Chapter -I

INTRODUCTION

Nepal is surrounded by two giant countries China and India: China lies in north and India lies in East, West and South. Although, it is a multicultural, multi religious, multi-ethnics, and biodiversity republic country, it has unity in diversity which is its real beauty. Mt. Everest; the highest peak of the world, Lumbini: birthplace of Lord Buddha and one-horn-rhino enhance its beauty.

Due to the cultural, geographical and religious attachments, Nepalese education system was highly reflection of the education of South-East Asia. The history of mathematics teaching in Nepal initiated with "*Gurukula*" in ancient period (Pandit, 2011). *The Gurukula* education system continued for many years and there were no formal schools as we have today's. In this education system in terms of *Jyotisha Shastra*, basic mathematics courses had been taught (Pant S. R., 2004).Teachers teachings *Jyotisha* were popular mathematics book written in Sanskrita like *Siddhant Siromani* of Bhaskaracharya(II).

We can't get systematic history of Nepalese education system. Beside this, *Sanskrita school* was established in 1877 A.D. and *Sidhanta Siromani, Lilavati, Bhaswati, Bij-Ganita* referred as textbook of those schools (Pant S. R., 2004). Schooling for general people began only after 1951 A.D. when a people movement ended the autocratic *Rana Regime* (1845-1950) and initiated a democratic system. Though, Durbar High School was established as early as 1853 A.D., it was only for the children of Rana Family (Wikipedia, 2014). This school was the first formal school in the history of education in Nepal and mathematics was taught at that school in English medium.

In 1885 A. D., during the Regime of Bir Shamsher, Durbar High School was opened for the public. At that time, Durbar High School was affiliated to the Calcutta University of India till 1980 A.D. and later on to Patna University till 1932 A. D. Nepalese students could not take metric examination in Nepali language till 1893 A.D. However, Patna University agreed to set up examination in Nepali Language if ample number of books could be found in Nepali language with Nepalese curriculum. This declaration of Patna University opened the door of writing mathematical books in Nepali language both in home and away (India). Thus catching this line Arithmetic of G. P. Pradhan, '*Ganitq Siksha'* edited by Naib Subba Pandit Rammani (*Aa. Di.)* published under the authority of Government of Nepal, '*Wyokta Chandrika'* of Gopal Dutta Pade, '*Ganita Sagar'* of Ganga Prasad Shrestha and *'Vichitra Ganita'* of Bramha Lal Shrestha had been written mathematics book in Nepali language.

It is found that some books translated in Nepali language in second half of the nineteenth century and various schools had followed those books as textbook, among them, Arithmetic of Narendra Mani Acharya that was translation of arithmetic of Jadav Chandra Chakravarti. Similarly, "*Nepali Arithmetic*" published by *Nepal Bhasha Prakasini Samiti* and *Saral Anka Ganita* of Bekhalal's were the textbook in the schools during the time of ruling Prime Minister Shree Chandra Samser in Nepal.

Beside this, in 1877 A.D., *Sanskrita School* was first established and basic mathematics courses had been taught. However, there were no mathematics books written in Nepal. Nepali Students in those days used to study renowned books on mathematics like *Siddhanta Siromani* of Bhaskaracharya (II), *Bhaswati, Lilavati, Algebra, Geometry* (Pant S. R., 2008). It is found that those are abstract books in mathematics so Nepalese scalars started to taught Arithmetic of Jadav Chandra Chakravarti which is mainly based on Lilavati (Pant et al., 2006). After that only

students of high level used to read Lilavati for more knowledge in mathematics. Although, teachers used to teach *Bhaswati, Lilavati (Paati mathematics),* Algebra, Geometry. Moreover, *Lekha, Arithmetic, Nepali Shrestha* and *Auntha* were taught after the establishment of *Shrestha Pathsalas* in 1906 A. D. (Pandit, 2011).

