correlation of sum of the originally selected learning strategies (1 – 9), which showed Pearson's correlation $r = 0.18$. It means the dummy variable was most possibly best to explain the result and fit to the original data.[1]

Table 31.

The Most Effective Learning Strategies

Learning Strategy	Mean	Std. Deviation	N
Most Effective Learning Strategies (1)[a]	58.41	21.41494	80
Least Effective/ineffective Learning Strategies (0)[b]	50.48	19.55549	98
Total	54.04	20.73449	178

[a.] Rehearsal, time and study management, and peer learning

[b.] Others (elaboration, help seeking, effort management, metacognition, critical thinking, and organization)

[1] This also explains that the random selection of the selected learning strategy of the students also fits to the originality of the sample.

The result showed that students could raise up to 8 percent score on average if they used multiple strategies (rehearsal, time and study management, and peer learning). Remaining learning strategies were not effective in raising the achievement.

In conclusion, students could have achieved 7.9% higher if they had used the most effective learning strategies– i.e. rehearsal, time and study management and peer learning. Hence, to get the best result, keeping other situations constant, students could achieve more if they used rehearsal, time and study management and peer learning.

The use of multiple learning strategies, instead of using single strategy, ensured better performance in mathematics. Mostly the high achieving students used more than one learning strategies consciously according to the context. This view was supported by Chamot and Kupper (1989); and Wenden (1998) when they reported: “Research has shown that successful learners tend to select strategies that work well together in a highly orchestrated way, tailored to be requirements of the learning task.” Similar remark was made by Gu (2003, p. 16) pointing out that learners integrate several types of strategies to deal with their learning in real situation. Gu also referred to the supporting study about the promising benefit of combinations of strategies (Ahmed, 1989; Gu & Johnson, 1996; Parry, 1997; Sanaoui, 1995). Concerning the combination of effective learning strategies, Nepalese mathematics students got best result when they combined rehearsal, time and study management, and peer learning. Those mathematics students who combined these strategies were the high achieving students. “I sit in a peaceful place and practise mathematics daily longer than other subjects. If I cannot solve myself I ask my friends more than teacher, because I feel comfortable with friends” (Student’s remarks in the interview) was the common reply of most of the high achieving students. Other strategies were less effective than the combination of these three strategies. The researcher also saw students involving in problem solving in the class, and they used to discuss with each other whenever they felt difficulties. However, the low achieving students were less conscious in combining these strategies. The low achieving students practiced less than the high achieving ones. This clearly showed that the combination of rehearsal, time and study management, and peer learning is the best combination for the best achievement for the Nepalese secondary schools mathematics students.

Section II: Teaching Strategies and Classroom Practices

Teachers' teaching strategies and effective classroom practices play significant role to promote students' learning strategies. This section attempts to see whether teaching strategies and classroom practices have helped students to promote effective learning strategies or not.

Role of Teaching Strategies to Promote Learning Strategies

Learning and teaching are iterative processes that ideally continue until a desired goal is reached. In the iterative learning environment, there are many strategies that can be used to produce the feedback required for reaching the goal. Before the information is used, however a gap analysis is performed to determine the "next step". Feedback fills the gap iteratively until the goal is met.

The use of iterative assessment strategies along with iterative instructional strategies in order to enhance student learning makes good educational sense. In fact, two are inextricably linked with each other. The definition of formative assessment, for example, contains many "actions" that students and teachers can take independently and collaboratively during the instructional process. The actions of the students and teachers produce feedback that is used to make adjustments either in teaching, learning, or in both and thereby, create successful interactive learning environment. For students, that information can come from teachers, other students or from the students to get feedback about a task helps a student to remain on target toward the desired goal. Interacting with oneself in the assessment/ instructional process builds self- monitoring, self reflection, self assessment, and self – regulation skills. When students develop these “self” skills, they become independent, lifelong learners.

Students learn in many ways by seeing and hearing; reflecting and acting; reasoning logically and intuitively; memorizing and visualizing. Teaching methods also vary. Some teachers use lectures, others demonstrate or discuss; some focus on rules and others on examples; some emphasize memory and others understanding. However, serious mismatches may occur between the learning strategies of students in a class and the teaching style of the instructor (Felder & Silverman 1998; Lawrence 1993; Oxford et al. 1991: Schmeck 1998), with unfortunate potential consequences. Students tend to be bored and inattentive in class, do poorly on tests, get discouraged from the course, and many conclude that they are no good at the subject of the course and give up (Felder & Silverman 1998; Goldleski 1984; Oxford et al. 1993; Smith & Renzulli 1984). Teachers, confronted by low test grades, unresponsive or hostile classes, poor attendance, and dropouts, may become overtly critical of their students (making things even worse) or begin to question their own competence as well.

Classroom organization, management, and use of different teaching methods/strategies were found to be the reflection of the teachers’ role in the class. The role of teachers in promoting learning strategies in students was the most important aspect. The teachers' teaching strategies and students' learning strategies needed to be matched. How far these gaps were bridged could be estimated from the level of practice in the classes. The researcher saw the teacher organizing the students, space, time and materials to foster students' involvement in all classroom activities and to establish a productive working environment. All these factors came under classroom management. It could be described as the teacher's ability to cooperatively manage the classroom activities under discipline and in a democratic way, a safe, orderly and conducive learning environment. The effective teacher was an extremely good classroom manager. Effective teaching and learning would not take place in a poorly managed classroom. If students were disorderly and disrespectful, and if no apparent rule and procedure guided behaviors, chaos would become the norm. Well managed classroom provided an environment in which teaching and learning would flourish. "I want supportive environment at school and at home," expected one of the students in interview. It should be noted that effective classroom management did not mean to create fear, anxiety and the use of authoritarian teaching. The teacher should be strict as well as friendly and supportive. "I have never asked any question to math teacher because I am afraid he might scold me," one of the respondents expressed his fear with the teacher. As a result, he never tried to seek help. All the students did not learn in the same way or their mental level was not the same. Therefore, teachers have to teach according to the students' interest and achievement level.

When the researcher was in class observation, every student learned and responded to information uniquely. To better serve a student's learning needs, researchers have discussed the role of teaching style in student learning. Many of those researchers support the view that matching teaching and learning styles improves student achievement (Stitt- Gohdes, 2001, Henson, 2004; Hou, 2007). Such teaching strategies of instructors could lead to an improvement in academic performance. However, the researcher found during observation in the sample school that the teachers used traditional teaching approach. From the observation checklist (see Appendix IV), constructivist teaching approach was not found. The teachers themselves made most of the decisions in the classroom, emphasized teaching the content, and put the students in a passive role. The teachers ignored the learner centered approach and used authoritative teaching style. The students copied from the board when teacher solved the problems and learned looking upon it. The student responded "our teacher solves the problems on whiteboard; I copy and try to understand looking at it."

The encouragement for active engagement and empowerment of students to direct their own learning was seldom used. As a result, students were unable to develop any effective learning strategies. Most of them were exam oriented and gave a nice 'output' but their perceived teaching style and learning strategies were not related. Furthermore, when the students' perceived teaching strategies were investigated in relation to learning strategy use, it was found that how they viewed their teachers did not influence their choice of learning strategies.

The study was focused on the understanding of the relationships among how teachers instruct for student learning, and the types of teaching styles better suited to promote learning in classrooms. Researcher studied students' perceptions of their teacher's teaching style and strategies. Chen (2008) found that the most prevalent teaching style perceived by student was the indifferent teaching style. The researcher also found that the low achiever students perceived indifferent teaching style, which was supported by the statement of the student in interview, “The teacher rarely talks outside the class about the subject matter, his experiences and our daily life beyond the class.”

The above assertions showed that teachers were indifferent towards personal life and behaviour. They did not care about students’ work. They did not care their students’ individually, which was also found in observation. The teacher just gave instruction in the class but did not care individually whether they performed well or not. The public school teacher did not deal with individual students. The researcher saw that the class size was large. Classroom arrangement was not favourable to the individual treatment. One of the high achieving students remarked in the interview, “The teacher did not pay much attention to the low achievers but their focus was on the high achievers.” During class observation the researcher also noticed teachers mostly looking at the talented ones during their teaching. The low achievers started making noise. The teachers were found not paying attention to the low achievers which was supported by the following expression of the low achiever in the interview, “The teacher asks us to solve the problems. He does not help much to solve the problems.”

Due to their failure to find the solution of the given class work and hesitation, the low achievers did not like to ask question to the teachers. In observation, once the researcher felt that when the low achiever asked a question to the teacher, other students started laughing at the same time. It happened because the question was very easy in the perception of high achiever. The teacher did not say anything to those students who were laughing. That activity showed that the teacher did not offer emotional support to the question raiser (low achiever student).

One of the students in interview said, “I ask the mathematics problems to my sisters at home.” This expression made it clear that there was no suitable learning environment in classroom for the low achiever students. In class observation, the researcher found teacher centered teaching style because the teacher did not involve the students to learn themselves. They did not facilitate much to their students while solving mathematics problems. The teacher did not encourage the students to solve the problems themselves. It was found in a study conducted by Norzila, Fauziah and Parilah (2007) that students preferred learner centered teaching styles, whereas the most frequently used teaching styles of lectures were teacher–centered in nature.

Teachers were the crucial agents to promote students’ learning strategies. Teacher needed to assist their students by designing instruction that meets the needs of individuals with different stylistic performances and by teaching students how to improve their learning strategies. The relationship between teachers and learners would be beneficial in the learning of mathematics. Connected to these points, Kingsley (1989) showed that students learned more when there was more effective learning relation and communication between the teacher and his pupils. Teaching and learning were inseparable. It could be argued that both entities were important in enhancing or impeding the learning process of students. Also, teachers’ view on learning strategies of their students was one of the factors that affect the learning of mathematics and had a great implication for learning. The well-trained teachers knew how to guide the learning of their students in the teaching–learning process. Biggs and Moore (1993) strengthened this idea when they argued that, the more the teacher mastered his/her subject, the better he/she will be able to teach it and the more pupils will learn in the end. A teacher was very important to carry out the responsibility in changing and shaping pupils' behaviors in school. In order for teachers to be more effective with diverse students, Pewewardy (2002) mentioned that it was crucial for teachers to recognize their own world views and understand the preferences of their students. Matching the teaching strategies of the teachers with the learning strategies of the student was important for reinforcing the learning content, for emptying diverse instructional approaches and for maximizing the learning of students. To sum up, mathematics teachers had a significant role in creating good atmosphere for the learning of mathematics and to arouse the interest of students to use their own preferred learning strategies. The researcher believed that teachers could play a major role in assisting the students to use their own preferred learning strategies by adjusting their teaching strategies; however, Nepalese school teachers did not play productive role to promote effective learning strategies.

Classroom Practices for Promoting Learning Strategies

Nepal is a country of diversity in terms of geography, language, castes, ethnicity, religion and cultures. Ministry of Health and Population (MOHP), Nepal (2014) stated that there are 125 caste/ethnic groups and speaking 123 different languages. The schools have children from different social, cultural, ethnic and economic backgrounds. In this situation teaching-learning often becomes a challenging work. It needs to pay attention to the social and cultural realities of the schools (Acharya, 2012). Teaching-learning situation in school is an important contextual factor for the development and use of learning strategies. As it has already been discussed, instruction can be effective when and until there is change in the teacher's beliefs and management of teaching and learning atmosphere from the school leadership. Classroom teaching-learning situations were observed in schools. The explanation of the teaching learning situation in the schools was made on the basis of the classroom observation and the facilities available in the schools.

It is generally recognized that there are a number of shortcomings in the traditional lecture approach to the teaching of mathematics. Most mathematicians agree that the best way to learn mathematics is by actively doing mathematics; by discussing it with others; and by synthesizing major ideas. However, in Nepal, the secondary schools mathematics students passively watched their teacher demonstrating the problem and solutions doing mathematics on the white board. They rarely interacted in class, often did not get to know from single fellow student, never synthesized or expanded upon the materials; but acquired knowledge from ‘rote’ and did not reflect on deep learning. A girl from the private school the researcher observed admitted, “I don’t use alternative method; I follow the teacher’s direction. I watch him carefully solving the problems, and try to solve myself following similar steps.” The teacher who solved all the problems was often liked by the students. They did not like the teacher who gave them class tasks and home assignments. One of the respondents said, “I like mathematics teachers who explain all mathematics lessons in detail and solve all the problems.” This situation was the result of traditional lecture method applied by teachers in the classroom. It was obvious that teachers needed to induce proper teaching strategies in order to motivate students to learn on their own rather than waiting for readymade knowledge. It was understood that students often did not see mathematics as the dynamic, exciting, creative discipline. They developed disinterest in mathematics; and failed to learn it well. Furthermore, studies indicated (Light, 1990) that women were particularly affected in this way, so that traditional teaching practices may have partially accounted for the small number of successful female mathematics students.

Traditional teaching method means the activities of teaching-learning without using scientific methods and without proper teaching materials. Khanal (2012) observes the weaknesses of traditional teaching methods as follows:

1. The creative faculty of students is neglected and certain rules and ways of teaching are used.
2. Students do not learn the ways of solving problems and their usefulness as broken knowledge is taught.
3. The teachers do not lead themselves and the students into definite destination because of the lack of planning– i.e. they teach without lesson plan.
4. Answer is focused rather than the right process to get right answers in traditional ways of teaching. As a result, the capacity of thinking is not developed– i.e. it focuses on rote learning methodologies.
5. Traditional way of teaching does not pinpoint strengths and weaknesses of the students; so good and bad students are not identified.
6. Traditional way of teaching is fully teacher centered.
7. Teachers themselves solve the problems instead of encouraging students.

Light's (1990) understanding of limitations was found relevant during the observation of Nepalese school mathematics classrooms. The teachers followed the traditional teaching methods without following scientific method. They focused on rote learning with emphasis on answers rather than on the understanding of concepts in the solution of the problems. The teaching of mathematics was guided by the evaluation system without caring the creative faculty. No planning was found; nor teacher pinpointed the weaknesses of the students. Therefore, teaching method should be scientific rather than traditional one. We should choose the method according to the number of students, nature of lesson, students' interest and the available teaching materials (Khanal, 2012).

Educationists have prescribed many effective strategies of teaching mathematics after a long research and experimentation thinking that they can be best to give competitive knowledge. They are: skill on child-centered approach, co-operative teaching approach, individualized instructional approach, instruction for costructivism (Khanal, 2012). However, mathematics teaching in Nepalese secondary schools was dominated by a teacher centered, book-centered approach, and an emphasis on 'rote' memory. Most students saw knowledge as something to be transmitted by the teacher rather than discovered by learners. They, therefore, found it normal to engage in modes of learning which were teacher-centered and in which they received knowledge but did not interpret it. One of the teachers, in an informal talks with the researcher, asserted, "My students expect me to solve each and every problem rather than explaining the main points."

From classroom observation, it could be generalized that the classroom teaching practice in mathematics was not substantially changed even as desired by the existing curriculum of Nepal. The existing curriculum demanded a shift in pedagogy with an inclusion of new contents in the secondary curriculum. In the existing curriculum regarding the methods of teaching mathematics, it is said that excessive presentation of teachers in the class should be replaced by the students' activities in the learning of mathematics. Instead of depending on the textbook exercise, some additional exercises should be given by the teachers including discussion with and among teachers and friends in solving problems, and the use of mathematics in the classroom teaching from day to day life. Six teaching methods have been mentioned in the curriculum to use in teaching mathematics. They include: demonstration method, question- answer, investigation, practical, inductive, and problem-solving (CDC, 2055, pp. 16 - 27).

The belief of secondary mathematics teacher towards teaching mathematics was guided by the evaluation system (examination system). The present examination system has focused testing student's memory based on rote learning and drilled exercises. Thus, teacher's belief towards learning mathematics was misguided by the examination system on one hand and by social pressure on the other. Parents became dissatisfied with the teachers when the students failed in the examination but did not consider how far the students learned mathematics meaningfully. The other tendency in teacher was the use of the traditional practices that do not need to have much preparation on the part of the teacher and no risk at all.

Regarding a question of using investigative methods in place of the most traditional drill/ practice methods, in short interaction a teacher said:

> It is difficult to complete the course using investigative methods, it is time consuming. We do not have that sort of classroom management to involve them in investigative work. It needs a lot of educational materials, our school cannot afford it. Students are not in that mood that they have to work and find the solutions; they expect the solutions from the teachers. The students are not that much capable. Students who study in the public schools are from the poor

> economic, social and educational background; so they have less knowledge and less motivation.

Teacher was misleading by the belief of completing the course from their side. Course completion here means to go across from the first chapter of the book to the last one; it does not carry the meaning that all students have to learn. Only the administrative motto is reflected in the present belief.

The teacher made a very embarrassing statement over the people in critical condition regarding teaching learning mathematics.

> In public government schools the students come from the family of lowest social strata. In such a situation, who can think of the modern approach, the investigative approach? It is the need to make them able to do some mathematics through drill or practice. This is also impossible for them too.

From the above narratives, it could be said that mathematics teachers were taking mathematics learning as the domain of the high class, elite people's children and not for the disadvantaged and poverty affected children. This belief might have guided the teacher in classroom practice. They might offer more learning opportunity to the students from the elite/advantaged group in the class. This fact was justified from the following statement of the students.

> Teachers should do the problems on white board; explain each and every concept clearly. He has to ask individual students where they do not understand. Instead of asking questions to the talented students, the teacher should put questions to those students who do not understand better in the class.