In Nepalese Mathematical development in Nepal Shripati, Hlayutha Bhatta, Satananda, Dharmaparibartan, Laxmi Pati Pade, Gopal Pade, Bramha Lal Shrestha, Ganga Prasad Shrestha, Nuru Dutta Pade, Tikaram Marasini, Chandrakala Devi Dhananjaye, Nay Raj Pant etc. had provided valuable contribution (Acharya & Pant, 2011). Nay Raj Pant took leadership role to study about Nepali mathematics history (Acharya E. R., 2011) then, S. R. Pant, D. R. Pant, M. P. Upadhayay, R. M Shrestha, M. B. Shrestha, K Jha, B. H. Subedi, E. R. Acharya, etc. discussed in history of Nepalese mathematics continuously. Similarly, Nepal Mathematics Society, Council for Mathematics Education, Nepal Mathematics Centre, Central Department of Mathematics Education T. U., Department of Mathematics K. U., etc. were established in the field of Mathematics and conducting the various programs like seminar, workshop, conference, and journals publication related to Nepalese mathematics history. Many institutions and persons are involved in the detection of the history of Nepalese Mathematics but it is not sufficient. Among Nepalese mathematicians, Bramha Lal Shrestha wrote the books named ‘'Vichitra Ganita’ part I’ and ‘Vichitra Ganita’ part II’ around 100 years ago but only ‘'Vichitra Ganita’ part II’ is available nowadays.

Background of the Study

Before 1853, or before the modern period of Nepalese education, Nepalese education and intellectual systems was influencing from religious system (Shrestha M. B., 2013). Furthermore, Shrestha presented his disagreement on Mathematics was

essentially developed in Europe. He showed lots of evidence on the role of India and south Asian countries on the development of Mathematics in ancient civilization to till now. According to Philosophy of Mathematics (Shrestha M. B., 2013) although the almost 3000 years old Vedas are mostly devoted to describing Gods and Goddess, it represents ancient civilization as well as shows the origin of mathematics in such areas like economic policy, algebra, geometry, astronomy and so on. *Sulva Sutra* was developed in order to systematize geometrical knowledge that was developed from Hindu practices needed in making *Bedi* and fire places (*Agnikunda*) (Boyer, 1968 ; Cooke, 2005 ; Das, 1927; Dutta, 1932).

Sulva Sutra was developed between 800 BCE to 600 BCE in course of the development of mathematics. Although the Pythagorean Theorem was found out in the fifth century, this has been discussed in detail in Sulva Sutra, Similarly, the following points have been made in Sulva Sutra.

- It contains discussion and non-axiomatic demonstrations of cases of the Pythagorean Theorem and Pythagorean triples (Boyer, 1968).
- It gives the construction of geometric shapes such as squares and rectangles.
- It presents approximate geometric area-preserving transformations from one geometric shape to another (Datta & Singh, 1938).
- Estimation of the square root of 2 (Cooke, 2005).

Shrestha further wrote that although the credit is given to the seventeenth century scientists Newton and Leibniz in developing calculus, it has been found that the development of fundamental ideas in calculus such as value of Pie(π) , expansion of infinite terms of trigonometry was in existence before the second century in Kerala (India). This shows the contribution of Hindu civilization in mathematics. When

talking about Hindu mathematics, *Mahabir's Jainism* has also played an important role in the sixth century. Similarly, great mathematician Aryabhata systematized the then mathematical practices and created *Aryabhtiya* in fifth century. Hindu civilization created great mathematical ideas and this has been evidenced with the creation of Brahamagupta's *'Bramha-Sphuta-Siddhanta'* in eighth century, BhaskaracharyaII's *Lilavati* in the eleventh century, Nepali Scholar Sripati's (1019 - 1066) *Dhruva-manasa, Siddhanta-Sekhara* eleventh century.