Use of teaching materials was highly important in teaching/learning mathematics. It should have been meaningful and simple which would make the teaching learning activities interesting and effective. By the use of appropriate materials, students could learn and remember the matter permanently. The retention capacity of students would be highly promoted by those materials. If teachers used simple teaching aids, teaching of abstract concept would become effective. These materials could be categorized as: literature (use of textual materials-the interesting, teachable and readable thing or text or articles); audio visual aids (use of both electronic and non-electronic materials like TV, radio, film, OHP, program projector etc.); and models and manipulative materials (use of demonstrative and laboratory materials). However, teachers rarely used those materials in public school as observed by the researcher. One of the students said in interview, “No materials were used in the class except for geometrical instruments. If the teacher teaches in a simple way using everyday materials, even the weak students can understand mathematics, but I have never seen our teacher using such materials.” In response to the question ‘why haven’t you used the teaching materials in the class?’ the teacher replied, “Mathematics course is too lengthy, it’s difficult to complete the course if we start using all materials and investigative method, the teaching materials are not available in the school either.” Nonetheless, the use of teaching materials was observed in the mathematics class of private school. The teacher explained derivation of the formula of a^3-b^3 and a^3+b^3 using block models. However, even the private school did not use the teaching learning materials as required to be constructive to develop learning strategies. Moreover, according to Upadhyay (2001) the characteristics of Nepalese classrooms are:

large number of students in a class, lack of T/L materials, overload of teaching periods to the teachers, problem to finish the course in time, etc.

There is a stereotypical procedure followed by every teacher in mathematics class: teacher enters the class; teacher and students exchange greeting, and teacher asks students about the lesson they have to deal in the class. Teacher takes a book from the students and deals with the students about the problems/ topics for the day. Such a procedure was observed in the sample class as well.

When the teacher was teaching a new topic or concept he explained using white-board demonstration, students listened to the teacher and if they felt something important they copied it or if the teacher directed them to copy it. When teacher was solving problem/ exercise from the book, sometimes he put questions to the students and incorporated his ideas in the problem. Most of the time teacher solved explaining the steps what he was doing. Teachers were not found in the class with the materials they had designed themselves for classroom presentation. Every time teacher taught things from the textbook. After this teacher gave some exercises from the textbook. The students solved them individually and they could not be confirmed on the process they followed and the result they derived, then they waited for the teacher to get his judgment. The teachers concluded the lesson giving some homework. Rare instance could be found giving feedback to the students.

To promote and develop every student's capability in the teaching and learning of mathematics the NCTM standards (1991, p.3) recommends five major shifts.

1. Toward classroom as mathematical communities-away from classroom as simply a collection of individuals.

2. Toward logic and mathematics evidences as verification- away from the teacher as the sole authority for right answers;
3. Toward mathematics reasoning, away from merely memorizing procedures;
4. Toward conjecturing, inventing, and problem solving away from an emphasis on mechanistic answer finding and
5. Toward connecting mathematics, its ideas, and its applications away from treating mathematics as a body of isolated concepts and procedures.

Among the above listed five shifts as suggested in NCTM professional standard to give the same ambitions mathematics program to all the students, even a single shift was not found in the practice of curriculum in the observed classes of Nepalese schools.

As observed in the classroom practices, teachers were the sole authority of right and wrong answer. They were not shifting the classroom practices to the system of logic and mathematical evidence to verify the answer. They were not shifting the classroom practices to the system of logic and mathematical evidence to verify the answer. There was no such practice to provide opportunity to the students to explain why the calculated answer was correct. Much of the activities were targeted for memorization and mechanical drills. Group work or cooperative learning was not used in the mathematics class. Neither the teacher could give time to all the students at a time nor was s/he using the alternative techniques/ strategies to engage the students as much as possible in the learning activity. Teachers were not aware about it.

Connection could be very important in teaching mathematics. As the students would learn something in the classroom in a one-on-itself notion, they rarely got chance to see how mathematics is related to other mathematics and to other disciplines and in everyday life. The sort of pedagogy that utilized the connection principles could develop a positive attitude towards mathematics and felt that mathematics could be an essential part in life, as a part of culture. This sort of connection principle in classroom teaching was not found. Students' life and mathematics were kept apart from each other by the teacher's classroom pedagogy.

The desired standard of mathematics contents for secondary level in this study was as similar as to the NCTM standard (1998) which expects the process of reform in mathematics education through the recognition of the need for more student centered learning environment, a focus on developing student's abilities as problem solver and need for students to demonstrate critical thinking as central components of learning mathematics (Small, 2001). The existing classroom reality, images of teachers and students towards learning of mathematics and the enabling conditions at schools seemed not matching to the approved standards. The mismatches between the classroom activities and students' nature resulted into the inattentive, poor performances in the tests and discouragement in promoting effective learning strategies. The observation showed the teachers' incompetency to manage class activities to address the diverse nature of students. Teachers were teaching in the traditional teacher-centered method without using effective and sufficient teaching materials which did not help promoting effective learning strategies.

Section III: Factors Contributing to the Formation of Learning Strategies

Many factors play important roles for encouraging students to select the effective learning strategies to learn mathematics. This section focuses on the contributing factors like students' perception towards teacher's teaching style, students' attitudes towards mathematics, curriculum design, career-related and goal oriented learning, classroom management, students' prior knowledge, family background and home environment etc. for the formation of learning strategies.

Students' perception towards learning of mathematics greatly affected the classroom teaching and learning situation and students' motivation to engage in learning mathematics during and out of school time. Perception towards teaching and learning was important for the formation of learning strategies. The researcher found remarkable differences in the use of learning strategies by the students of different gender, ability group, school type, and school location. The researcher searched for differences in the contributing factors among these variables for the formation of learning strategies; however, remarkable differences were not found. The researcher found the similarity in the positive and negative contributors, and presented as they were.

Public school students in the interview said that mathematics was the difficult subject compared to other subjects. However, they considered mathematics as an important subject. This version was from low achiever, back sitters in the classroom who usually tried to keep themselves out from the eyes of the teacher in the class. Students from both high and low economic statuses who were normally in lower position in the class according to the merit of the scores gained in the final examination of the previous class said so. However, those who participated in the classroom activities and at the top 5 positions in the class were highly positive to mathematics and said it was not so difficult for them to learn mathematics. The students who felt difficulty in mathematics and disliked the subject enumerated the following point that caused them to think/ feel mathematics as a difficult subject in their life. It became a terrible subject to block them for their future study and career in life. The anxiety to mathematics began from the early grades, and the sources of anxiety were the teachers and their teaching behavior. Previous story of success in mathematics and personal interest of the students were the other factors that could have inhibited students' study habits and higher achievement. The following discourse of the students explains this fact clearly. "Continuous failure de-empowered us in front of mathematics and we never imagine that mathematics could be friendly in this life" (Students' expression in the interview)

How the students sense the classroom environment for their learning is important for higher or lower achievement. What the low achievers felt about the classroom behavior was the reality of the influences of classroom practices in the hidden form to categorize them as low achievers.

In the beginning of a new session when we promoted from one grade to another, we are more attentive to the teacher's teaching in the class. We think we understand better, but when we go home and make a review study or homework, we do not understand anything and cannot proceed on. We come to school thinking in mind that we have to put question. But when the class begins the teacher proceeds on the activities as per the need of the good students. We do not dare to ask questions. Sometimes we are not in the position to ask anything because it needs understanding in some level to put questions. Sometimes we feel that we will be embarrassed by our friends in our ignorance of mathematics and do not dare to put questions to the teacher even when we do not understand teaching. One day and the next day the same story continues and finally we are distracted from mathematics because we feel we can do nothing in mathematics. (Low achiever's remark in interview)

The above quotation of the low achiever showed that the classroom practice in the present schooling was one of the major factors for making mathematics as a critical filter. Classroom observation showed that the authoritative discourse was prevalent in the exiting classroom teaching that was more favorable for the dominant group of people. The deprived ones became deprived ones in educational attainment due to teachers' behavior in the classroom. Categorically, this discourse raised two basic issues: i) content versus contextual teaching and ii) principle of equity in classroom practice.

The first issue was teacher's focus on the contents given in the curriculum to be completed in the end of the session. Teacher's emphasis was on giving theoretical foundation without considering students' contexts of understanding mathematics. Much worry was on the completion of the course which was expressed in teachers' statements. This belief working in classroom teaching was the implication of the students' expression here. What was important to be considered in the instance shown in the above narrative was the use of contextual teaching in mathematics meant that relating learning of mathematics to their real life focusing on selecting topics. This approach could bring empowerment among the low achievers, for they are fully safe in some portion of the curriculum with clear and useable understanding. Contextual teaching was the great lacking in the mind and beliefs of mathematics teachers and the sub-system of mathematics education (Sauian, 2002, as cited in Sharma, 2007).

The other issue was the equity issue expressed in the above discourse. There are different definitions given in the principle of equity in education, which are relevant to discuss here to bring reform in classroom practices in mathematics. The term 'equity' may have a number of different meanings. For example, equity may mean physical access, inclusion and capacity building, multicultural realism and diversity, or it may mean special services (Powell, 1994).

From a multicultural perspective, equity is “the equal understanding and appreciation of the various cultures from which the students come (by the students and teacher), the development of knowledge within those cultural frameworks, and an understanding of mathematics (and science) within varying cultural frameworks” (Hill, n.d-a p.1 as cited in Sharma, 2007). In 2000, the National Council of Teachers of Mathematics (NCTM) released the equity principle, which stated that making equity a reality for all students “requires raising expectations for students’ learning, developing effective methods of supporting the learning of mathematics by all students, and providing students and teachers with the resources they need”. Yet, Powell (1994) articulated “equity” in the most inclusive way:

> Equity means that each student will be addressed as an individual, with instructional opportunities, content, and approaches that meet his or her specific needs, strengths, and interests. All students will be engaged in meaningful learning, in a school environment that values differences and encourages students to participate actively in the learning process. (p.3)

Capitalizing on the importance of high expectations, effective instruction and support, the principle further warrants that equity does not mean equality – it does not mean that every student should receive identical instruction or the same quantity of instruction (Hill, n.d –b, Sutton, 1991 as cited in Sharma, 2007). Rather, the principle calls for appropriate accommodations, learning opportunities, high expectations, and adequate resources and support so that outcomes for every student are equitable (Krueger & Sutton, 2001 as cited in Sharma, 2007, p. 177).

Equity principle does not consist of the matter related to the access and opportunity; it should be the matter of expectation in the assessment of learning. Along with these critical parts, the effectiveness of the Equity Principle is tightly related and depends on other principles, such as curriculum, teaching, learning, assessment, and technology. Without all of these principles in effect, systematic reforms can hardly take place and all students cannot develop their own learning strategies.

Even though the equity definitions in both mathematics and science standard documents are not identically verbalized, they both center on the same principles: (1) high expectations, (2) learning opportunities, (3) accommodations, and (4) support for all students. Enhancing instructional practices that are multicultural and address different student learning styles requires teacher to develop guiding frameworks that address all these equity components and ensures that students receive high quality mathematics education.

Cultural value system towards education could be one of the important contributors to the learners making them motivated to learning and become optimistic to future carrier. This value system in the family and the community had apparent effect in motivating students towards learning mathematics and to feel empowered in mathematics. In interview, ordinary students said, “As we go home, our father / mother/ brother says mathematics is difficult subject, you need to do much practice, drill for better understanding. When we come to class, teacher says math is difficult and you have to study hard. We think that learning mathematics is really a difficult task for us.”

Poverty in general was a great barrier in the schooling of children. The effect of poverty was seen in learning mathematics in the schools of Nepal. Students' conditions in the public schools were so. There was a possibility of great learning opportunity to those who were affluent in the experience of the students regarding learning of mathematics.

The above narrative showed that multiculturalism was creating diversity in mathematics classroom. Again the principle of equity and contextual teaching were the important matters for addressing this issue in mathematics education particularly in classroom pedagogy. In response to the question 'how should a teacher teach in the class?' The students said,

Teacher should do the problems on whiteboard; and explain each and every concept clearly. He has to ask individual students when they do not understand. Instead of asking questions to the talent and understanding students, the teacher should put questions to those students who do not understand better in the class. Chances are given to the 'janne vidhyarthi' (talent students) najanne le pani mauka pauna parchha (less talent, or no talent should get the opportunity).

The important thing in the expectation of pedagogy in classroom teaching for the students from lower socio- cultural background was directed teaching. Students felt cooperative learning less charming than constructivist approach to learning. The increased attention to mathematics education was on the direction of cooperative learning and the constructivist approach globally. This was reflected in the teacher training curriculum of Nepal (NECD, Competency-based curriculum of teacher Training, 2005). So when students' perspectives on the preferred learning strategies were analyzed, there was a possibility of irrelevance of the reform in the present "internationalization" discourse of reform in the Nepalese classroom. A greater input and intervention was demanding.

All the above discussion describes the existing classroom teaching practices in schools. The Nepalese classroom context and discourse was authoritative and guided through purist thought. The diversity in the classroom was so powerful obstruction for students in getting learning opportunity. The principle of equity in all respects was seen the necessary preparation for the better mathematics education in the schools so improvement of present situation was to be done through the standards movement uniting and bringing people together to address the issue of inequity for getting learning opportunity.

Reform intervention acceptable to the existing education culture of the schools could work successfully. Which classroom discourse was mostly respected and expected is another big issue at present. Both students and teachers had strong beliefs on authoritative learning culture, which was reflected in classroom observation. One representative observation episode is presented here.

The teacher was very kind and respectful to the students and never used ruthless /harsh words and physical punishment. Teacher's teaching was different from the other teachers. He attempted to get the problem solved by the students having given clues, information etc. But students disliked his teaching. The students said, "They can learn other subject working themselves in group or interacting each other, but it is not so for mathematics. This subject is different from others. They said, "There are rules, tricks, formulas that we do not know, but the teacher knows them and if s/he says/ demonstrates we can learn. We cannot learn discovering ourselves". During class observation, it was seen that the students were less interested in doing the problems/ tasks assigned by the teacher. Instead of thinking and doing the tasks, they started to talk in other matters (gossiping). Students were not found participating effectively. Due to some sorts of power pressure of the teacher, they were seen involved in the class activities. Regarding teacher's activity in the class, students said:

The teacher should be alert to the off-task behavior of students who make noise and create disturbance in the class. Sometimes we do not get chance to listen to what the teacher says. Students have the belief that 'when a teacher is strict, students are found motivated and attentive in the class.' But it does not mean that everyone should be treated strictly and rudely.

From the above classroom discourse, it could be inferred that the public school students' attitude towards mathematics teaching and learning were not seen adopting the constructivist's belief that 'learners' activity was the base for better learning' . Student's belief towards the learning of mathematics through self-activation was negative. The classroom culture they received in the past was the main cause to develop that sort of belief. From the portrait of the class of a teacher who was motivated with the student centered method, the students did not like this approach very often. On the other hand, the power relation in the class and the practices were creating negative attitude in students to mathematics and de-empowering the students towards learning mathematics. They were made feeble in the presence of mathematics from teacher's behaviors as well as according to the values inherent in the society regarding mathematics and its learning that for only a selected few with gifted potentiality mathematics learning was possible. Furthermore, there are paradoxes of teaching and learning mathematics. On one hand students demanded activity-centered classroom teaching, with full participation in constructing and reconstructing mathematics in the class; on the other hand they were demanding teachers' more i.e. almost absolute disposition in the class for learning mathematics.

The case in the private school was different. Students came there with high ambition of 'becoming a 'thulomanchhe' (great personality) such as doctor, engineers, etc. as told by their parents. They had high expectation to be a privileged citizen with power. They did not have problems in any respects. They said "when we do feel problems either we ask the teachers; or if not possible, go to join tuition". They had not encountered much failure in mathematics. School organized coaching classes for the weaker ones; and for the better ones extra coach was given to make them better.

In the above description of teaching and learning mathematics by the students of private schools, it could be said that these students had positive attitude towards mathematics 'because of the teacher's activity and the opportunity provided to them by the family for learning mathematics. They were empowered in learning mathematics through shadow schooling. The interesting things were the self image of the students in their future life after study. They had a strong self-image and a vision of identity in future, and all these had become the motivating factors for their learning mathematics.

However, the common thing found in both public and private school students was the conviction that extra help for mathematics besides classroom teaching was necessary. Most of them wanted to have tuition or coaching classes at home or at school. Those students who attended several tuition classes but failed in the examination said that they did not know the cause of their failure.

Mathematics curriculum design was another important contributing factor for the formation and selection of learning strategies. Viewing curriculum as intended enacted and achieved forms, it was a great matter to assess curriculum in different sense for the sake of learning mathematics strategically. Sharma (2007) argues that the existing curriculum was driven by the urban elite needs and designed accordingly. In Nepal, there is national curriculum and no one is allowed to make own curriculum in school. Every decision related to curriculum was done at conjecture, unprofessional and political level. At this level, the design of curriculum was based on western model without considering how far it was contextual in the Nepalese context. At first, curriculum was designed at national level, and later on, it came to the teachers for implementation. Several issues and dissatisfactions were raised from implementation aspects. The cause of many students' failure in mathematics was the mismatch between the social, cultural and economic background of the students and the existing curriculum (Sharma, 2007).

One of the students said, "There are dissimilar types of problems in the textbook, one differs greatly from the other questions and we are confused." In an informal talk with mathematics teachers, they said, "There are so many cases of content beyond the mental level of the students in the course. And the course is so lengthy that it's very difficult to complete it, we have no sufficient time to use teaching materials properly and to revise."

Goal oriented learning was another significant factor for the formation of learning strategies. Goal orientation had emerged as an important motivational construct in exploration of learning strategies. Students with a learning goal orientation focus on the development of competence, who appeared to be the most competent. As a result, they worked hard and made a lot of effort in order to learn more from the mathematics course. Orientation toward goals was presumed to be a function of individual differences, or to be included by situational constraints, as it influences the approach that students adopt to learn and the strategies they use in learning. Those students who adopted surface level learning were motivated just by 'how to pass' aspiration and hence, developed minimum effort for learning strategies. And those who were guided by mastery goal motivation used a lot of effort, elaborated the matters, thought critically and used time study management properly. One of the interviewees said, "We must not learn to pass only, we should understand it and be able to use mathematical skills in our daily life." Such students were mastery goal oriented students; they did not learn to pass only. However, the others who were motivated by 'how to pass' aspirations studied maths as it was put compulsorily in the course. "I feel as if I shouldn't study math, but as it is a compulsory subject, I must pass it to go to upper grade," admitted other students. Such students did not use effort to learn mathematics. They just tried to pass by asking their peers, teachers or family members.

Similarly, career-related instruction and learning also played significant role in the formation of learning strategies. If the students had the desire to achieve a higher professional career in math related field, they used much of their effort and had positive attitude towards mathematics and teachers. Many students came to school to study with the dream of becoming a doctor, pilot and engineer. These students conducted deep study of mathematics and performed better. However, the students who had less desire for mathematics related profession they were motivated by pass only aspiration in maths and use less effort. They just followed their teacher but did not think critically about the problems and situations. An interviewee said, “Mathematics is a subject of my interest.” She also added, “I want to become a doctor in the future.” The response showed that the interviewee had thought to choose doctor as her career, so had developed positive attitude towards mathematics; and her achievements in mathematics was also very good. However, another student with pass only aspiration said, “I want to pass the SLC, after SLC I don’t need to study maths.” The student’s performance was observed to be not very good. So the students needed to be exposed to career-related learning to motivate them to select effective learning strategies to improve their achievement in mathematics.

Classroom management was one of the most significant factors for the formation of learning strategies and determining the achievement of the students. Classroom management is the term used by many teachers to describe the process of ensuring lessons run smoothly without disruptive behavior by the student. It is closely linked to the issue of motivation, discipline and respect (Ahmad, n.d.). Classroom management refers to all the things that a teacher does to organize students, space, time and materials for quick student involvement and co-operation in all classroom activities and to establish a productive working environment (Ahmad, n.d.). It is described as the teacher’s ability who cooperatively manages time, space, resources and student roles and student behavior to provide a climate that encourages learning (Ahmad, n.d.). Due to an effective classroom management, students flourished in a positive class climate and a compassionate environment. From a student’s perspective, “classroom management provides them with the opportunities to socialize themselves in learning.” While managing classroom fruitfully, the behavioral aspects of the students must be addressed. In well managed classroom, students thrived in a positive class climate and environment in which they felt safe, cared and involved which made the learning interesting. And when learning became interesting, students were encouraged to form and use all possible learning strategies. Positive and negative contributors for the formation of learning strategies are summarized in table 32.

Table 32.

Positive and Negative Contributors for the Formation of Learning Strategies

Positive Contributors	Negative Contributors
Career related and goal oriented teaching, effective classroom management, prior knowledge, educated family member, positive attitude towards mathematics, student centered teaching method, availability of resources, maximum use of teaching/learning materials, previous story of success in mathematics, cooperative classroom environment, contextual teaching, equity principle, motivation	Curriculum design, ineffective classroom management, uneducated family members, negative attitude towards mathematics, traditional teaching method, cultural value system, anxiety towards mathematics, continuous failure in mathematics, lack of resources, inability of teachers to address multicultural classroom, lack of motivation

CHAPTER V

FINDING AND DISCUSSION

This chapter describes the major findings drawn from the analysis and interpretation and discussion resulted from collected data/information. The discussion of the findings is focused on making interpretations more validating and the results more authentic by analyzing literature, theories, field information/ data and my personal reflection towards the study. Furthermore, debates and issues are created on the results to explain and highlight the results. The major findings are divided into different groups according to the objectives of the study. Then the discussion is made after listing out all the findings.

Major Findings

Major findings are grouped according to the theme derived from the objectives of the study.

Learning Strategies of Mathematics Students

The following cross-cutting learning strategies were found from the study:

a) Students created and used different learning strategies while learning mathematics like: peer learning, elaboration, help seeking, effort management, rehearsal, time and study management, organization, metacognition and critical thinking.

b) Peer learning, elaboration, help seeking and effort management were the most preferred learning strategies used by mathematics students.

c) Rehearsal, time and study management and peer learning were combinely used by the students as the most effective learning strategies. Hence, to get better result, keeping other things constant, students achieved high when they used rehearsal, time and study management and peer learning.

The researcher found the following learning strategies in disaggregated form:

d) There was a significant difference in the preferred learning strategies of boys and girl students. Girls were more likely to use peer learning, help seeking and rehearsal whereas boy students were more likely to use elaboration, effort management and critical thinking as their most preferred learning strategies. However, all nine learning strategies were used by some percentage of both boys and girl students.

e) Though statistically no significant difference was calculated, differences were observed in the preferred learning strategies between high achievers and low achievers. Both high achievers and low achievers used nine learning strategies in varied proportions.

f) There was a significant difference in the preferred learning strategies of urban school and rural school students. The urban school students preferred peer learning whereas the rural school students preferred elaboration as their effective learning strategy. While comparing all nine learning strategies, urban school students excelled to use almost all the strategies except for elaboration and organization in which rural school students excelled.

g) The present curriculum of mathematics was elite favoured and designed to meet the need of urban school students. As a result, urban school students used more learning strategies; but rural school students depended on limited learning strategies.

h) There was a significant difference in the learning strategies used by public and private schools students. Public school students were more likely to use elaboration, help seeking and rehearsal whereas private school students were more likely to use peer learning, effort management and critical thinking. However, both types of school students used all nine learning strategies to some extent.

Role of Teaching Strategies to Promote Learning Strategies

a) Teachers' teaching strategies had contributing role in promoting students' learning strategies. However, mismatches existed between teachers' teaching strategies and students' learning strategies.

b) The effective teacher was an extremely good classroom manager. Effective teaching and learning could not take place in a poorly managed classroom.

c) Most of the mathematics teachers used indifferent teaching strategy in class. They were indifferent towards the personal life and behavior of students.

d) Mathematics teacher had significant role in creating good atmosphere for the learning of mathematics and to arouse the interest of students to use their own preferred learning strategies.

Classroom Practices for Promoting Learning Strategies

a) Teaching and learning situation in the school was an important contextual factor for the development and use of learning strategies.

b) Secondary school mathematics teachers in Nepalese school used traditional teacher-centered approach for teaching mathematics without encouraging students to participate in the classroom activities.

c) Use of teaching/learning materials was very significant in teaching/learning mathematics. However, teachers rarely used those materials which did not help Nepalese secondary school students to develop effective learning strategies.

Contributing Factors for the Formation of Learning Strategies

a) Students' perception towards learning of mathematics greatly affected the classroom teaching and learning situation and students' motivation to engage in learning mathematics during out of school time. Perception towards teaching and learning was important for the formation of learning strategies.

b) Teachers' teaching strategies played important role as the contributing factor for the formation of learning strategies. Mismatch between the teachers' teaching strategies and students' learning strategies resulted into the low performance of students.

c) Cultural value system towards education could be one of the important contributing factors to the learners making them motivated to learn and form learning strategies.

d) Students' family background, environment and attitude were also the important contributing factors in the formation of learning strategies and achievement.

e) Mathematics curriculum design was another important contributing factor for the formation and selection of learning strategies. But the existing curriculum of mathematics in Nepal was driven by urban elite needs. The cause of failure in mathematics by many students was the mismatch between the social, cultural and economic background of the students and the existing curriculum.

f) Goal oriented learning was another significant factor for the formation of learning strategies. Goal orientation has emerged as an important motivational construct in exploration of learning strategies.

g) Career-related instruction and learning also played important role in the formation of learning strategies. Those students who had desired to choose mathematics related career in the future developed more effective learning strategies.

h) Classroom management was another factor for the formation of learning strategies. Well managed classroom helped to make teaching learning process a fun, which ultimately played significant role for the students to participate in learning process.

Discussion

The major findings are discussed on the backdrop of learning theories, empirical results and the context as follows.

Learning Strategies of Mathematics Students

The researcher derived the finding based on the analysis of quantitative data and analysis of information collected from interviews and observations. It was found that students used all of the nine strategies. However, use of the students' learning strategies could be seen clearly in three kinds: the mostly used learning strategies were peer learning, elaboration, help seeking and effort management. Likewise, moderately used strategies were rehearsal and organization, and the least used strategies were time and study management, metacognition and critical thinking.

This finding was supported by the two types of learning strategies developed by Pintrich, Smith & McKeachie (1989) which are: cognitive strategies and resource management strategies. It also corroborates with several other studies. O'Malley et al. (1985, p 582-84) categorized learning strategy into three broad types: cognitive strategy, metacognitive strategy and socio-affective strategy. In addition, Cangelosi (1996) has pointed out that learning strategies include cognitive, metacognitive, affective and resource management. However, Mayer (1992) noted that, to cope up with the high level of cognitive, metacognitive, affective and resource management demands, students must regulate their learning, develop expertise in how to learn and use that expertise to construct knowledge.

Regarding the learning strategies of mathematics students, this study found out that those students did not passively receive the process information; they were the active participants in the learning process. Effective learning required to take control over their learning process and know how, when and where to use various learning strategies. They were prone to exploring how the skills related to things one had learnt in other context or determining how the information might be applied in other contexts. Students undoubtedly used the skills they had learned in one context to understand or to solve the problems in another context. Students were seen using two broad learning strategies categorized by Pintrich, Smith & McKeachie (1989) which were cognitive strategies (rehearsal, elaboration, organization, critical thinking, metacognition) and resource management strategies (effort management, time and study management, peer learning and help seeking) to learn mathematics.

The broad categories were further elaborated explaining all the details. Rehearsal strategies included attempts to memorize the material by repeating it over and over or other types of more ‘shallow’ processing. Students learned through practice which is common among all Nepalese mathematics students. In contrast, elaboration strategies reflected a deeper approach to learning, by attempting to summarize the materials, putting the materials into own words, etc. Finally, organizational strategies also involved some deeper processing through the use of various tactics such as note-taking, drawing, diagrams, listing, or developing concept maps to organize the materials in some manner. Metacognitive strategies included various planning, monitoring, setting goals, etc. in the process of learning (Wolters, Pintrich & Karabenick, 2003). Similarly, critical thinking included contrasting and comparing, using logic to solve the problems. Students used rehearsal, elaboration, organization, metacognition and critical thinking very often. Specific rehearsal tactics including "repeating the material aloud, copying the material, taking selective verbation notes and understanding the most important parts of the material" (Weinstein & Mayer, 1986, p. 3, 18) were remarkably noticed in the secondary mathematics students. Similarly, they used elaborative techniques like paraphrasing, summarizing, creating analogies, generative note-taking, question answering and building the connection between what was being learned and previous knowledge. They remarkably used these strategies to learn mathematics. Likewise, they were also seen outlining, making network, diagramming the information, listing, developing concept maps during learning process. Not only this, they were also prone to setting goals while learning mathematics, skimming the materials and generating questions, and asking their teacher. These metacognitive strategies helped them to test their understanding (Pace, 1985, as cited in Jonassen, 1985).

Moreover, students used resource management strategies which included effort management, time and study management, peer learning and help seeking also as effectively as other cognitive and metacognitive strategies. Effort management is the process by which a learner utilizes tactics such as attribution to effort, mood, self-talk, persistence, and self-reinforcement (Mckeachie et. al., 1986). Time and study management is the development of a setting, including time & space, that is conducive to learning. According to Mckeachie et. al. (1986), “The nature of setting is as important as the fact that the student recognizes that this particular location and time is set aside for studying (p. 29)”. The students were found selecting peaceful location for studying in their favourable time. Seeking of help was seen as one of the most effective learning strategies used by the mathematics students in Nepalese secondary school. Students must learn to utilize this support by seeking help from other students (peer learning), the teacher and the adults (help seeking). When students “can’t solve problems, understand the text material or complete assignments, their options include seeking assistance from friends, family, classmates and teachers as well as persistence or abandoning tasks” (Feather, 1961; 1963, as cited in Wolters, Pintrich & Karabenick, 2003). The researcher found that the secondary school students who used other strategies also sought help from their peers, teachers and adults.

The findings of this study comply with behaviourist, cognitivist and constructivist theories also. Behaviourist learning theory holds that learning is the result of an event (stimulus), the reaction to the event (response) and the consequences for the response (Burton, Moore & Mayliaro, 2004 as cited in Upadhyay, Pradhan and Dhakal, 2010). A behaviourist strategy in mathematics learning tends to stress practices that emphasize rote learning and memorization of formula, single solutions and adherence to procedures and drill.

Cognitivist learning theory states that sense impression (awareness) is the primary source of information. Learning is a change in mental schemata. It becomes knowledge only when mind systematizes it. Mental representation of the world plays a central role in individual’s perception, thoughts, and actions (Kowtrakool, 2002).

Constructivist learning theory includes two theories: cognitive constructivism and social constructivism (Kowtrakool, 2002). According to cognitive constructivism, students are active as well as constructing their own knowledge. Therefore, they have to adapt their prior knowledge with new information until there is cognitive dissonance or new knowledge. Social constructivism theories based on Vygotsky's developmental theory hold the view that students construct their own knowledge by social interaction with others (adult or friend) while they participate in activities within social context which is an indispensable variable. Social interaction causes the students to construct knowledge through the transformation of previously obtained knowledge being more correct, complex, or extensive.

Social cognitive learning theory among different types of cognitive learning theory is discussed in the study developed by Bandura. Bandura believed that most learning is caused by "observational learning" or "imitation" (Kowtrakool, 2002). Furthermore, human beings always interact with their surrounding environment. He explained that learning occurs by interaction between students and their social environment. According to Bandura, observational learning is a cognitive process.

Concerning the learning strategies used by girls and boys, the study showed that there was significant difference in the learning strategies that they used to learn mathematics. There were marked differences between boys and girls in their interest and enjoyment of mathematics as well as in their self-related beliefs, emotion and learning strategies related to mathematics. With respect to students' use of learning strategies, boys consistently used effort management, critical thinking and elaborative strategies more often than girls, whereas girls used peer learning, help seeking and rehearsal. Grieb

(1982), in his study has stated ‘girls tend to memorize algorithms and specific solutions to the problems, whereas boys tend to evaluate and use more complex problem solutions.” Similar notion is expressed by Peterson (1985) who says, “Girls don’t develop the type of autonomous learning strategies needed for complex problem solving in mathematics.” This study has showed that girls who tend to show greater avoidance of problem solving situation do not take risks, but memorize problems’ solutions and request more assistance than boys do. The finding of this study was also approved by Oxford and Nyikos (1989) when they stated “Women more frequently use memory, cognitive and social strategies which are identifiable with rehearsal, peer learning and help seeking. Likewise, Kaylani (1996) has found that male students differ from their female counterparts in the extent of strategy use. She has found that female students use memory, cognitive, compensation and affective strategies more frequently than male students. Therefore, significant differences were found between boys and girls regarding their use of learning strategies. Girls were seen practising and memorizing more than the boys. Though they avoided risk taking situation and did not use remarkable effort management and critical thinking, they excelled in peer learning and help seeking than boys. They were found seeking help from their friends, teachers and adults. However, boys used more elaborative strategies, effort management and critical thinking. They tried alternative methods to solve the mathematical problems unlike girls who tend to memorize and follow their teachers’ method. Boys were able to establish the connection between the ideas learned and the previous knowledge more often than girls. They even tried to solve the problems looking worked-out examples. Nevertheless, the researcher cannot deny the use of all nine learning strategies by both girls and boys, the difference lies in the recurrent use of those aforementioned learning strategies.

The finding of this study stated statistically no significant differences between high achievers and low achievers in the matter of using learning strategies. The students with high achievement as well as low achievement used help seeking, peer learning, elaboration, rehearsal, effort management, organization, time and study management, metacognition and critical thinking, but in varied proportion. High achievers (46.5%) used peer learning as their main learning strategies. They studied with friends, discussed with friends and solved the problems independently. Peer learning (29.5%), help seeking (22.7%) and organization (18.2%) were the mostly used strategies of the low achievers. Rehearsal was another strategy where significance difference was seen between high achievers and low achievers. 9.3% of high achievers used rehearsal whereas only 2.3% low achievers used it. This showed that high achieving students practised much to memorize whereas low achievers did less practice. Similar remarkable difference could be seen in the use of organizational strategies also. 18.25% low achievers used organization while only 4.7% high achievers (the strategy that they used least) used it. Thus, using a range of different strategies clearly showed that there were differences between low achievers and high achievers in terms of their use of learning strategies. Still all cognitive, metacognitive and resource management strategies were used by all students in varied frequency. These findings are supported by another study conducted in Taiwan by Chang (2010); who found that the majority of the junior high school students used both cognitive strategies and resource management strategies to help themselves perform learning tasks in the Chinese language courses. The study showed that the students exhibited greater use of three learning strategies: Effort management, help-seeking, and time and study management. According to Ko (2002), learning strategies involves cognitive process, metacognitive process, techniques, procedures, or behaviour used to facilitate learning.

In a study conducted by Holschuh (2000), it was found that the high achieving learners used a greater number of strategies than low achieving learners. High–achieving students also used more content-specific learning strategies, which suggests that these students know better how to select strategies that meet their learning needs. In addition, these high –achieving students were able to describe the reason for using certain learning strategies to help them learn science. The high achievers used more learning strategies more effectively and consciously than low achievers. This finding is supported by O'Malley and Chamot (1990) as they state that learners can identify the strategies they use and state the reason why they use them. And low achievers were unable to select appropriate learning strategies in context. This finding is supported by Anthony (1996) when he noted that maths students do not perform well when they use inappropriate learning strategies.

High achievers were the students who remembered the answer, worked hard to achieve and generated advanced ideas. They were interested, interceptive, humorous and pleasing. Therefore they were never bored, responded with interest and opinions and performed highly in the group. These students learned with ease, enjoyed the company of peers, group learning and completed their assignments. Likewise, they were accurate and complete, highly alert and observant. They gathered information from various sources and used self-regulation and control. The high achievers and low achievers were the persons with different attitude, motivation and self-regulation, and their learning strategies also differed greatly. The first and the foremost difference in their strategies was interaction. The high achievers were more interactive than the low achievers. This claim is supported by Jones and Gerig (1994, p. 169 as cited in Willson, 1999) with their findings that there is evidence to strengthen the view that "verbally active" students are high achievers. The reasons for being less interactive are feeling embarrassed, feeling frustrated at their interactions, not being acknowledged by the teachers, lacking confidence, concerned about being wrong, getting teased by other students, just not waiting to be involved, being uncertain of the answer and not wanting to be the only person initiating an interaction. The high-achievers interact with teachers, ask questions and answer. They seemed cheerful and felt close with their teachers. However, the low-achiever who was termed as 'weak' hardly asked any question. They felt ashamed thinking that their friends might tease them saying 'ignorant'.