Jha, Adhikary, and Pant agreed that about 125 year ago there were no mathematics books written in Nepali (Pant, et al., 2006). Nepali students in those days used to go to Kashi (Banaras) to learn Sanskrita. They were taught famous books on mathematics like Lilavati, Siddhant Siromani of BhaskaracharyaII, etc.(Pant S. R., 1980). Nepali students were influenced from Indian mathematician and trying to write books.

Pant stated the first book of mathematics written in Nepali language is found to be 'Wyokta Chandrika' which was published in 1883 A.D. (Pant N. R., 1980). This book contains numerous problems dealing with beloved Hindu topics: linear and quadratic equations, both determinates and indeterminate, simple mensuration, arithmetic and geometric progressions, surds, pythagorean triads and others the same as Lilavati. In the preface of Wyokta Chandrika Pade wrote,*" The method of calculating about ordinary numbers, one, two, three and other is called Wyokta Ganita (Arithmetic)* " (Pade G., 1883). This is extremely similar to the definition provided by Bapu Dev Satri in his book named *Wyokta Ganita*. With the influence of his teacher Satri's book, Pade may name his book Wyokta Chandrika. Beside this claim there is logic as Pade defined term Wyokta Ganita as same as Sastri's. Pade wrote his work by selecting beautiful examples, useful contents, simple and spirited

problems. It was quote popular in Nepal as well as India during that time. It was composed first, second and fourth part in Nepali language and third part in Hindi language during 1883 A.D. to 1914A.D. He was the great mathematician of that period. Nuru Dutta Pade, Meru Nath Pade, Kavi Raj Pade, and Ganga Prasad Shrestha were students of *Pandit* Gopal Pade (Pant, 1980) and Ganga Pd. Shrestha wrote Mathematics book in Nepali medium 'Ganita Sagar' in 1916 A.D. (Shrestha G. P., 1916). During that periphery 'Vichitra Ganita' was written by Bramha Lal Shrestha which was published in 1918 A.D (Shrestha B. L., 1918). Nevertheless, only 'Vichitra Ganita part II' is available nowadays. Where is the book named 'Vichitra Ganita part I'?, who was Bramha Lal Shrestha? are unanswered questions. So without having the debate and discussion on such issues if it goes on the womb of forgetting, it is questionable and regrettable. The work of people having in the centre of Nepal cannot be available even in less than a century then it could be easily deducted what would be the circumstances of those living in countryside, hilly region and for remote corner. It becomes our duty and responsibility to seek and search such genius. Who search our history but we if not searched now when?

Statement of the Problem

In the development of mathematics, different works have been done by different people. In the context of Nepali Mathematics, Sripati, Laxmi Pati Pade, Gopal Pade, Ganga Prasad Shrestha, Bramha Lal Shrestha, Chandrakala Dhnanjay, Nay Raj Pant were representative characters who has written mathematics books until 20th century. Among them Bramha Lal Shrestha was a person who published the book 'Vichitra Ganita' in 1918 AD. But no one studied about him, different aspects of his personality, his contribution on mathematics, and evaluate his books. Almost mathematicians of Nepal are found unknown about Bramha Lal Shrestha and his

contribution in Nepali Mathematics. It becomes our duty and responsibility to seek and search answer of such questions. This research study sought the answer of the following questions:

- Who was Bramha Lal Shrestha?
- What are the mathematical contributions of Bramha Lal Shrestha through his book 'Vichitra Ganita'?

Objective of the Study

The goal of qualitative research is discover the meaning through the patterns of the observed information which emerge after close observation, careful documentation, and thoughtful analysis of the research topic (Sharma, 2011). It is said that if there is no objectives then the work is seen as a boat without rudder. The objective of any research is to discover answer to questions. In other words, the main intent of research is to find out the truth which is secret and has not yet been discovered. Although every research has its own specific objectives, the study has the following objectives:

- To find out biography of Bramha Lal Shrestha.
- To explore the contributions of Bramha Lal Shrestha in mathematics and to characterize his book 'Vichitra Ganita'.