Thus, differences were found between high achievers and low achievers in terms of their use of learning strategies. The high achievers were the users of multiple learning strategies. They used them consciously with appropriate reason. Furthermore, they were the active learners; they even shared the ideas among peers whereas low achievers, though they used many strategies, were less conscious users. They were less active and less interactive. So, they achieved lower than the high achievers. Moreover, their attitude, environment, behaviour, and family background also contributed to be low achievers.

There was a significant difference in the use of mathematics learning strategies between urban school students and rural school students. The urban school students preferred peer learning whereas the rural school students preferred elaboration as their effective learning strategy. While comparing all nine strategies, urban school students excelled in almost all the strategies except for elaboration and organization in which rural schools students excelled. The urban school students had the reach to many resources for study; however, rural school students did not have such facilities. They depended mostly on books and notes which they used to solve problems. This finding is supported by Redding and Walberg (2012) when they claim that rural schools are often limited in the range of classes they offer, in access to educational resources that might advance students' learning in their particular areas of interest, and in the ability to provide remedial support to struggling students. As the rural school students lived in poverty and they lacked many resources for study, they needed to rely on the limited resources; they had no alternatives. Similarly, parents' attitude, cultural background, and learning environment also played important roles to develop learning strategies. Rural school students' parents were mostly uneducated who had negative attitude towards education; they did not encourage students to concentrate on the study, whereas the urban school students' parents had positive attitude towards education. They were constantly encouraged by their parents to study. This helped them to develop learning strategies and use them for their benefit. Therefore, the urban school students themselves developed more concern about their study. This claim is consistent with the claim of Peterson (1978) who claims that adolescents from large urban communities thought more highly about themselves than did adolescents from rural communities. When students become self aware, they are likely to develop more attentive individual strategies to assist themselves to achieve their mathematical aspirations. Cox, Sproles & Sproles (1988) found significant differences between rural and urban school students as he reports variations in preferred learning styles between students in rural and urban school settings. Likewise, the "elite favoured" (Sharma, 2007) curriculum has also contributed negatively for the rural students to use multiple learning strategies. This curriculum is not the discourse of rural students, but thought out on the basis of learning opportunities available in the urban elite culture, which is not suitable for poor rural students. This has also discouraged rural students to develop varied learning strategies. As a result, the achievement level of rural students in Nepal is comparatively far below urban students. This has contributed to create dislike for mathematics in most of the rural students. They become passive in mathematics class. They think mathematics is not the subject for them. This negative attitude prevents them from being creative versatile reader. These adverse situations in rural setting schools have confined rural students to use limited learning strategies. Elaboration and organizational strategies are mostly used by rural students, though some of them used all nine strategies to some extent. But urban school students used peer learning, elaboration, help seeking and effort management remarkably more often than rural students.

The learning strategies between the students of public and private school students differed significantly. As a result, even the achievement level was greatly different. The use of learning strategies was determined by how students perceived mathematics, their attitude in mathematics, their participation and the classroom environment. In the private schools, the teachers cooperated students and encouraged them to participate themselves in learning mathematics; however, public school teachers were seen indifferent towards student participation and the use of learning strategies. In the private school classroom, activities among peer groups were encouraged so students learn more from their peers.

This finding is supported by the statement, “Private school students are more heavily exposed to in-class work and exercises. Private school students also have an advantage over public school students in terms of the learning environment provided by their peer groups (World Bank, 1995; p. 77).

Effective teaching and learning cannot take place in a poorly managed classroom. Classroom management refers to all the things that a teacher does to organize students, space, time and materials to foster students’ involvement and cooperation in all classroom activities and to establish productive strategies. Classroom management should be done addressing physical, psychological as well as behavioural aspects of the students. In Nepal, classroom sitting arrangements are made in both types of schools but behavioural problems were not addressed in public school. But this aspect was addressed in private school. The researchers found that private school teachers encouraged students for active participation, group discussions were conducted, but these factors were missing in public school. Likewise, private school teachers were in intimate relation with students while public school teachers created distance between them and their students. These activities of the teachers contributed greatly for the private school students to use a lot of strategies as per their need, however, public school students had to rely on some limited strategies. Public school students were more likely to use elaboration, help seeking and rehearsal, but private schools students were more likely to use peer learning, effort management and critical thinking as effective learning strategies. However, students in both types of schools were seen using all nine strategies in varied frequencies. The private school students used strategies more effectively as they had technology, resource and well managed classroom facilities, but public school students lacked these facilities.

As they were from poor family background, they sought more help from their teachers and elders and practised themselves more to perform better in the exams. They had to elaborate the materials themselves and used their prior knowledge to learn mathematics. In effort management, public school students were below private school students because they were mostly teacher dependent, the teachers did not encourage them to use their own effort in learning. In the matter of time and study management also, private school students were ahead of public school students. It was because of the family background and economic background of the students. As they had uneducated family, they had to manage time for household work and for looking after their youngsters. All above mentioned factors contributed a lot for the use of learning strategies to learn mathematics, and the significant difference could be seen between public and private school students.

The students' use of effective learning strategies had great effect on their achievement level. The selection of effective learning strategies ensured high achievement whereas random and unconscious use did not guarantee so. If the students used multiple learning strategies in cohesion, it increased their achievement. The study showed that those students who used only one strategy scored 52.8% marks, those who used two strategies scored 57.2%, and those who used three strategies scored 62.75% marks. This showed that the students should use more than one strategy to learn mathematics.

Nepalese mathematics students used different types of cognitive, metacognitive and resource management strategies commonly. According to Mckeachie et al. (1986), and Weinstein and Mayer (1986), cognitive strategies are important for understanding how information is processed and encoded in a learning environment. Metacognitive strategies allow a student to monitor his/her performance through planning, monitoring and self-regulation (Mckeachie et al., 1986). Resource management strategies assist the student in managing the learning environment and available resources (Mckeachie et al., 1986). Proper combination of effective learning strategies support students to perform better and achieve better. This finding is supported by Chamot and Kupper (1989) and Wenden (1998) when they reported, “Research has shown that successful learners tend to select strategies that work well together in a highly orchestrated way, tailored to the requirement of the learning task.” Similar remark was made by Gu (2003, p. 16) who pointed out that learners integrate several types of strategies to deal with learning in the real situation. Gu also refers to the supporting study about the promising benefit of combinations of strategies (Ahmed, 1989; Gu & Johnson 1996; Parry, 1997; Sanaoui, 1995).

Concerning the combination of effective learning strategies, Nepalese students got better result when they combined rehearsal, time and study management, and peer learning. Other combinations did not seem as effective as these three. The students who combined the other three ineffective strategies scored 58.8% whereas those who combined and used rehearsal, time and study management and peer learning scored 99%. This was the clear evidence that the combination of rehearsal, time and study management, and peer learning was the best to achieve high for the Nepalese secondary school mathematics students.

Role of Teaching Strategies to Promote Learning Strategies

Teachers’ teaching strategies had a significant role in promoting students learning strategies. Students learned in different ways; reflecting and acting; reasoning logically and intuitively; memorizing and visualizing. Teachers' teaching methods also varied: some used lecture method; others demonstrated or discussed; some focused on rules, others in examples; some emphasized memory, others understanding. However, mismatches existed between teachers' teaching strategies and students' learning strategies. "Serious mismatches may occur between the learning styles of students in a class and the teaching styles of the instructor (Felder & Silverman, 1998; Lawrence, 1993; Oxford et al., 1991; Schmeck, 1998) which result in learning difficulties in students. When there is a mismatch between these two, students tend to be bored and inattentive in the class, and perform poorly in exams. As a result, they may develop negative attitude towards learning mathematics, and give up study. Therefore, the teaching strategies of the teachers must be effectively matched with the learning strategies of the students. Effective instruction reaches out to all students and becomes coherent with their learning strategies, not just those with one particular learning style. This finding is consistent with the views of Smith & Renzulli (1984): Students taught entirely with methods antithetical to their learning style may be made too uncomfortable to learn effectively, but they should have at least some exposure to those methods to develop a full range of learning skills and strategies.

Teachers are the crucial agents to promote learning strategies. Teachers need to assist their students by designing instruction that meets the needs of individual students with different stylistic performances and by teaching students how to improve their effective learning strategies. The teacher should create good learning environment in the class to ensure students' maximum involvement. Teachers' motivational strategies greatly help students to be involved in learning process and develop learning strategies.

Valuing learning, and believing in the importance of the task increases students' achievement orientation and motivation. When students value goals associated with task, they are more likely to be high achievers. Intrinsic value consists of the enjoyment that a task brings. The effect of goals may be mediated through self-regulatory strategies (Wigfield, 1994). Self-regulation comprises the processes by which people are metacognitively, motivationally, and behaviourally active participants in their own learning (Zimmerman, 1994). The teacher can play crucial role to motivate students towards their task. The more the students are motivated, the more they are likely to develop more effective learning strategies. About the importance of motivation Graham & Wiener (1996); Pintrich & Schunk (2002) say, "Motivation is consistently viewed as a critical determinant of students' learning and achievement within academic settings.

It is important for both teachers and students to realize that learners always encounter many situations that are not adapted to their own preferences. What we teachers need to do is to help students develop the skills and strategies needed for learning effectively from teachers who do not match the students' preferred learning "strategies." Methods of teaching-learning strategies are described by Weinstein and Mayer (1986), and McKeachie, Pintrich and Lin (1985). Good teaching involves more than communicating the content of one's discipline. A good teacher also needs both to motivate students to continue learning and to teach them skills and strategies needed for continued learning.

However, encouragement and motivation for active involvement of the students to direct their own learning was least used in the Nepalese mathematics classes. As a result, students were unable to develop effective learning strategies. Teachers were indifferent towards students' interest and personal life, and imposed only their authoritarian teaching styles without bothering themselves to understand students' learning strategies. Such style differences between students and teachers consistently and negatively affect student grades (Wallace and Oxford, 1998). It is when students' learning styles are matched with appropriate approaches in teaching that their motivation, performances, and achievements will increase and be enhanced (Brown, 1994).

Similarly, classroom management was a significant part of an effective teaching learning process. The teacher should be aware of the role of classroom management in effective teaching learning activities. Efficient teacher is an extremely good classroom manager. Effective teaching learning cannot take place in poorly managed classrooms. Due to an effective classroom management, students flourish in a positive class climate and compassionate environment where they can feel safe, cared and out of fear. This encourages them to continue their work, with teachers' appropriate instruction and feedback. If the students are disorderly and disrespectful, and no apparent rule and procedure guide behaviours, teacher has to choose certain norms to control the class. Effective classroom management refers to create harmony between the classroom environment and students' behavior. Effective classroom management does not refer to create fear, anxiety and use of authoritarian method. But it means the strategies that teachers use to create a safe, orderly and conducive learning environment in the classroom (Ahmad, n.d.). Effective teachers also use rules, procedures, and routines to ensure that students are actively involved in learning. They use management not to control student behavior, but to influence and direct it in a constructive manner to set the stage for instruction (Ahmad, n.d.).

At last, teacher's teaching strategies played important role to promote students' learning strategies. Teachers' teaching strategies and students' learning strategies were inseparable to each other. The teacher should understand the students' needs and behaviours and design the teaching strategies accordingly. The mismatches between the teachers' teaching strategies and students' learning strategies resulted into ineffective attempts for the promotion of learning strategies.

Classroom Practices for Promoting Learning Strategies

Mathematics classrooms were full of students with diverse social, cultural, ethnic and economic background. In this context, it needs to pay attention to social and cultural realities of the school (Acharya, 2012) because classroom practices in the school were important contextual factors for the formation and use of learning strategies. The teachers should structure classroom activities competitively, individualistically and interactively. The classroom practice the teachers design greatly influence students' interactions with others' knowledge and attitudes (Carson, 1990; Johnson & Johnson, 1987 as cited in Kshetree, 2009). Similar view was expressed by Johnson & Johnson (1991) as they claimed, "In a competitively structured classroom, students engage in a win-lose struggle in an effort to determine who is best." In the class, the teachers should manage the interactive situation where students can have the opportunity to learn from their peers. While learning from the peers, students actively build their own knowledge, and are strongly influenced by what they already know. This claim is supported by Tobin & Tippins (1993, as cited in Kshetree, 2009) as they reported that learning is a social process of making sense of experiences, constructing new speculations of reality and further negotiating meaning through social activity, discourse and debate in groups.

However, in the classroom practices of Nepal, instead of focusing group activities or any other student-centered method, the teachers were found teaching in traditional teacher-centered “authoritarian teaching style” (Khanal, 2011). There are many shortcomings in the traditional lecture approach to teaching of mathematics. Most mathematicians agree that the best way to learn mathematics is by actively doing mathematics; by discussing it with others; and by synthesizing major ideas. But in Nepalese secondary mathematics classes, students watch teachers doing mathematics on the board and copy them. Interactions are not found as required. It is obvious that teachers need to induce proper teaching strategies in order to motivate students to learn on their own rather than waiting for readymade knowledge. Most of the students see knowledge is something that can be transmitted by the teachers rather than discovered by the learners (Khanal, 2011).

Teaching mathematics in secondary school mathematics classes in Nepal was guided by the evaluation system, and the present examination system has focused on testing student’s memory based rote and drilled exercises. The misconception of teachers and students had encouraged teachers’ dependent and rote learning practices rather than discovering knowledge through interactions. Therefore, creating an interactive learning environment inside the mathematics classroom in which students engaged in mathematics learning could be challenging. Students might experience discomfort about their own level of mathematics content knowledge and might shy away from participating openly in class discussion and responding to teachers’ questions. This caused adverse effect on the formation of effective learning strategies. According to Motani and Garg (2002), a successful learning environment is one in which students and teachers interact easily, continuously and without any inhibitious. In this type of learning environment, student learning is not left to chance; rather, teachers know whether their students understand the given (intended) concepts. In such classrooms, students do not depend only on teachers, but also participate actively to construct meaning using several effective learning strategies and their prior knowledge. However, as most mathematics classes in Nepal have practised authoritarian teaching method, it supported very little for the formation of effective learning strategies. It could be one reason why more students failed in mathematics at secondary level.

Mathematics learning requires the use of various teaching materials. Teaching materials facilitate students to understand the abstract mathematical concepts clearly. The retention capacity of students is highly promoted by those materials. However, mathematics teachers have rarely used any teaching materials while teaching mathematics especially in public schools. There was a stereotypical procedure followed by every teacher in mathematics class. Teacher entered the class, exchanged greetings with students, and asked students the lesson they had to deal in particular class. Then teacher took the book from a student and dealt with the problems. Such is general practice in secondary school mathematics class in Nepal. Such practice had made the mathematics class monotonous.

At last, classroom practices had a significant role for the formation of learning strategies. However, the authoritarian teaching approach had adverse effect to form effective learning strategies. The researcher had assumed that the teachers would use the strategies established by the behaviourist, cognitivist and constructivist learning theories. The teachers were well informed about these teaching strategies and they were well experienced. They were trained about the mathematics teaching. However, they were not found conscious about it and used the traditional method of teaching, why is it so? This can be the subject of elaborative study, but this study has not focused on this aspect.

Contributing Factors for the Formation of Learning Strategies

Various factors were responsible for the formation of students' learning strategies like: students' perception towards learning mathematics, teachers' teaching strategies, students' family background, environment and attitude, mathematics curriculum, goal oriented and career-related learning, classroom management etc.

Students' perception towards learning of mathematics greatly affected the classroom teaching and learning situation and students' motivation to engage in learning mathematics. The positive perception of students encouraged them to form and use more and effective learning strategies. However, negative perception resulted into ineffective learning strategies. The continuous failure in mathematics developed negative perception among students. Similarly, mismatches between teachers' teaching strategies and students' learning strategies also resulted into boredom, frustration and giving up of the mathematics study. They developed the feeling that mathematics was a difficult subject, which ultimately distracted the students to escape away from mathematics learning. They lacked confidence and did not participate in interactions with the teachers and peers. The reasons were feeling embarrassed, feeling frustrated at their interactions, not being acknowledged by the teachers, lacking confidence, concerned about being wrong, getting teased by other students, etc. (Willson, 1999). Such students developed anxiety in mathematics from their early grades which finally had negative influence on the students.

Moreover, the perception of teachers' teaching strategies by the students also played determining role for the formation and use of learning strategies. The perception of classroom events and teachers' teaching strategies existed among most students, both the high achievers and low achievers who had developed, through their schooling experiences, an insight into teacher expectations and the academic capabilities of their peers. Such a view is supported by Wittrock who believes that children, as a result of their schooling, learn quickly to rate themselves and their peers as high or low achievers (Wittrock, 1986; p.300, as cited in Willson, 1999). Students themselves are classroom observers, they are aware to a great extent of their own academic standing in the classroom, as well as that of others. They evaluate the overall classroom activities as well as their teachers' teaching.

The information related to the students' perception of secondary school teachers' teaching strategies were found by taking interview with the students and by class observation, the majority of the students perceived their teachers' teaching style as indifferent and authoritarian. Sharma (2007) also found that the Nepalese teachers' teaching style was authoritarian. From the students' viewpoint, their classroom teachers were classified as indifferent and authoritarian. Majority of the students interviewed perceived these types of teaching styles. These findings are supported by another study conducted in Taiwan which found that most junior high school students indicated that they had indifferent teachers. The teachers were indifferent towards personal life and behavior of students. They did not care about students' work. The teachers did not care their students individually, which was also found in observation. The teacher just gave instruction in the class but did not care individually whether they performed well or not.

In class observation, the researcher found teacher centered teaching styles because the teacher did not involve the students to learn themselves. They did not facilitate much to their students while solving mathematics problems. The teacher did not encourage the students to solve the problems themselves which was also found in a study conducted by Norzila, Fauziah and Parilah (2007), which showed that students preferred learner-centered teaching styles, whereas the most frequently used teaching styles of lectures were teacher–centered in nature. The observations and opinions of the students showed that the teacher's teaching style was authoritarian. The democratic and lassiez-faire teaching styles were not frequently observed in class observation. The students' opinions were also not in favour of these teaching styles.