Significance of the Study

History can develop into a hunt for understandings of one's own, as new ideas about connections between one thing and another spring to mind (Mcneill, 2014). Properly written history always stimulates interests in addition to ignorance of history that is, absent or defective collection. Historical knowledge is no more and no less

than carefully and critically constructed combined memory. This study presented records and evaluated accomplishments of Bramha Lal Shrestha, his remarkable contributions to the Nepalese mathematics and explore the mathematics practiced around 1918 A. D. in Nepal. It is believed that this study empower the students in tracing the development of Nepalese Mathematics. Findings of this research will be significant and helpful for mathematics teachers and students who want to study Nepalese history of mathematics and comparative study of Nepalese mathematics from second decade of 20th century because this study would identify the relationship of mathematics that the past has to the present.

Also, finding of this research would be applicable for researchers and those who are interested to carry out research on the Nepalese history of mathematics. This study showed an interpretation of historical changes that helps readers better understand the forces and consequences of these shifts.

Delimitation of the Study

Qualitative research has more challenges in comparison to quantitative research because qualitative research has to maintain its rigor by writing, liveliness, and verisimilitude. The researcher carried out the study taking the following delimitations:

- The research was limited with the contribution of Bramha Lal Shrestha in mathematics. It gave very brief information of Nepali mathematicians' around 1915 that were the contemporary of Bramha Lal Shrestha.
- This study was based on the sources of information obtained by his family members, friends and library resources on the centre of 'Vichitra Ganita'.

Definition of Terms Used

Bedi:- A small fire wood especially needed in worship developed from Hindu practices.

Brahmin:- One of the highest priestly communities of Nepal which mostly amalgam Hindu and traditionally assigned to the priesthood.

Ganesha:- Seems as elephant-headed man one of the best-known most worshipped deities in the Hindu pantheon. Load of success. Hindus started any auspicious events with remembrances of Ganesha.

Ganithasagar :- Name of a book written by Ganga Prasad Shreast (Shrestha) which was published 1916 A.D. and contained number of problems unitary method, fraction, number system, geometry, HCF, LCM, profit and loss etc. Ganga Prasad Shrestha was a mathematics teacher of Shrestha Pathsala.

Gurukula:- A type of school Practised in Nepal as well as India, resendential in nature, with students living near the teacher, often with in the same house.

Jyotisha :- The scientific study of matter and phenomenon in the universe, especially in outer space, including the positions, dimensions, distribution, motions, composition, and evolution of the celestial objects.

Jyotisha Shastra :- A discipline which study about Jyotisha in the universe, especially in outer space, including the positions, dimensions, distribution, motions, composition, and evolution of the celestial objects.

Lilavati :- A book written by Bhaskaraacharya published in 11^{th} century contained Bija-ganita, Arithmetic as well as Geometry.

Maila Gurujyu :- Devotional advisory of government of Royal family.

Mathematical Personality:- Mathematical writing style, character, structure, idea, theme and works on the field of mathematics.

Newar :- One of the indigenous communities of Nepal which mostly amalgam Hindu and Buddhist cultures.

Tahabil:- An office where something that facilitates an action or process.

Vichitra Ganita:- A book written by Bramha Lal Shrestha which was published 1918 A.D. and contained numbers of problem based on unitary method, profit and loss, ratio, measurement, simple interest and compound interest, HCF,LCM and others.

Wyokta Chandrika:- A book written by Pd. Gopal Pade and published in 1885-1914A.D.It was first mathematics book of Nepal written in Nepalese language and contained Bija-ganita, Arithmetic as well as Geometry.