Teachers were found using traditional teaching approach in mathematics class. Constructivist teaching approach was not found. The teachers themselves made most of the decisions in the classroom, emphasized teaching the content, and put the students in a passive role. The teachers ignored learner-centered approach and used authoritative teaching style. The students copied from the board when teacher solved the problems and learned looking at it. The student responded, "Our teacher solves the problems on whiteboard; I copy and try to understand looking at it."

The encouragement for active engagement, empowerment of students, to direct them for their own learning was seldom used. As a result, the students were unable to develop any effective learning strategies. Most of them were exam oriented and gave a nice 'output' but their perceived teaching style and learning strategies were not related.

Students learn in many ways by seeing and hearing; reflecting and acting; reasoning logically and intuitively; memorizing and visualizing. Teaching methods also vary. Some teachers lecture, others demonstrate or discuss; some focus on rules and others on examples; some emphasize memory and others understanding. However, serious mismatches may occur between the learning styles of students in a class and the teaching style of the instructor (Felder & Silverman 1998; Lawrence 1993; Oxford et al. 1991: Schmeck 1998), with unfortunate potential consequences. The students tend to be bored and inattentive in class, do poorly on tests, get discouraged about the course, and many conclude that they are no good at the subject of the course and give up (Felder & Silverman 1998; Goldleski 1984; Oxford et al. 1993; Smith & Renzulli 1984). Teachers, confronted by low test grades, unresponsive or hostile classes, poor attendance, and dropouts may become overly critical of their students (making things even worse) or begin to question their own competence as teachers.

Every student learns and responds to information uniquely. To better serve a students' learning needs, researchers have discussed the role of teaching style in student learning. Many of these researchers support the view that matching teaching and learning styles improves students' achievement (Stitt- Gohdes, 2001, Henson, 2004; Hou, 2007). Such teaching styles of instructors could lead to an improvement in academic performance. The use of continual assessment strategies along with instructional strategies in order to enhance student learning makes good educational sense. In fact, these two are inextricably linked to one another. The definition of formative assessment, for example, contains many "actions" that students and teachers can perform independently and collaboratively during the instructional process. The actions of the students and teachers produce feedback that is used to make adjustments either in teaching, in learning, or in both and thereby, create successful interactive learning environment. For students, that information can come from teachers, other students or from the students to get feedback about a task that helps a student to remain on target towards the desired goal. Interacting with oneself in the assessment/ instructional process builds self- monitoring, self-reflection, self-assessment, and self–regulation skills. When students develop these "self" skills, they become independent, lifelong learners.

However, when the students' perceived teaching styles were investigated in relation to learning strategy use, it was found that how they viewed their teachers did not influence their choice of learning strategies. The students preferred mixed use of cognitive, metacognitive, socio-affective and resource management strategies regardless of the perceived teaching styles and strategies.

Cultural value system towards education also influences the teaching-learning processes and the formation of learning strategies. The Nepalese students, mostly in rural settings, come from poverty and uneducated family background and their opportunities and life experiences may be limited. Even some families in rural communities do not see the value of education, and do not encourage students for study. Moreover, the classrooms of Nepalese schools include students from multiculture, though; the teaching system does not match the psychology, needs, attitudes and cultural expectations of all the students. Equity from multicultural perspective is lacking in Nepalese classrooms. Equity is "the equal understanding and appreciation of the various cultures from which students come, the development of knowledge within those cultural frameworks, and an understanding of mathematics within varying cultural frameworks" (Gill, n.d-a p.1 as cited in Sharma, 2007). It is the "call for appropriate accommodations, learning opportunities, high expectation, and adequate resources and support so that outcomes for every students are equitable (Krueger & Sutton, 2001, as cited in Sharma, 2007, p.177). Design of classroom activities from multicultural perspective influences greatly for the students to develop and use of learning as the students from every culture feels free and independent in learning. They are motivated for learning. Such cultural value system in school as well as in family and community has apparent effect in motivating students in learning mathematics.

Moreover, learning strategies are not biological matters; they are developed and influenced by behaviours and cultural experiences, and may be formed and revised as a result of training or changes in learning experiences. Learning strategies are thus "moderately strong habits rather than intractable biological attributes" (Reid, 1987; p.100) and with a moderate training, sub/unconscious styles can become conscious learning strategies. Through the cognitive give and take of social interactions, one constructs personal knowledge. In addition, the context in which learning occurs is inseparable from emergent thought. Social constructivism captures the most general extant perspective on constructivism with its emphasis on the importance of social exchanges for cognitive growth and the impact of cultural and historical context of learning (Applefield, Huber & Moallem, n.d.). These opinions of different researchers and theorists support the finding that cultural value system, behaviour, attitude, family background and environment contribute greatly for the formation of students' learning strategies. Similarly, Nepal is a country of diversity in terms of geography, language, castes, ethnicity, religion and cultures. As stated by MOHP, Nepal (2014), "Nepal is a multi-lingual, multi-religious and multi-ethnic society" (p. 78). This shows that the school has children from different social, cultural, ethnic and language backgrounds. It needs to pay attention to the social and cultural realities of their students while designing teaching strategies. Thus, social and cultural backgrounds of students have greatly affected the formation of learning strategies of students.

The findings of this study showed that the nature and the design of mathematics curriculum were one of the important contributing factors for the selection and use of learning strategies. Curriculum is viewed as specific constructs and skills that students are expected to comprehend and apply. The development of appropriate curricula should be “guided by the culture of the stakeholders involved in the educational process” (Akbar, 1985). In the process of enhancing mathematics instruction in Nepal, one must examine the curricular framework on which it is built. This implies that the mathematics curriculum–that is what concepts are learned, and why they are learned–should be constantly reevaluated to assure that student has the opportunity for meaningful mathematics learning. There are several ways of contextualizing mathematics so that it becomes meaningful and useful for students (Ladson-Billings, 1995).

However, the existing curriculum of mathematics in Nepal was “driven by urban elite needs” (Sharma, 2007) and the available learning opportunities. This curriculum was not designed considering the social, cultural, ethnic and economic realities of the Nepalese students. The curriculum was designed purely at conjecture, professional and political level. The design of Nepalese mathematics curriculum was based on the western model without having critical study regarding how far it was contextual in the Nepalese context. Therefore, as the students were unable to form effective learning strategies to learn mathematics, the case of many students’ failure in mathematics was due to the mismatch between the social, cultural and economic background of the students and the existing curriculum (Sharma, 2007).

The finding claimed that goal oriented learning was also one of the important factors for the students' use of learning strategies. Goal orientation theory is a social-cognitive theory that has particular utility for examining motivation both in terms of classroom context and individual students' beliefs (Maehr & Midgley, 1996; Midgley, 2002). Rather than viewing students as possessing or lacking motivation, this theory instead considers the achievement goals, defined as the "meaning or purpose for engaging in academic behavior, as constructed by students", that students pursue (Kaplan, Middleton, Urdan & Mingley, 2002, p.22).

Goal orientation has emerged as an important motivational construct in pursuing learning strategies. This finding is supported by many studies which demonstrated important links between students' perceptions of the goal structures emphasized in their classes and a range of student level motivational and performance outcomes. A mastery goal structure has been shown to promote students' adoption of effective learning strategies and positive feelings about self and school, and it has been associated with students' positive affect and coping strategies as well (e.g., Ames & Archer, 1988; Anderman, 1999, 2003; Kaplan & Maehr, 1999; Kaplan & Midgley, 1999; Ryan, Gheen & Midgley, 1998; Urdan, Midgley & Anderman, 1998 as cited in Freeman & Anderman, 2005).

Students with mastery goal orientation focused on the development of competence. They wanted to master in the matter they were learning. As a result, they worked hard and put a lot of effort in order to learn more. Such students used multiple effective learning strategies; however, the students with pass only goal did not work hard or put effort on understanding the whole concept but to get the pass mark. They did not pursue their career in the future. In this regard, career-related teaching and learning also came together with goal orientation. Those students who wanted to pursue mathematics related career tended to develop mastery goal orientation, and learned using effective learning strategies. However, those students who did not want to pursue mathematics related career in future and studied mathematics as it was the compulsory subject in their curriculum tended to develop pass only goal orientation, and did not use effective learning strategies. Career–related teaching and learning had important implication on creating interest and achievement of students. This finding is supported by Okereke (2006) who found from a study that prior knowledge of career implications of mathematics topics facilitated the interest and achievement of students in mathematics. So the students need to be exposed to career-related learning to motivate them to select effective learning strategies to improve their achievement in mathematics.

Effective classroom management was found to be one of the most significant contributing factors for the formation of effective learning strategies. Classroom management is managing all the components of the classroom to run the classroom activities without any disruptive behaviour shown by the students. Classroom management strategies are a crucial part of teachers' success in creating a safe and effective learning environment for students. The purpose of classroom management is to provide a safe and friendly environment in order for learning to take place. Furthermore, classroom management affects the physical elements of the classroom, making it more productive environment for its users. They strategically place furniture, learning centers, and materials in order to optimize student learning and reduce distractions (Ahmad, n.d.). In the poorly managed classroom, teaching and learning cannot be effective. But if the classroom is well managed, the focus lies in learning activities. Students concentrate on solving the related problems using different strategies. In effectively managed classroom students get positive class climate and compassionate environment. As a result, it motivates students to development and use effective learning strategies which facilitate them in learning mathematics.

Table 33 compares and contrasts the theoretical assumptions and field findings regarding learning strategies use.

Table 33.

Comparison of Theoretical Assumptions and Field Findings

Theories	Theoretical Assumptions	Field Findings
	Learning Strategies	Learning Strategies
Behaviourist Theory	Imitation, rote learning, learning without understanding, exercise, rehearsal, practice makes a man perfect	Imitation, rote learning, learning without understanding, exercise, rehearsal, practice makes a man perfect
Cognitivist Theory	Changing mental processes and mental structures, repetition, researching, translation, grouping, note taking, deduction, recombination, imagery, conceptualization, mnemonic, thinking, self management, physical actions, auditory representation	Repetition, note taking, mnemonic, metacognition, elaboration, organization, self management, effort management, critical thinking, physical actions, auditory representation
Costructivist Theory	Social interaction, management of the environment and activities, discovery approach, inquiry learning, active learners who build and create meaning and knowledge, asking questions, learners who reflect and make associations with prior knowledge to reach new understandings, self-regulation, self-encouragement, cooperative learning, critical thinking, peer learning, help seeking, elaboration	Social interaction, , inquiry learning, asking questions, learners' reflection, self regulation, cooperative learning, peer learning, help seeking, time and study management

Regarding learning strategies, the Behaviourist theory assumes that the students imitate their teachers without understanding. They believe that practice makes a man perfect. They do exercise and adopt rehearsal strategy. As assumed by the theory, the students used same rote learning strategies. They did not bother to understand but kept on practicing.

Cognitivist theory assumes students use the strategies like replication, researching, note taking, translations, deduction and recombination. Students conceptualize the lessons through imagery, mnemonic, thinking and through physical action. Students were found in the field study to have used some of these strategies like repetition, note taking, mnemonic, elaboration, organization, self-management, effort management, critical thinking, physical action and auditory representation. Other strategies were found not in use as assumed by the cognitivist theory.

Similarly, the constructivist theory assumes students to have social interactions, manage the learning environment themselves and discover new strategies and knowledge in a constructive way. The students are active learners who ask question, do research and reach a new understanding. They seek help, use peer learning, become cooperative and provide self-regulation with proper management of time and study. The constructivist theory assumes that the readers become critical and discover new knowledge through social participation. However, the students were found using only few of these surgeries in the actual learning. They sought for help. Cooperative learning and peer learning were found to be used. Some the students asked questions and managed reflection etc. The researcher found the students not aware on the very important strategies assumed by constructivist theory.

In conclusion, theoretical base is applied here for reference; and literature supported the researcher to fill the gap of knowledge and the theoretical concept guided the study in the appropriate way.

CHAPTER VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of the study on the whole and conclusions drawn from the major findings. The recommendations are in two aspects: implications of the study for the improvement of mathematics education based on the findings of the study; and areas for the additional study to be carried out. This chapter is organized into sub-sections: summary, conclusions, implications, and areas for further study.

Summary of the Study

Many secondary school mathematics students have difficulties in understanding mathematics, investigating, generalizing the mathematical situation, and adopting mathematics. Therefore, the number of failing students in mathematics examinations is remarkably high. The reason behind this may be because of the effectiveness of the learning strategies used by the students. The major purpose of the study was to investigate the various learning strategies used by mathematics students, and the different contributing factors for the promotion of learning strategies used by mathematics students in the secondary schools of Nepal.

The objectives of the study were: (a) to explore students' learning strategies in mathematics, (b) to analyze the differences in learning strategies by gender, ability group, location and school type, (c) to explore the most effective learning strategies for better achievement in mathematics, (d) to examine classroom practices as learning strategy promotion activities, and (e) to determine contributing factors contributing to the formation of learning strategies.

In order to achieve the above objectives of the study descriptive, interpretive and exploratory method was used with field flavor and the information was based on both primary and secondary data sources. The multistage sampling procedure was used for the selection of the samples of the study. In the first stage, stratified random sampling approach was applied by dividing the whole country into three strata based on its geographical regions: Mountain region, Hilly region and Terai region. In the second stage, urban and rural areas were separated in each of these districts by using stratified random sampling. Then, in the third stage, public and private schools were selected by using random sampling. In the fourth stage, boys and girls students were selected using incidental sampling method. Finally, purposive sampling was used to include both high achieving and low achieving students after studying the school records. The informants were selected from 12 districts for quantitative study. 24 schools were selected from the 12 districts including 4 schools from 2 districts of Mountain region, 14 schools from 7 districts of Hilly region, and 6 schools from 3 districts of Terai region. Informants were selected from 17 public and 7 private schools from both urban (16 schools) and rural (8 schools) setting of the various districts including 652 boys and 742 girls students. For the qualitative study Kathmandu district (1 district from 12 districts selected for quantitative study) and Dhading district were selected to incorporate urban and rural schools. For this purpose, information was collected from 24 students (12 high achievers and 12 low achievers including 6 boys and 6 girls from each achievement levels from each school) of one public and one private schools of Kathmandu district and 4 students from a rural school of Dhading district. The MSLQ tool (developed by Pintrich, Smith & McKeachie 1989), modified in Nepali version and done pilot test using item total correlation, and

Cronbach alpha test statistics, was used to obtain quantitative data using survey method; and qualitative information was collected by interviewing, observing, diary keeping and video recording.

The collected data/information was analyzed using quantitative and qualitative methods. Both quantitative and qualitative methods were used to study the learning strategies of mathematics students, most used learning strategies, preferred learning strategies used by boys and girl students, learning strategies used by high achieving and low achieving students, learning strategies used by urban and rural students, learning strategies used by public and private school students, and combination of learning strategies for better achievement in mathematics. However, only qualitative method was used to study the role of teachers' teaching strategies in promoting students' learning strategies, role of classroom practices for promoting learning strategies, and factors contributing to the formation of learning strategies. Based on the correlated and reliable dataset, frequency count and Chi-square test were the methods mostly used in quantitative analysis. Likewise, to see the relation of learning strategies with the achievement, ANOVA, Univariate General Linear model, and regression analysis, was used. Regarding qualitative analysis, personal experiences, researcher's reflective diary, classroom observations, various books, seminar papers, multilateral reports, students' in-depth interviews, informal talk with the mathematics teachers and relevant internet study were reviewed, and analyzed. Collected data were encoded categorically and thematically. Then interpretation of analyzed data was done based on the framework of behaviourist, cognitivist and constructivist learning theories. And nine learning strategies model/ taxonomy was followed as developed by Pintrich, Smith & McKeachie (1989).

The analysis showed that students did not passively receive the process information; rather they were active participants in the learning process, constructing meaning in ways shaped by their own prior knowledge and new experiences. They are prone to exploring how the skills relate to things one has learnt in other context or determining how the information might be applied in other contexts. Students were seen using learning strategies categorized by Pintrich, Smith and McKeachie (1989) which are cognitive strategies (rehearsal, elaboration, organization, critical thinking and metacognotion), and resource management strategies (effort management, time and study management, peer learning and help seeking) to learn mathematics. Though the students used all nine learning strategies, they mostly preferred to use peer learning, elaboration and help seeking. Comparing the learning strategies used by boys and girls, both types of students used all nine learning strategies, but girls were more likely to use peer learning, help seeking and rehearsal strategies than boys, and boys were more likely to use elaboration, effort management and critical thinking strategies than girls. Regarding the learning strategies used by high achieving and low achieving students, though there was no significance difference, remarkable differences were found from observation and interviews. High achievers were the users of multiple learning strategies consciously with appropriate reasons, and low achievers were less conscious learners. There were differences in attitude, environment, participation and family background between high achievers and low achievers. Similarly, significant differences were found between the urban and rural school students in terms of the learning strategies they used. Urban school students preferred peer learning, elaboration, help seeking and effort management strategies; however, rural school students mostly preferred elaborational and organizational strategies. Likewise, in terms of use of learning strategies, public and private school students were also different. Public school students preferred elaboration, help seeking and rehearsal strategies, whereas private school students preferred peer learning, effort management, and critical thinking strategies, although both types of school students used all the strategies discussed in this study. However, rehearsal, time and study management, and peer learning were seen as the most effective learning strategies. Hence, to get the best achievement in mathematics, students can combine these three effective learning strategies.

Different factors were found to have influenced the formation and promotion of learning strategies. Among them, teachers' teaching strategies, cultural value system towards mathematics education, students' background, environment, economy and attitude, mathematics curriculum design, goal oriented and career-related teaching and learning, and classroom management were found to be some of the important contributing factors. However, the teachers' teaching strategies, being authoritative and less interactive, did not help much to the Nepalese mathematics students for the formation of effective learning strategies. Similarly, design of mathematics curriculum also was not seen in the favour of Nepalese mathematics students for the formation of effective learning strategies, as the curriculum was designed purely at conjectural, professional and political level without thinking critically about the context of Nepalese students.

Conclusions

Students do not passively receive the process information; rather, they actively take part in the learning process. Effective learning needs students take control over their process and knowledge regarding how, when and where to use various learning strategies. For effective learning, selection of effective learning strategies is a must. It is obvious that students use all the nine learning strategies as categorized by Pintrich, Smith and McKeachie (1989) which are cognitive strategies (rehearsal, elaboration, organization, critical thinking and metacognition), and resource management strategies (effort management, time and study management, peer learning and help seeking) to learn mathematics.