Chapter -II

REVIEW OF RELATED LITERATURES

Gottschalk referred ‘history as record'. Moreover, “The process of critically examining and analyzing the records and survivals of the past is called historical method (Gottschalk, 1951). We look at history as a way of motivating the learner to see the significance of the area being studied. A new entry in the field therefore should have characteristics not already presented in the available research. There is few of research in the field of history of Nepali mathematics especially on the field of biographic and works of Nepalese mathematicians among them some of the major research works are as follows:

Acharya (2015) studied on 'Studies on mathematical works of Nay Raj Pant'. This study was mainly focused with books written by Nay Raj Pant, contents of his mathematical books and his contribution to develop mathematics. The data for this study were taken from primary as well as secondary sources like interview, manuscript, publications, personal memorandum, governmental records etc. the nature of the study was descriptive, qualitative analysis. The major findings were

- Nay Raj Pant simplified the way of presenting mathematical content.
- Pant critically analysed previous mathematical works.
- Pant compared Hindu mathematics with Greek mathematics.
- Pant continuously studied the history of Nepalese mathematics.

“Contribution of Nay Raj Pant in Siddanta Jyotisha” (Khanal, 2012) was carried out by Shyam Khanal which was mostly concerned in the biography of Prof. Nay Raj Pant and his contribution in Jyotisha. The main purpose of study was to explore the mathematical system of arithmetic, geometry, astronomy, trigonometry,

and others. The study was done by qualitative design but, study limited about Nay Raj Pants' contribution and his book Siddanta Jyotisha. So this study unable to provide brief history of Mathematics books practiced in Nepal.

Acharya (2012) had given Naye Raj Pant's biography, persanility and his contribution in Nepalese mathematics in a article which was published by Ramanuj Society of Mathematics and mathematical sciences. Furthermore, he examined in the wake of the earlier studies of the anciant matheamtics easpically in astronomy, jyoitosha, cuberoot, trigonomety, sumatitantra and analysis of manuscripts of mathematics. The study was done by qualitative design but, study limited about Nay Raj Pants' contribution through his publication and manuscripts. This study was incapable to provide brief history of mathematics books practiced in Nepal.

Acharya (2011) carried out a research on "An Analytical Study of Nepalese History of Mathematics" with a view to finding out the development of mathematics in Nepal using the historical and theoretical description. In this research Acharya had explained developments of Mathematics in Nepal in different communities, times, and regions by Nepalese people using classical documents such as manuscripts, biographies, inscriptions, books etc.

"The Mathematics of Niels Henrik Abel: Continuation and New Approaches in Mathematics during the 1820s" was conducted by Sorensen H. K. (Sorensen, 2010) by describing and analyzing trends in the development of mathematics during the first half of the nineteenth century. The aim of the study was to describe and analyze Abel's mathematics within its historical context and to draw perspectives on the general development of mathematics in the early nineteenth century from the Abelian corpus of Mathematics. The study was structured into different parts:

1) An introductory part consisting of biographical and other historical framework.

2) Descriptive parts devoted to a particular theme analyzed from a particular discipline in Abel's mathematical production.

3) Analysis part comprising the syntheses of a general transition in mathematics in the early nineteenth century as seen from the perspective of Abel's works by using interpreted based analysis.

Acharya had been written an article entitle "Gorkha Bij-Ganita Siksha ko Samikksha" (Acharya, 2009). In the article he presented some facts (sign, involution and evolution, simultaneous equations, Ratio, Series etc.) about book named 'Gorkha Bija Ganita Shiksha' which was written by Nuru Dutta Pade. The main objective of this study was to explore the mathematical terms which was used in Gorkha Bija Ganita Shiksha and to analyze the content of that book.

Similarly, another research work on the history of mathematics teaching in Nepal was conducted by Jha, Adhikary, and Pant (2006). The main objective of paper was to present a brief historical account of the Nepalese mathematicians up to nineteenth century and their remarkable contributions to the mathematical sciences in Nepal. In this paper, they had presented the history in condense form by subjecting to strict discipline, sketching the unfolding of a few main ideas and minimizing reference to other developments. They had been divided their work into two parts: historical background and modern period among them historical background includes the survey work of mathematical activities in Nepal. But this study silence about mathematics books written in Nepali language and content.

"Essays on Georg Rasch and his contributions to statistics" was conducted by Lina Wohlk Olsen (Olsen, 2002). This work consists of six self-contained articles such as biography of Georg Rasch, rediscovers Rasch's work, how Rasch developed the Rasch models etc. and all of them are connected to Georg Rasch and his contributions to statistics. The main sources to this study are interviews with people, who knew Rasch, library studies and Olsen includes an empirical examples. The main propose of study was to explore about the Georg Rasch and his theory (Rasch models which is a class of statistical models designed for the analysis of questionnaires.) that he developed and explore the events.

"Nay Raj Pants' Biography, personality and his Attribution" was conducted by Alka Sharma Calise (Calise, 2000). The purpose of this study was to find Pants' biography, different aspects of his personality, and introduce his work. The study was done by qualitative design by using interview schedule and library based study. The study was structured into different parts: introductory part, next part biography of Nay Raj Pant, Personality of Pant, Next Part consisting analysis and synthesis of the work of Nay Raj Pant, and last part consisting summery and evaluation. . The study was mainly base on works of Pant but, this study can't provide brief information of his intellectual conclusions.

Nay Raj Pant (Pant, 1980) had published a book named "Pd. Gopal Pade and his method of getting Cube Root". The purpose of this study was to study about Pd. Gopal Pade and illustrate his method of getting cube root. He further studied about the new approach of getting cube root of Pd. Gopal Pade. This new approach was considered as a remarkable contribution of Gopal Pade in Nepalese mathematics. The study conducted by Pant was done by qualitative design. The data was collected by interviews, counselling with resource persons, study of profiles, study of printed and

collected documents like books, journals, articles etc. In that work Pant revealed about history of mathematics books written in Nepali language but that was only overview of mathematics books written in Nepali language.

In spite of the fact that several research works have been carried out to the history of Nepalese mathematics, nobody has carried out research work entitled ‘Biography of Brahm Lal Shrestha and his contribution in Nepali Mathematics’. That is to say, the researcher much interested to conduct this research. Acharya E. R.(2011) augured, "History is backbone of every subjects and a strong background of Mathematics helps in all round development of the country." Since the truth of the matter is history, historical memory is the key to self-identity and provides the reasons how things have already been done, therefore, this research is being carrying out.

Implications of the Review for the Study

History is a meaningful record of human progression. It is truthful integrated account of the relationship between persons, events, times and places. However, the research reviews had been found to be lacking some features whatever the approaches and methods came into existence. Despite this, implication of the review of studies had been beneficial to develop mental framework, select appropriate tools, use suitable methods and provide some insights to carry out research works in terms of sampling procedures, and sources of data collection.

Conceptual Framework

On the basis of the above reviewed, researcher developed a conceptual framework that demonstrates how to this study was conducted. The researcher explored mathematical contribution of Bramha Lal Shrestha on the basis of triangulation within his biography, analysis of his book and analysis of contemporary mathematics books.

Conceptual Framework of the Study

This study mainly concentrated on mathematical contribution of Bramha Lal Shrestha and analysis of his contemporary Mathematics books. In order to explore his contribution in Nepalese Mathematics, the researcher went through the biography of Bramha Lal Shrestha. Therefore, at first the researcher studied about biography of Bramha Lal Shrestha by the help of in-depth interview, documents analysis. In this

section, the researcher studied different aspects of Bramha Lal Shrestha: childhood, family background, interest, difficulties and rewards. It is assumed that biography of Bramha Lal helped to analyze his book.

The researcher used content analysis approach to analyze his book named 'Vichitra Ganita' where the researcher described prevailing conditions, importance, interest, problems, level of difficulty, use of symbol, literary style, arrangement and area of content. It is also believed that contemporary books such as Wyokta Chandrika of Gopal Pade, Arithmetic of Narendra Mani Acharya that was translation of arithmetic of Jadav Chandra Chakravarti would help to analyze 'Vichitra Ganita'. Furthermore, the researcher studied ancient Mathematics books like Lilavati, Arayabhattiya, Bij-Ganita to find out what type of content included in the book that Bramha Lal Shrestha wrote.