Students attempt to memorize material by repeating over and over. Similarly, they even elaborate by summarizing and putting the materials in their own words. They are also involved in deeper processing through the use of various tactics such as note-taking, drawing diagrams, listing, developing concept map or organizing materials in some manner. Students even use critical thinking strategies to learn mathematics. Students do certain planning, summing and setting up goals as promoted by metacognition strategies. Moreover, they tend to use the learning strategies that enable them to use study hours well and choose the environments that can facilitate learning and help them persist in achieving their learning goals. In addition, they preferred to seek assistance from their peers, teachers and elders. Asking for help is a good strategy as it allows students to learn from others when he/she cannot deal with the problems alone.

Mathematics students use rehearsal, elaboration, organization, critical thinking, metacognition, effort management, time and study management, help seeking and peer learning strategies to learn mathematics effectively. Students go through many actions independently or collectively during the learning process. They learn in different ways like: By seeing and hearing; reflecting and acting; reasoning logically and intuitively;

analyzing and visualizing steadily. The actions of varied students produce varied strategies in learning. However, peer learning, elaboration, help seeking and effort management are the learning strategies mostly used by the mathematics students. Likewise, moderately used strategies are rehearsal and organization; and the least used strategies are time and study management, metacognition and critical thinking.

There is a striking difference between boys and girls in the use of learning strategies. Obviously, girls and boys think and learn differently as well as interact and respond with the equipment differently. Their perception, motivation, self-related beliefs as well as their emotions also differ. Similarly, there are marked differences between boys and girl students in their interest and enjoyment of mathematics. These factors greatly affect their selection and use of learning strategies. As a result, boy students consistently use effort management, critical thinking and elaborative strategies more often than girls, whereas, girls prefer to use peer learning, help seeking and rehearsal strategies more often than boys. Girls involve in practicing and memorizing more than the boys students. Though they avoid risk taking situation and do not use remarkable effort management and critical thinking, they excel in peer learning and help seeking than boys. They seek help with their friends, teachers and adults. However, boys try for alternative methods to solve mathematical problems unlike girls memorizing and following their teachers. They even try to solve problems using worked out examples. They even do the connection between the ideas learned and the previous knowledge more often than girls.

There are remarkable differences in the learning strategies used by high achieving and low achieving students. Although collective judgment shows that both high achieving and low achieving students use all nine learning strategies discussed in this study, if we see individual students using learning strategies, there is an obvious difference in their use of learning strategies. High achieving students are the users of multiple strategies in content-specific manner. They know better how to select these strategies that meet their learning needs. In addition, high achieving students are able to describe reason for using certain learning strategies. They are more conscious learners than the low achievers. High achievers are the students who remember the materials, work hard; and they are able to perceive and generate the ideas. They are interested, interceptive, humorous and pleasing. They learn with great ease, enjoy the company of peers and perform at the top of the group, and are never bored. They are accurate, complete, highly alert and observant. They involve in the interactions with their teachers. However, the low achievers differ from high achievers in terms of their perception, attitude, motivation and self-regulation. They are less interactive, embarrassed, feeling frustrated in their studies. Therefore, their learning strategies also differ greatly.

There is a significant difference between urban and rural school students in their use of learning strategies. The urban school students prefer peer learning whereas rural school students use elaboration as their effective learning strategies. While comparing all the nine strategies discussed in this study, urban school students are far ahead in almost all the strategies except for elaboration and organization. Rural school students' family background, attitude, environment, cultural value system, limited exposure to the learning resources and materials are the major causes for these differences. The design of mathematics curriculum, which is elite favoured, is also another cause for this difference. However, the urban school students have a greater reach in the technology and educational resources. The rural school students' uneducated family background has disabled them to form efficient learning strategies and affected their achievement level. Unlikely, the urban school students have easy access to educational resources, technology, and educated family background which have enabled them to develop and use effective learning strategies, and achieve high. These adverse situations have discouraged the rural school students to develop and use effective learning strategies, therefore, they use limited learning strategies. Elaboration and organizational strategies are mostly used by rural students whereas urban school students use peer learning, elaboration, help seeking and effort management remarkably.

There is a significant difference between public and private school students in terms of use of learning strategies. Public school students prefer to use elaboration, help seeking and rehearsal more often than private school students, whereas private school students are far ahead to use peer learning, effort management and critical thinking than public school students. Private school students are encouraged and cooperated by their teachers to participate in learning process, however; public schools are indifferent regarding students' participation. Private school students are encouraged to participate in the activities among peer group, and are exposed to in-class work and exercise. Similarly, there is a difference in classroom management also. Classroom management is done in both public and private schools, but behavioural aspect is addressed in private school whereas this aspect is not addressed in public school. Use of teaching learning materials also creates differences. Private school teachers use teaching materials, and try to facilitate students' learning; but this aspect is lacking in public schools. Likewise, the anxieties of students in public school about mathematics also affect the development of learning strategies. These factors contribute greatly for the difference in the use of learning strategies between public and private school mathematics students.

The combination of rehearsal, time and study management and peer learning is the most effective way of using learning strategies. The selection of effective learning strategies ensures high achievement whereas random and unconscious use of learning strategies does not improve achievement level. The students who use multiple strategies in cohesion will achieve higher than random users.

Teachers' teaching strategies have a significant role in promoting learning strategies. Students learn in different ways, and teachers' teaching strategies are also different. The teaching strategies of the teachers and the learning strategies of the students must be matched. Mismatch between these two results in ineffective teaching-learning activities. Teachers are crucial agents to promote learning strategies. Teachers need to assist their students to promote effective learning strategies by designing instruction that meets the needs of individual students with different strategical performances. However, there is a mismatch between the teaching strategies of teachers and the preferred learning strategies of students. Students whose learning strategies match with their teachers' teaching strategies will have greater ease to learn mathematics than the students whose strategies are mismatched with the learning strategies (She, 2005). When students are taught with the methods dissonant from their learning strategy preferences, they do not succeed in mastering the subject matter as quickly as they could have (Doolan & Honlgsfeld, 2000). The teachers are indifferent towards the interest and personal life of the students. The encouragement and motivation for active involvement of the students to direct their own learning is least used in Nepalese mathematics classroom. As a result, the students were unable to form effective learning strategies. Thus, mismatch between teachers' teaching strategies and the students' learning strategies in Nepalese mathematics classes has not contributed much for the promotion of students' learning strategies.

Classroom practices play significant role in promoting students' learning strategies. The classrooms in Nepalese schools consist of students from varied social, cultural, ethnic and economic background. In this condition, classroom activities should be designed addressing these aspects. Due to the mismatches between classroom practices and students' background, teaching does not become effective, and students cannot develop effective learning strategies. The secondary school mathematics teachers view the differences in approaches to learning mathematics as problems inherent in students themselves rather than encouraging their students to learn in their own ways. Most of the secondary school mathematics students tend to solve problems following similar procedures that their teachers have shown them to solve other mathematical problems. The teachers also explain mathematical topics using textbooks, give them examples, and instruct them to solve other problems in a similar way. Thus, mathematics teachers follow autocratic/authoritative teaching strategies. The encouragement for active engagement, empowerment of students to direct their learning is seldom used. On the contrary, if students' learning preferences are identified and students are permitted to learn according to their preferences, then their achievement, motivation and interest in school subjects will be enhanced (Renzulli et al., 1998). Likewise, teachers can make their approach more comprehensive in its appeal to match diverse learning strategies of their students (Prescott, 2001). The classroom practices in Nepalese secondary school mathematics class are teacher centered authoritative strategies, which have not helped students much to promote their learning strategies.

Students' perception towards learning mathematics, teachers' teaching strategies, students' family background, environment and attitude, mathematics curriculum, goal orientation and career-related learning, classroom management are the major contributing factors for the formation of students' learning strategies. Students' perception towards learning of mathematics greatly affect the classroom teaching and learning situations and motivation to engage in learning mathematics during and out of school time. How the students perceive classroom environment and mathematics education as a whole affect greatly for the formation and use of effective learning strategies. The positive perception helps to form effective learning strategies whereas negative perception results into ineffective learning strategies. If the students have anxiety about mathematics, they develop negative perception like 'mathematics is a difficult subject' or 'I cannot do better in mathematics.' Such perception results into boredom and students give up their study of mathematics. Those students who have positive perception, become interested, use effective learning strategies can score high, if not, low.

Similarly, teachers' teaching strategies also contribute a lot to the formation of effective learning strategies. The teachers' teaching strategies and students' learning strategies must be matched. Mismatches result in boredom, frustration and giving up of the study of mathematics. Nepalese mathematics teachers use indifferent and authoritative teaching styles. They do not care about teaching learning strategies. As a result, mathematics students' learning strategies and teachers' teaching are mismatched, which result into ineffective learning strategies and poor achievement.

Moreover, students' family background, cultural background, environment and attitudes are also the significant factors for the formation of effective learning strategies. The students from educated family are interested in study, develop positive attitude and use effective learning strategies, and achieve high. But those from uneducated family background develop anxiety about mathematics, are disinterested and score low because their learning strategies are less effective. Some families in Nepal do not see the value of formal education. They do not encourage students to learn mathematics effectively. Likewise, the classrooms of Nepalese schools consist of students from multiculture, however, the teaching strategies do not match the psychology, needs, attitudes and cultural expectations of all the students. Equity from a multicultural perspective is lacking in Nepalese classrooms. These adverse conditions have affected the use of learning strategies by the students while learning mathematics.

The nature and design of mathematics curriculum is also one of the important contributing factors for the formation and use of learning strategies. However, the existing curriculum of mathematics in Nepal is 'elite favoured and driven by urban elite need' (Sharma, 2007) and the available learning opportunities in the urban areas. The mathematics curriculum is designed purely in conjectural, professional and political level without paying enough attention to the multicultural realities of Nepal. So, it has not encompassed the multicultural expectations of Nepalese students. As a result, mathematics students have problems in forming and using of effective learning strategies.

Goal-oriented learning is another significant factor for the formation of effective learning strategies. Goal orientation is an important motivational construct in exploring learning strategies. Students with goal orientation focus on the development of competence; so they work hard and put a lot of effort in order to learn more and develop mastery goal motivation. Others are motivated by “pass only” aspirations, so use minimum effort in learning. Similarly, career–related learning also plays important role to develop effective learning strategies. The students with desire to a higher professional career in mathematics related field use much effort, develop positive attitude towards mathematics and teachers. And those who have no desire for mathematics– related career develop “pass only” aspirations and use less effort in learning mathematics. Their learning strategies are also less effective. Likewise, classroom management is also the important contributing factor for the formation of learning strategies. Due to an effective classroom management, the students flourish in a positive class climate and compassionate environment. If a classroom is full of disorder and anarchy, teaching/learning does not become effective. In such environment students cannot concentrate on the study. They tend to develop frustration, boredom and irritation. While managing classroom, the behavioural aspect of the students also should be addressed; if not students do not feel safe, cared and do not get the feeling of involvement which makes learning disinteresting. In such environment they cannot form and use effective learning strategies.

Recommendation

Mathematics is considered to be a difficult subject by most of the students comparing it with other subjects. The central part of mathematics education is the teaching/learning process adopted in the mathematics classrooms as well as in its learning. Therefore, teachers’ teaching strategies and the students’ learning strategies should be mutually matched to make teaching /learning process effective. Students’ preferred learning strategies should be considered from the beginning of mathematics curriculum design up to the implementation stage by the concerned stakeholders such as curriculum designers, school administrators and mathematics teachers.

Likewise, the factors contributing to the formation and promotion of students' learning strategies should be identified and resolved properly so that mathematics students feel ease to develop and use effective learning strategies which can assure their high achievement. This study has interpreted the learning strategies used by girls and boys students; urban and rural schools students; public and private schools students; and high achieving and low achieving students.

The educational implications of the study are discussed under the sub-topic 'Implication', and further studies are suggested which are discussed on 'Areas for further study'.

Implications

In case of learning strategies, innumerable researches have been conducted in the international context (Chang, 2010). In the national context of Nepal, such research is limited. All of them are highly appreciable and meaningful in the modern period. But they do not represent the complete picture of the learning strategies used by secondary school students.

The study has analyzed the learning strategies used in studying mathematics by the secondary school students. This study can be used to provide secondary school teachers with the knowledge that students may approach learning in different ways. Knowing how students perceive teaching strategies help educators see their role from a different point of view objectively and understand the importance reflecting on as well as adjusting their teaching strategies. By getting the insight of students' strategies use, teacher may realize that it is important to teach various learning strategies according to specific situation and needs. Teachers need to use various teaching strategies and to help students in their learning difficulties, to develop their learning strategies and to use these strategies effectively and efficiently.

Students use different strategies for learning mathematics in various contexts, so it has direct implication for syllabus designing, material preparation, teacher training and learner training in the context of Nepal where students fear from mathematics. Though students use various strategies in learning mathematics, they may not be aware of the strategies and their effects. Raising awareness among students on what strategies they would employ and what strategies would be effective for them to learn mathematics, therefore, are important.

Effective learning requires students to take control over their learning process and know how, when and where to use various learning strategies. Similarly, teachers need to be aware of the strategies adopted by their students. This awareness allows teachers to design and implement their teaching strategies. This study, in the sense of mathematical learning, can be a valuable reference among teachers and students. However, even the mathematicians, curriculum designers, teacher trainers; learner trainers etc. also can apply it in different ways and for different purposes.

Reflecting on this research outcome, the educational implications of this study is drawn. So, this study can be one of the reference materials in the case of secondary mathematics education. The knowledge about students' preferred learning strategies can be used for the instructional design in secondary school education, especially mathematics education. Similarly, the perception of students in teachers' teaching strategies help the school teachers to rethink about their instructional design and establish relationship between their teaching strategies with students' preferred learning strategies. Likewise, awareness about different contributing factors for the formation of effective learning strategies helps all the stakeholders of mathematics education including curriculum designers, school administrators and mathematics teachers to design mathematics curriculum, classroom practices and instructional strategies.

Children acquire knowledge and skills, and develop an understanding of mathematics by using their prior knowledge and individual effort. School mathematics can be more meaningful when it is rooted in real life context and situation, and when children are given the opportunity to become actively involved in learning. Teachers and other adults play a very important role in providing children with rich and meaningful mathematical experiences.

The present study has derived implications for the institutions, teachers, and the students.

For the Institutions

1. Students' preferred learning strategies are to be considered from the beginning of mathematics curriculum to its design up to the implementation stage by stakeholders such as curriculum designers, school administrators and mathematics teachers. School administrators are expected to consider the preferences of students in order to provide a viable educational environment. Sufficient learning materials, creation of democratic learning environment, encourage students' participation in the learning process, and individual dealing with the students are therefore ways to promote their

learning strategies. Mathematics curriculum designers are expected to consider all the learning approaches that allow students to use their own preferred learning strategies in learning mathematics. Hence, an interactive mathematics classroom is derived to promote dialogue between teacher and students.

2. Nepalese students, mostly in rural settings, come from poor and uneducated family background and their opportunities and life experiences have been limited. Some families in rural communities do not even see the value of education. Moreover, the classrooms of Nepalese schools consist of students from multicultural background implying that mathematics curriculum and teaching system do not match their psychological needs, attitudes, and cultural expectations. It is therefore implicative that mathematics curriculum be designed as local discourse based on the Nepalese context, and the teachers are expected to be careful to design their teaching strategies according to the contextual realities. In this context, sharing of skills, experiences and knowledge among teachers of rural and urban setting can help to develop the quality of education and to interchange teaching strategies. Likewise, facilitation of mathematics learning is to be ensured through the use of technology to increase students' learning resources.

3. Teacher education institutions are expected to incorporate teaching and learning strategies in their training program for both the pre-service and in-service teachers. They are to be made aware about students' learning strategies and the ways to design their teaching strategies so as to match students' learning strategies.

For the Teachers

4. As mathematics teachers are expected to promote insightful approaches to learning through the creation of appropriate environment that students perceive as safe, supportive and helpful, they are to present opportunities for exploration, inquiry, and experimentation by posing problems to be solved. In other words, teachers are to instruct and guide the students properly according to the contents and process of learning; they are to have the knowledge and expertise about appropriate learning strategies and their thinking, knowledge, perceptions and beliefs can then be the major contributing factors for the empowerment or enablement of the students.
5. As teaching strategies and assessment methods employed by mathematics teachers are to be congruent with students' learning preferences, teachers' teaching strategies and students' learning strategies are to be matched to make the learning of students more meaningful. Therefore, the teachers are further expected to try to understand the learning strategies of different groups of students as reflected in their dealing with mathematical problems. Similarly, teachers can improve methodologies that take into consideration individual differences of students, and promote self-regulated learning. Teachers are to be aware of all the mathematics learning strategies and factors affecting them and prepare their lesson plans in accordance with them. As Green and Oxford (1995) state, "The more the teachers know about such factors, the more readily the teacher can come to grip with the nature of individual differences in classroom. Such knowledge is power- the power to plan lessons so that students with many different characteristics, including varied strategies, can receive what they need" (p. 292). By doing this, teachers have an opportunity to reflect on their teaching

styles and strategies and see if they need to make adjustments. It is therefore implicative that teachers address diversity of learning strategies in mathematics class as demonstrated by the students from different backgrounds.

6. Student-centered approach includes informal and effective teaching methods like discovery method, problem solving method, enquiry method, creative and critical method. Such methods can be used with individual touch of students to avoid them from parroting learning. The teacher is often a facilitator and is expected to be conscious in setting high expectations for the students for developing their confidence for the intended success. Building on what the students already know and focusing on structure and pace of learning experience makes learning both enjoyable and challenging. Developing passion for learning, making individuals as active partners in their learning, developing learning skills and personal qualities for better result can directly contribute to students' learning strategies.
7. The nine learning strategies discussed in this research can be useful in the classroom in two ways: altering teachers' and students' behaviors. Teachers' behavior can be altered by having the teacher design their lessons according to generative principles. It implies that teachers behave in a purposeful manner with the intent of directing or guiding students' cognition. Teachers' behavior can be altered in three ways. First, teacher provides the content in a form that promotes strategic processing, that is, the teacher provides illustrations to promote imagery, suggests a mnemonic for remembering some piece of information or provides a concept map to clarify chapter content; second, teacher guides students' thinking in planning assignments that require students to engage in strategic thinking, that is, the tasks in which students

engage are designed to make them use imagery, think of mnemonics, create a summary or concept map; and third, during the course of classroom activities, the teacher can prompt students to engage in strategic activities like creating a concept picture in the mind that will help them to remember.

Altering students' behavior means to teach them how to use strategies, when to use them and what they are for. Students' behavior can be altered by teaching them how to use strategies for improving their learning. Several methods of instruction like direct instruction, self–instruction, and reciprocal instruction can help students become more strategic. Direct instruction involves the teaching of strategies directly and explicitly. The teacher explains the strategies to the students, followed by a demonstration of how the strategy works to a guided practice with feedback. In this connection, self-instruction involves explanation, guided practice, independent practice, and thinks aloud process. Reciprocal teaching which is expected to make learning strategies active refers to a form of small group instruction in which teacher and students take turn explaining and modeling the strategies while trying to learn some content (Seifert, 1993).

8. High achieving students are more conscious learners and use content-specific learning strategies; they are interested, interactive, perceptive, humorous and pleasing. However, low achieving students are less interactive, embarrassed, feeling frustrated and performance avoiding. Teachers are expected to help change the low achieving students' motivational belief pattern to performance approach and preferably to mastery goal, and design the teaching strategies in a motivating way to self-regulate

learning and to use the learning strategies used by high achieving students to increase their performance level.

9. Mathematics students perform better when they are taught using goal-oriented and career-related instructions. It implies that students be exposed to goal-oriented and career-related learning to motivate them to use more effective learning strategies and to improve their achievement. It is, therefore, implicative that teachers discuss with the students about their future career and goal. It would be beneficial if the teachers share with the students about the success stories and the importance of mathematics in their lives.
10. The study implies that private school teachers are cooperative and encourage students to perform activities in peer groups by exposing them to in-class works and exercises, compared to the public school teachers who are indifferent towards students' participation. Similarly, private school teachers use teaching materials more than public school teachers; therefore, public school teachers are expected to be cooperative and facilitative in students' learning. Both types of school teachers are expected to use teaching materials, especially public school teachers are expected to use more teaching materials while teaching mathematics to the secondary students. In the same vein, teachers are expected to observe students' behavioural problems carefully and decide how to manage classroom addressing their behavioural problems that emerge from varied ability groups, sex, social, cultural, ethnic and economic background. It is also worthy to note that more interpersonal relationships help children to reduce anxiety and tension, increase self-esteem among the students,

reduce alienation and loneliness, and provide freedom to talk aloud and explore thoughts and ideas with one another by maintaining discipline in the classroom.

For the Students

11. As rehearsal, time and study management and peer learning are seen as the most effective learning strategies, the students can be benefited by combining these strategies to achieve high score in mathematics. It implies that students practise mathematics as much as possible giving sufficient time in a peaceful environment so that their concentration can retain in their practice. In classroom, they are expected to discuss and share with their teachers and peers with knowledge of all nine learning strategies and their use. It is therefore implicative that various learning strategies can be used according to the nature of the subject matter in mathematics learning.
12. As this study has shown that boy students use less peer learning and rehearsal than girls, and girls use time and study management less than boys, boys are expected to participate more in group activities and practice, and girls are to manage time and study environment to promote their learning outcome in mathematics.
13. Low achieving students have to be motivated to performance approach and preferably to mastery goal by using the learning strategies of high achieving students in order to increase their achievement level. This further suggests that low achieving students can greatly benefit from the application of learning strategies used by the high achievers.

Areas for Further Study

Based on the discussion and conclusions of the study, the following recommendations are made for further study.

1. The present study should be replicated among the secondary school students in other subjects. It would be beneficial to have other data that could be compared with the findings of this study.
2. Further study is suggested to compare and contrast the influence of one subject with another subject. The results would reveal whether there is a difference in use of learning strategies between content areas. A study like this would allow classroom teachers to better understand the learning differences and needs of individual students, especially as these needs relate to specific subject matter.
3. An extensive research is recommended to see which type of learning strategies helps which branch of mathematics like Algebra, Geometry, Arithmetic, Trigonometry, and Statistics etc.
4. An elaborated study should be conducted to find the relationship between teachers' teaching strategies and students' use of learning strategies.
5. Future research should investigate the actual teaching styles and strategies used by teachers or teaching styles and strategies perceived by students and teachers' supervisors. This would help to determine if learning strategy use of students is influenced by their perceptions of teaching styles and strategies. Moreover, it is possible that teachers' goal orientation and career-related instruction are rather influential. Performance goals of teachers may affect students differently than if the teachers were more focused on learning goals for the students.
6. This study is based on data/information retrieved from questionnaire, class observation and students' interview. Therefore, it would be better to have a study with interviews and reflections of teachers, parents, mathematicians,

educationists, planners and curriculum developers along with questionnaire, school records, class observation and students' interview.

7. Can students be taught the use of effective learning strategies? If yes, how? A detailed study is recommended about this.
8. An elaborated study is recommended regarding the contributing factors to the development and use of students' learning strategies. A study is needed about how to arrange those factors in a favourable way; and who are the responsible agents to supply those factors favourably.
9. This study has not included the equal number of public and private schools, and urban and rural schools. Therefore, a study is recommended with proportionate number of public schools and private schools, as well as the schools of urban and rural settings with equal number of students.
10. An extensive research is recommended to see the differences in the use of learning strategies by the students belonging to different castes, cultures and religions.
11. As the teachers were unaware about the strategies established by behaviourist, cognitivist and constructivist learning theories, and they used traditional method of teaching, this can be the subject of extensive study.

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Appendix 1.Questionnaire for Learning Strategies

Personal Information

Name……………………….. Date………………….

Gender………………………. Class………………….

Dear Students:

You will be asked to answer questions related to your use of learning strategies in Mathematics class. This is not a quiz or test so there are no right or wrong answers. Use the scale below each statement to answer the questions. If you think the statement is very true of you, circle 7; if a statement is not at all true of you, circle 1. If the statement is more or less true of you, choose the number between 1 and 7 that best describes you. Only I will see your individual responses, so please answer the questions as correctly as possible. Your score will be kept confidential.

Note: Circle the answer.

	Not at all True of me						Very true of Me
1. When I study the readings for this course, I outline the material to help me organize my thoughts.	1	2	3	4	5	6	7
2. When studying for this course, I often try to explain the material to a classmate or friend.	1	2	3	4	5	6	7
3. I usually study in a place where I can concentrate on my course work.	1	2	3	4	5	6	7
4. When reading for this course, I make up questions to help focus my reading.	1	2	3	4	5	6	7
5. I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do.	1	2	3	4	5	6	7

6. I often find myself questioning things I hear or read in this

course to decide if I find them convincing. 1 2 3 4 5 6 7

7. When I study for this class, I practice saying the material to myself over and over. 1 2 3 4 5 6 7

8. When I become confused about something I'm reading for this class, I go back and try to figure it out. 1 2 3 4 5 6 7

9. When I study for this course, I go through the readings and my class notes and try to find the most important ideas. 1 2 3 4 5 6 7

10. I make good use of my study time for this course. 1 2 3 4 5 6 7

11. If course readings are difficult to understand, I change the way I read the material. 1 2 3 4 5 6 7

12. I try to work with other students from this class to complete the course assignments. 1 2 3 4 5 6 7

13. When studying for this course, I read my class notes and the course readings over and over again. 1 2 3 4 5 6 7

14. When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence. 1 2 3 4 5 6 7

15. I work hard to do well in this class even if I don't like what we are doing. 1 2 3 4 5 6 7

16. I make simple charts, diagrams, or tables to help me organize course material. 1 2 3 4 5 6 7

17. When studying for this course, I often set aside time to discuss course material with a group of students from the class. 1 2 3 4 5 6 7

18. I treat the course material as a starting point and try to develop my own ideas about it. 1 2 3 4 5 6 7

19. When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions. 1 2 3 4 5 6 7

20. Before I study new course material thoroughly, I often skim it to see how it is organized. 1 2 3 4 5 6 7

21. I ask myself questions to make sure I understand the material I have been studying in this class. 1 2 3 4 5 6 7
22. I try to change the way I study in order to fit the course requirements and the instructor's teaching style. 1 2 3 4 5 6 7
23. I ask the instructor to clarify concepts I don't understand well. 1 2 3 4 5 6 7
24. I memorize key words to remind me of important concepts in this class. 1 2 3 4 5 6 7
25. I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for this course. 1 2 3 4 5 6 7
26. I try to relate ideas in this subject to those in other courses whenever possible. 1 2 3 4 5 6 7
28. When reading for this class, I try to relate the material to what I already know. 1 2 3 4 5 6 7
29. I have a regular place set aside for studying. 1 2 3 4 5 6 7
30. I try to play around with ideas of my own related to what I am learning in this course. 1 2 3 4 5 6 7
31. When I study for this course, I write brief summaries of the main ideas from the readings and my class notes. 1 2 3 4 5 6 7
32. When I can't understand the material in this course, I ask another student in this class for help. 1 2 3 4 5 6 7
33. I try to understand the material in this class by making connections between the readings and the concepts from the lectures. 1 2 3 4 5 6 7
34. I make sure that I keep up with the weekly readings and assignments for this course. 1 2 3 4 5 6 7
35. Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives. 1 2 3 4 5 6 7

36. I make lists of important items for this course and memorize the

lists. 1 2 3 4 5 6 7

37. I attend this class regularly. 1 2 3 4 5 6 7

38. Even when course materials are dull and uninteresting, I manage to keep working until I finish. 1 2 3 4 5 6 7

39. I try to identify students in this class whom I can ask for help if necessary. 1 2 3 4 5 6 7

40. When studying for this course I try to determine which concepts I don't understand well. 1 2 3 4 5 6 7

41. When I study for this class, I set goals for myself in order to direct my activities in each study period. 1 2 3 4 5 6 7

42. If I get confused taking notes in class, I make sure I sort it out afterwards. 1 2 3 4 5 6 7

43. I try to apply ideas from course readings in other class activities such as lecture and discussion. 1 2 3 4 5 6 7

Appendix 2. Questionnaire for Learning Strategies

(ADAPTED NEPALI VERSION)

सिकाई उत्प्रेरक रणनीतिहरुको प्रश्नावली

व्यक्तिगत विवरणः

नामः मितिः

लिङ्गः कक्षाः

विद्यालयको नामः जिल्लाः

विद्यालयको प्रकारः सामुदायिक / संस्थागत सदरमुकामः हो/होइन

नगरपालिकाः हो/होइन

प्रिय विद्यार्थीहरु,

यस प्रश्नावलीमा तपाईंले गणित अध्ययनमा कक्षामा प्रयोग गर्नुहुने तरिकाहरु सम्बन्धित प्रश्नहरु गरिनेछ। यो कुनै परीक्षा या हाजिर जवाफको प्रश्न नभएकोले साँचो या झुटो जे उत्तर दिएपनि मतलब हुने छैन। प्रत्येक उत्तरको तहमा चिन्ह लगाउनुपर्छ। तपाईंलाई धेरै मात्रामा सत्य / साँचो लागेमा अंक ७ मा घेरा लगनउनुहोस र यदि तपाईंलाई धेरै मात्रामा असत्य /झुटो लागेमा अंक १ मा घेरा लगाउनुहोस्। यदि तपाईंलाई धेर थोर सत्य लागेमा अंक १ र ७ को विचमा उयुक्त नम्बरमा घेरा लगाउनुहोस्। म तपाईंहरुको व्यक्तिगत प्रतिक्रियाहरुलाई गोप्य राखी सो को अध्ययन गर्नेछु। तसर्थ यथासम्भव सही उत्तर दिनुहोला।

मलाई धेरै मात्रामा झुटो लाग्छ — मलाई धेरै मात्रामा सत्य लाग्छ

१. गणित पढ्दा मेरा विचारहरुलाई संगठीत गर्न आवश्यक सामग्रीहरुको सहयोग लिन्छु। १ २ ३ ४ ५ ६ ७

२. गणित विषय पढ्दा म प्राय

	मेरा साथीहरुका/सहपाठीहरुका लागि बुझ्नकठिन हुने पाठ्यवस्तुहरुको व्याख्या गरिदिन कोसिस गर्छु।	१	२	३	४	५	६	७
३.	म सामान्यतः ध्यान केन्द्रित गर्न सक्ने एकान्त स्थानमा पढ्न बस्छु।	१	२	३	४	५	६	७
४.	जब म यो विषय पढ्छु , म आफ्नो अध्ययनमा केन्द्रित हुन आफैँ प्रश्नहरु बनाउँछु।	१	२	३	४	५	६	७
५.	यो विषय पढ्दा मलाई अल्छी/ दिग्दार लाग्छ र पटक पटक कक्षा पूरा हुनु अगाडि नै कक्षा त्याग्छु।	१	२	३	४	५	६	७
६.	म आफैलाई यो विषय सुन्न , पढ्न र बुझ्नलाई पटक पटक आफैँसँग प्राय प्रश्नहरु गर्छु।	१	२	३	४	५	६	७
७.	जब म यो विषय अध्ययन गर्छु पाठलाई वाचन गर्दै पटक पटक अभ्यास गर्छु।	१	२	३	४	५	६	७
८.	जब म यो विषय पढ्दा दोधारमा पर्छु, पुनः दोहोऱ्याई बुझ्न खोज्छु।	१	२	३	४	५	६	७
९.	जब म गणित अध्ययन गर्छु म पाठ्य सामाग्रीहरु जस्तैः कक्षा नोटहरु हेरी महत्वपूर्ण विचार, जुक्ति निकाल्न खोज्छु।	१	२	३	४	५	६	७
१०.	म यो विषय अध्ययनको लागि राम्रो समयको सदुपयोग गर्छु।	१	२	३	४	५	६	७
११.	पढ्ने विषय बुझ्न कठीन भएमा म पढ्ने तरिका परिवर्तन गर्छु।	१	२	३	४	५	६	७
१२.	विषयगत कार्यहरु सम्पन्न/ पूरा गर्न म कक्षाका अन्य साथीहरु सँग कार्य गर्छु।	१	२	३	४	५	६	७
१३.	यो विषय पढ्दा आफ्नो कक्षा नोट र कोर्श पटक पटक पढ्छु।	१	२	३	४	५	६	७

१४. जब कुनै सिद्धान्त, सुत्र, व्याख्या र निश्कर्ष कक्षामा प्रस्तुत गरिन्छ वा पढ्दा निस्कन्छ, म त्यसको राम्रो प्रयोग तथा प्रमाणका आधारमा निर्णय गर्न खोज्छु । १ २ ३ ४ ५ ६ ७

१५. हामी कहिलेकाहि के गरिरहेका छौँ भन्ने थाहा नहुँदानहुदै पनि यो कक्षामा राम्रो गर्नको लागि म मेहेनेत गर्छु । १ २ ३ ४ ५ ६ ७

१६. पाठ्य सामग्रीको व्यवस्थापन र संयोजन गर्नलाई म साधारण चार्ट, चित्र वा तालिका बनाउँछु । १ २ ३ ४ ५ ६ ७

१७. यो विषय अध्ययन गर्दा म पटक पटक कक्षाका साथीहरु/ समुहसँग छलफल गर्न समय मिलाउँछु । १ २ ३ ४ ५ ६ ७

१८. यो विषयका पाठ्यवस्तुहरुलाई मुल आधार बनाई म आफ्नो विचार र चिन्तन विकशित गर्न सुरु गर्छु । १ २ ३ ४ ५ ६ ७

१९. जब म यो विषय अध्ययन गर्न लाग्छु, म सबै स्रोतहरु जस्तैः शिक्षकको व्याख्या, छलफल र पढेका सामग्रीहरुबाट सूचना संकलन गर्छु । १ २ ३ ४ ५ ६ ७

२०. नयाँ विषयवस्तु पढ्नु अघि ती सामग्रीहरु कसरी संगठित गरिएको छ भनी प्राय सरसर्ती हेर्छु । १ २ ३ ४ ५ ६ ७

२१. कक्षामा प्रस्तुत विषयवस्तुहरु मैले बुझेँ या बुझिन भनी म आफैलाई प्रश्न गर्छु । १ २ ३ ४ ५ ६ ७

२२. पाठ्यवस्तुको र शिक्षकको शिक्षण सिकाई क्रियाकलापको उपयुत्ताको लागि म स्वयम परिर्वतन हुन प्रयत्न गर्छु । १ २ ३ ४ ५ ६ ७

२३. नबुझेको धारणा प्रष्ट हुन म शिक्षकलाई सोध्छु । १ २ ३ ४ ५ ६ ७

२४. महत्वपूर्ण धाराणाहरु सम्झिन म मुख्य शब्दहरु सम्झन्छु । १ २ ३ ४ ५ ६ ७

२५. म कुनै पाठ पढ्न मात्र भन्दा मैले त्यसबाट के सिक्न सक्छु भनी विचार गर्न कोशिस गर्छु । १ २ ३ ४ ५ ६ ७