Chapter -III

METHODS AND PROCEDURES

In this chapter the researcher dealt with the methodology that was adopted to fulfil the objectives of the study. This included design of the study, area of the study, procedure for data analysis etc. At each operational step in the research process, researchers are required to choose from a multiplicity of methods, procedures and models of research methodology which would help them to best achieve their objectives. Methods means the way of collecting information for the chosen study and interview, observation, group discussion, documents analysis are the popular methods practiced in qualitative research (Sharma, 2011). The researcher chose primary and secondary data as source of data.

In the beginning of the research, the researcher visited different libraries, consulted with the mathematician, teachers and consulted resource persons. The main source for the biography of Bramha Lal in this research was interview. The search for sources of data began with wide reading of preliminary sources including published biographies, specialized chronologies, dictionaries of quotations and terms. The main source to analyze mathematics named 'Vichitra Ganita' was library study. The nature of the research was historical basis.

Design of the Study

Since this research work attempts to explore the biography of Bramha Lal Shrestha, his contribution in mathematics, analysis of mathematics book written in Nepalese language etc. The researcher cannot manipulate any events and neither control environments so the design of this study is qualitative and historical descriptive. The researcher used content analysis approach in which researcher

employed published works as its data (in the case of history of textbooks, these might be readers, or examples of the changing contents) and subjects them to a careful analysis that usually includes qualitative aspects. Documents study such as books of Bramha Lal Shrestha, Gopal Pade etc. and interview were the methods to collect the information. The research questions were answered using qualitative data and it mostly based on in-depth interview and library study.

First of all, in the beginning of the research the researcher visited different libraries such as *National Library, Kesher Library, Madan Purashkar Guthi, Central library* etc., consult with the mathematicians, teachers, and resource persons to collect necessary information for the research. The main source to this research was interview with resource persons for the biography of Bramha Lal Shrestha. In order to collect information for the research work, the researcher went to the field to take in-depth interview for further inquiry with the nephew, nephew- in- law, granddaughters of Bramha Lal and others key resource persons. Before that the researcher got permission from the Bramha Lal's relatives, authority to consult the necessary information. Then, the researcher took in-depth interview with the respondents until the level of satisfaction. To collect information the researcher used personal communications such as telephone calls, e-mails and SMS texts with respondents. Next, the researcher studied classical documents like books, journals etc. to analyze mathematics book. After that, the researcher evaluated the information.

Information Analysis and Interpretation Procedure

Collected information does not provide any meaning to the readers. So, the systematically collected information was studied from as many angles as possible to explore the new facts. This study based on historical biography, historical documentation and description. Thus, the analysis of information required

interpretation of them in a logical, analytical and descriptive manner. In this study the researcher divided this analysis and interpretation into two parts. First section was about Bramha Lal's biography where the researcher included overview as mathematician, childhood, family background, interest, difficulties and rewards etc. and second section was about analysis of 'Vichitra Ganita' on the basis of mathematics content, languages, etc. with the help of books: Lilavati, Wyokta Chandrika, Bij-Ganita, 'Vichitra Ganita'. The researcher compared and constructed content of book with current secondary curriculum of Nepal because 'Vichitra Ganita' seems to be prepared for *Madhyama* (equivalent to SLC level). The researcher analyzed and interpreted the information.

Chapter- IV

BIOGRAPHY OF BRAMHA LAL SHRESTHA

This chapter dealt with presentation, analysis and interpretation of the collected information from primary as well as secondary sources. The main focus of the study was to highlight the contributions of Bramha Lal Shrestha in Nepalese mathematics through his book named 'Vichitra Ganita'. For this, the researcher got some information about Bramha Lal Shrestha via some books. In order to get further information about him, the researcher went to his family members and took interview with his family members in home and away via Skype. To get as detailed as possible biography of him, the researcher discovered his family background, childhood, interest and nature, habits, education and economic status, marriage and family life, visits, rewards and influence and motivation to write having an in-depth interview with his kiths and kin and acquaintances.