२६.	सम्भव भए सम्म म यो विषय पढ्दा अन्य विषयका विचारहरुलाई सम्बन्धित गराउन कोशिस गर्छु ।	१	२	३	४	५	६	७
२७.	जब म यो विषय पढ्छु, म आफ्नो कक्षाको नोट हेर्दै महत्वपूर्ण धारणाहरुको खाका बनाउँछु ।	१	२	३	४	५	६	७
२८.	जब म यो विषय अध्ययन गर्छु मैले पहिल्यै अध्ययन गरेको विषयवस्तुसँग सम्बन्धित गर्न कोसिस गर्छु ।	१	२	३	४	५	६	७
२९.	अध्ययनको लागि मसँग एक नियमित बस्ने ठाँउ छ ।	१	२	३	४	५	६	७
३०.	यो विषय अध्ययन गर्दा मैले सिक्न खोजेको कुरालाई मनमनै खेलाउँछु ।	१	२	३	४	५	६	७
३१.	यो विषय अध्ययन गर्दा म कक्षा नोट तथा पढेको विषयवस्तुको मुख्य मुख्य अंशको सारांश लेख्छु ।	१	२	३	४	५	६	७
३२.	यो विषयका पाठ्यवस्तुहरु जब म बुझ्दिन म मेरा कक्षाका साथीहरुसँग सहयोगको लागि अनुरोध गर्छु ।	१	२	३	४	५	६	७
३३.	पढेको विषयवस्तु र शिक्षकको व्याख्याको सम्बन्ध स्थापित गरी म विषयवस्तु बुझ्न कोशिस गर्दछु ।	१	२	३	४	५	६	७
३४.	यो विषयको पढ्ने लेख्ने कार्य हप्तै पिच्छे गर्नु पर्नेमा म निश्चित छु ।	१	२	३	४	५	६	७
३५.	जब म कक्षामा कुनै निर्क्यौल या निष्कर्ष सुन्छु, वा पढ्छु म जहिले पनि सम्बन्धित सम्भाव्य विकल्पहरु खोज्छु ।	१	२	३	४	५	६	७
३६.	म यो पाठको महत्वपूर्ण विषयवस्तुहरुको सूची बनाई सम्झने गर्छु ।	१	२	३	४	५	६	७

३७.	म यो कक्षामा नियमित उपस्थित हुन्छु ।	१	२	३	४	५	६	७
३८.	विषयवस्तु आकर्षक नभइ दिक्क लाग्दो भएतापनि म पढ्ने काम नसकिएसम्म लागि रहन्छु ।	१	२	३	४	५	६	७
३९.	मलाई आवश्यक पर्दा कक्षामा कसले सहयोग गर्नसक्छ भनी साथीहरु मध्ये सहयोगी साथी चिन्न कोशिसगर्छु ।	१	२	३	४	५	६	७
४०.	यो विषय अध्ययन गर्दा कुन धारणा मैले राम्रो सँग बुझ्दिन् म त्यो धारणा पत्ता लगाउन कोसिस गर्छु ।	१	२	३	४	५	६	७
४१.	यो विषय कक्षामा पढ्दा प्रत्येक पिरियडमा आफ्नो क्रियाकलाप निर्देशित गर्न म लक्ष्य निर्धारण गर्छु ।	१	२	३	४	५	६	७
४२.	कक्षामा नोट लेख्दा झुक्किएमा म पुनः सच्याउँछु ।	१	२	३	४	५	६	७
४३.	अन्य विषयको कक्षा कियाकलापमा भएको व्याख्या तथा छलफलमा पनि यस विषयका धारणाहरु प्रयोग गर्न कोसिस गर्छु ।	१	२	३	४	५	६	७

Appendix 3.Interview Guidelines for Students (Translated version of Nepali language)

Personal Information

Name……………………….. Date………………….

School…………………………... Gender…………………

Class………………….

Students' Learning Strategies

1. Do you explain material with friends? If yes how?
2. What type of study place do you select for concentration or the course work?
3. How often do you ask question about the things you hear or read in this course to convince yourself?
4. When you study this course how do you find the most important ideas?
5. When you became confused about something, how do you try to figure out?
6. How much time do you use for the study of mathematics?
7. If course reading are difficult to understand what alternative method do you use to learn?
8. Do you work with other students to complete the course assignments? If yes with whom?
9. How do you study this course?
10. What do you do when a theory, interpretation or conclusion is presented in class?
11. Why do you think some students perform better than others?
12. What do you do to organize your course materials?
13. When studying for this course, how often do you discuss course material with a group of students from the class?
14. When you study mathematics from which sources do you collect information ?
15. To see how it is organized, how do you skim new course materials thoroughly?
16. How do you find out that you have understood the materials or not?
17. How do you adjust your learning strategies to fit the course requirements and instructor's teaching style?
18. How often do you ask the instructor to clarify the concepts you don't understand?

19. To remind you the important concepts in the class do you memorize key words? What are the ways do you use to memorize them?
20. How often do you relate ideas in this course from other subjects?
21. When reading for this class what do you relate?
22. How do you relate to what you are learning in this course with the skills you have learned in previous classes?
23. When you study this course how often do you take note?
24. What do you do when you don't understand the material in this course?
25. Do you do weekly reading and assignments for this course? If yes how often?
26. Wherever you read or hear and assertion or conclusion in this class, do you think possible alternatives?
27. How do you ask necessary help in the class?
28. When you study for this class do you set goals to direct your activities in class? If yes how?
29. If you get confused taking notes in class what do you do?
30. With whom do you ask for help to solve mathematical problems at home?

Students' Perception on Teacher's Teaching Strategies

1. What should your parents and teachers do for you to score high in mathematics?
2. How does your teacher teach you mathematics?
3. What do you do when a theory, interpretation or conclusion is presented in class?
4. How do you adjust your learning strategies to fit the course requirements and instructor's teaching style?
5. How often does your teacher ask you questions?
6. How often does your teacher involve you in the interaction in class?
7. What does your teacher do to manage discipline in the class?
8. What types of teaching materials does your teacher use to teach mathematics?
9. What ways does your teacher suggest you to learn mathematics?
10. Does your teacher asks questions to all the students equally or focuses on some students only?

11. How often does your teacher talk with you about your interest, hobby or personal life?

Contributing Factors for the Formation of Learning Strategies

1. How do you feel is mathematics? Difficult or easy? Why?
2. What should your parents and teachers do for you to score high in mathematics?
3. Why do you think some students perform better than others?
4. What types of problems arise in class while learning mathematics?
5. When you study mathematics from which sources do you collect information ?
6. How often do you relate ideas in this course from other subjects?
7. How often do you become absent from the class?
8. With whom do you ask for help to solve mathematical problems at home?
9. What is your future aim? What do you want to become in future?

Classroom Practices for Promoting Learning Strategies

1. What should your parents and teachers do for you to score high in mathematics?
2. Before you finish which was planned to do you feel so lazy or bored and quit the class?
3. How often do you ask question about the things you hear or read in this course to convince yourself?
4. How does your teacher teach you mathematics?
5. When you study this course how do you find the most important ideas?
6. How do you study this course?
7. What do you do to organize your course materials?
8. When studying for this course, how often do you discuss course material with a group of students from the class?
9. What types of problems arise in class while learning mathematics?
10. How do you adjust your learning strategies to fit the course requirements and instructor's teaching style?
11. How often do you ask the instructor to clarify the concepts you don't understand?
12. What do you do when you don't understand the material in this course?

13. How do you try to understand material in the class?
14. How often do you become absent from the class?
15. How do you ask necessary help in the class?
16. When you study for this class do you set goals to direct your activities in class? If yes how?
17. If you get confused taking notes in class what do you do?
18. How often does your teacher involve you in the interaction in class?
19. What types of teaching materials does your teacher use to teach mathematics?
20. Does your teacher asks questions to all the students equally or focuses on some students only?

Appendix 4. Class Observed

Teacher:
School:
Date:

Observation Checklist for Learning Strategies

Learning strategies	Not At all	Moderately so			Very much so
1. Students making up question	1	2	3	4	5
2. Students reflecting on learning difficulties and misconceptions	1	2	3	4	5
3. Students reviewing and classifying (Interviewing each other, drawing concept maps)	1	2	3	4	5
4. Students constructing or building on each other's idea	1	2	3	4	5
5. Student's devising and using making schemes	1	2	3	4	5
6. Students diagnosing errors critically	1	2	3	4	5
7. Students assessing themselves against statement of attainment	1	2	3	4	5
8. Students predicting their own performance	1	2	3	4	5
9. Students teaching students	1	2	3	4	5
10. Students writing meaning for different mathematical statements	1	2	3	4	5
11. Students use terminology and definitions	1	2	3	4	5
12. Students conducting mini-debts	1	2	3	4	5
13. Students conduction small group discussions	1	2	3	4	5
14. Students observing students	1	2	3	4	5
15. Students describing what learning feels like	1	2	3	4	5
Total Score					

Signature of Observer

Source: Shell Centre for Mathematics Education, University of Nottingham, UK (cited in Upadhyaya & et. al, 2010, p.272)

Appendix 5. An Observation Guideline for School and Classroom

A. General Observation

The school and teaching-classrooms were minutely observed with respect to the following variables:

1. School environment and available resources, size of classroom, No. of teachers, No. of students, co-curricular/extra activities;
2. The availability of trained, experience, qualification, teaching license of male/female teachers;
3. Classroom setting, furniture, capacity of seats, student sitting pattern 9by gender, caste, religion, intelligence, friendship);
4. The preparation of teachers for lesson plan, mental plan, used methods, teaching/learning materials;
5. The interaction (inter and intra) of groups, collaboration, comfortability, participation, reward/punishment system, learning psychology, discrimination of any type confidence/self-esteem of the students;
6. The provision of revision of lesson, tests, types of tests, homework, class works, individual works, direct questions, use of blackboard/whiteboard, cultural activities or impacts, seasonal effects, languages, individual differences, special students, special treatments, motivations, participation in extracurricular activities, participation on the basis of intelligence, gender, caste, social behavior etc.

B. Observation of classroom practices

The classroom management and teaching/learning practices were observed on the basis of eight fundamental perspectives with their further categories:

Right of the students

Freedom (interaction, self initiation, flow of ideas, social relations); Justice (dealing student as a person, as object); Equality (opportunity, power sharing, reward, punishment, giving information); Autonomous class;

Participation of the student

ask question relevantly, answer teacher’s question, participate in the classroom, follow of directions, learning by doing activity, solving related problem, other activities

Interaction

Sharing view, sharing interest, sharing problems with peers and teachers, others

Facilitation and Self-Regulation

Making easy in concept by teacher, cooperation, decision making, shared responsibility, accountability, forethought, volitional control, self-reflection, achievement motivation, independent learning strategies

Equal opportunity and Individual Difference

In questioning, material using, giving opportunities (according to individual difference), in other learning process

Democratic Method of Teaching

Play-way method, heuristic method, discovery method, group discussion method, experimental, demonstration, problem solving and others

Social Activities: Social, cultural, co-curricular, others

Preparation of Learning Materials

The democratic practices with respect to the preparation of the content of curriculum, textbooks, examples, note-taking, diagrams, developing concept maps etc.

Appendix 6. List of Sample Schools

S. N.	Name of the School	Address	District	School Type	Location
1.	Janata higher Secondary School	Bagdula	Pyuthan	Public	Rural
2.	Mahendra Namuna H. S. School	Khalanga	Pyuthan	Public	Urban
3.	Green Valley E. School	Dadeldhura	Dadeldhura	Private	Urban
4.	Shiva Parbati High School	Katal	Dadeldhura	Public	Rural
5.	Sharada H. S. School	Dhangadhi	Kailali	Public	Urban
6.	Jyeces Everest B. School	Dhangadhi	Kailali	Private	Urban
7.	Jana Higher S. School	Surkhet	Surkhet	Public	Urban
8.	Adarsharaj M. H. S. School	Surkhet	Surkhet	Private	Urban
9.	Thuti Pipal H. School	Thutipipal	Rupandehi	Public	Rural
10.	Bhairahawa Namuna H. S. School	Bhairahawa	Rupandehi	Public	Urban
11.	Gandaki B. School	Lamachaur	Kaski	Private	Urban
12.	Bindhabasini H. S. School	Batulechaur	Kaski	Public	Urban
13.	Neelkantha H. S. School	Dhadingbesi	Dhading	Public	Urban
14.	Deurali H. School	Sasaha	Dhading	Public	Rural
15.	Rasuwa H. S. School	Dhunche	Rasuwa	Public	Urban
16.	Highland B. School	Dhunche	Rasuwa	Private	Urban
17.	Garma H. School	Garma	Solukhumbu	Public	Rural
18.	Janajagriti H. S. School	Salleri	Solukhumbu	Public	Urban
19.	Little Flowers H. School	Birtamod	Jhapa	Private	Rural
20	Mahendra Ratna H. S. School	Birtabazar	Jhapa	Public	Rural
21.	Amar H. S. School	Barbote	Ilam	Public	Rural
22.	Aadarsha H. S. School	Ilam	Ilam	Public	Urban
23.	Geetamata H. S. School	Bijeshwori	Kathmandu	Public	Urban
24.	The Excelsor School	Swoyambhu, Halchowk	Kathmandu	Private	Urban

Appendix 7. Item Wise Item-total Statistics of the 43 Items Used

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Item No. 1	218.62	718.33	**-0.04**	0.86
Item No. 2	218.93	689.26	**0.41**	0.85
Item No. 3	219.11	679.23	**0.43**	0.85
Item No. 4	221.04	668.58	**0.41**	0.85
Item No. 5	218.16	707.45	**0.11**	0.85
Item No. 6	219.36	675.72	**0.45**	0.85
Item No. 7	220.18	659.68	**0.57**	0.84
Item No. 8	220.44	778.72	**-0.46**	0.88
Item No. 9	218.66	702.41	**0.23**	0.85
Item No. 10	218.70	684.86	**0.44**	0.85
Item No. 11	219.11	684.14	**0.39**	0.85
Item No. 12	218.98	706.53	**0.12**	0.85
Item No. 13	219.30	669.86	**0.52**	0.85
Item No. 14	219.32	679.29	**0.51**	0.85
Item No. 15	219.00	690.82	**0.25**	0.85
Item No. 16	220.60	661.02	**0.52**	0.84
Item No. 17	219.86	660.72	**0.53**	0.84
Item No. 18	220.78	676.26	**0.41**	0.85
Item No. 19	219.44	688.34	**0.37**	0.85
Item No. 20	219.52	680.32	**0.41**	0.85
Item No. 21	219.12	677.04	**0.47**	0.85
Item No. 22	219.62	701.22	**0.14**	0.85
Item No. 23	218.88	665.06	**0.55**	0.84
Item No. 24	218.76	682.94	**0.45**	0.85
Item No. 25	219.00	677.78	**0.52**	0.85
Item No. 26	220.18	692.52	**0.24**	0.85
Item No. 27	219.65	681.76	**0.32**	0.85
Item No. 28	219.75	679.28	**0.43**	0.85
Item No. 29	219.62	698.51	**0.12**	0.86
Item No. 30	219.74	690.20	**0.25**	0.85
Item No. 31	220.70	662.34	**0.46**	0.85
Item No. 32	218.54	712.63	**0.05**	0.85
Item No. 33	218.92	680.36	**0.56**	0.85

Item No. 34	220.20	676.23	**0.33**	0.85
Item No. 35	220.51	675.30	**0.42**	0.85
Item No. 36	219.69	675.73	**0.39**	0.85
Item No. 37	218.07	711.08	**0.10**	0.85
Item No. 38	219.25	691.30	**0.25**	0.85
Item No. 39	218.99	704.94	**0.11**	0.85
Item No. 40	218.95	679.03	**0.54**	0.85
Item No. 41	219.14	675.86	**0.52**	0.85
Item No. 42	218.08	703.05	**0.28**	0.85
Item No. 43	219.41	681.33	**0.39**	0.85

Appendix 8. Item Total Statistics of All the Items of the Observation

Items	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
QN_1	222.70	884.53	**0.15**	0.89
QN_2	223.37	869.82	0.30	0.89
QN_3	223.30	867.61	0.29	0.89
QN_4	224.73	854.69	0.35	0.89
QN_5	222.41	884.39	**0.13**	0.89
QN_6	223.59	855.90	0.43	0.88
QN_7	223.91	859.41	0.33	0.89
QN_8	222.81	869.24	0.27	0.89
QN_9	223.13	857.49	0.45	0.88
QN_10	223.00	855.16	0.51	0.88
QN_11	223.49	858.08	0.28	0.89
QN_12	223.54	871.44	0.22	0.89
QN_13	223.62	852.48	0.45	0.88
QN_14	223.57	858.16	0.43	0.89
QN_15	223.50	868.20	0.20	0.89
QN_16	224.47	845.32	0.46	0.88
QN_17	224.25	844.48	0.45	0.88
QN_18	224.46	846.22	0.35	0.89
QN_19	223.59	845.61	0.32	0.89
QN_20	223.96	850.32	0.42	0.88
QN_21	223.46	855.54	0.41	0.89
QN_22	223.51	863.94	0.35	0.89
QN_23	222.84	858.23	0.46	0.88
QN_24	223.46	852.08	0.48	0.88
QN_25	223.31	861.32	0.42	0.89
QN_26	224.39	859.68	0.35	0.89
QN_27	223.88	841.33	0.54	0.88
QN_28	223.78	855.71	0.46	0.88
QN_29	224.11	858.69	0.27	0.89
QN_30	223.52	858.95	0.40	0.89
QN_31	224.51	837.91	0.49	0.88
QN_32	222.80	866.93	0.19	0.89
QN_33	223.42	854.44	0.52	0.88

QN_34	224.11	837.91	0.50	0.88
QN_35	224.22	843.51	0.51	0.88
QN_36	223.81	844.24	0.51	0.88
QN_37	222.57	879.13	0.25	0.89
QN_38	223.36	860.43	0.38	0.89
QN_39	222.95	864.19	0.39	0.89
QN_40	223.33	851.12	0.53	0.88
QN_41	223.87	855.86	0.43	0.88
QN_42	222.53	868.38	0.40	0.89
QN_43	223.75	859.79	0.37	0.89

Appendix 9. Learning Strategies

A. Cognitive strategies:

i) Rehearsal: It refers to students' use of strategies to recall and repeat learning material.

ii) Elaboration: It includes summarizing information and putting ideas into one's own words.

iii) Organization: It concerns students' use of strategies to make connections across learning experiences

iv) Critical thinking: It refers to how learners question or analyze statements and concepts learned in class.

v) Metacognition: It concerns how students set learning goals and monitor/regulate the learning process.

B. Resource management strategies:

i) Time and Study Management: It refers to strategies students use to manage their time and learning environments.

ii) Effort Management: It refers to students' commitment to achieve their learning goals even when there are difficulties.

iii) Peer Learning: It includes strategies students use to work with their friends and classmates.

iv) Help-seeking: It involves how students seek assistance from their teachers and classmates in the learning process