Family Background

The researcher requested with Susila Shrestha, the granddaughter of Bramha Lal Shrestha to describe his family life in detail. She answered, *Sidhdhi Lal Shrestha, father of Bramha Lal Shrestha, was a well known person around Marubicche Tole who used to be an accountant in a private office of that time. His family was a joint family where he lived together with his wife, offspring, uncle, aunt, parents and his grandparents. Life of his and family members was quite hard at that time according to the then Newar status. In business oriented/ minded Newari society of that time being an accountant his economic condition was not satisfactory.*

However, through these statements the researcher concluded that Bramha Lal's family deserved an honourable position as he worked for the social welfare.

Childhood

Bramha Lal Shrestha, the one of the Nepalese mathematicians of modern times, was born on December 22, 1889 at Marubicche Tole, Basantapur in Kathmandu. His Father, Sidhdhi Lal Shrestha and mother Bhupal Laxmi Shrestha, had three sons named Surya Lal Shrestha, the eldest, Bramha Lal Shrestha and Bishnu Lal Shrestha as the youngest. In the questions about birth, birth of Bramha Lal Shrestha's siblings, Nava Raj Shrestha, nephew of Bramha Lal responded as, "*Bramha Lal passed his childhood living with his parents at Marubicche Bahaal, a typical Newari family"*. Moreover Susila Shrestha replied *"With the reference of my grandmother Laxmi Shrestha, my grandfather had three brothers with him and he was middle one and most handsome one, tall figure and fair skin colour. He had quite sound of personality. He didn't like to speak more, believing into less speak and sweet speak, calculative mind, always trying to keep himself superior by his activities. Moreover, he practised most of the mathematical logic*".

Interest and Nature

Each person in the world has got strange type of interest, hobby, nature and habit. So, he was also not an exception. Interest and nature are shaped and sized on the basis of family and social environment, family relationship, parents, friends and company, educational status and manner.

Through the discussion with Nava Raj Shrestha it was found that Bramha Lal was guided and taken care of by his parents. His father worked as an accountant so he befriended higher castes and status people from his childhoods so, reading became his habit. Writing in free time, making friendship with higher social status, castes and educated people, speaking less but precisely were some of his interests. He was soft

spoken, liked to maintain status and respect of others also included his nature. Moreover, softly speaking in tone, preciseness in speech, gambling and eating came under his interest and hobby. Furthermore, it seemed that he was sharp minded intellectual, could solve big calculation orally in childhood and kin interested since he was child, thus he had been successful to publish the mathematics book.

Habits

Regarding the habits of Bramha Lal Shrestha, the researcher came to know, with the interview of different persons, Kiran Kumari Pade, Susila Shrestha, Nava Ras Shrestha for example and acquainted to, that he was strict to maintain his and other respect and hospitality. He liked to speak less but wanted precise in his speech. He was very fond of eating different dishes and he too. He had the habit of gambling, through this he calculates quickly. In relevance to his strictness regarding respect and hospitality, Prakashaya Raj Pade quoted, "*once I handed him a letter addressed as Shree Bramha Lal Shrestha but he refused to accept the letter. To the question why the letter was rejected, he replied that he wasn't addressed as Mukhiya Shree Bramha Lal Shrestha as he was promoted to the level of Mukhiya".* Consequently, he concerned the position which is regarded in the mathematics.

Marriage and Family life

According to Hindu *Varnashram* system, generally people get married after ending education and before the development of a career. According to *Manusmriti*, a well known book of Hindus, generally boys get marriage around 25 years of age. Consequently, being the follower of Hinduism Bramha Lal Shrestha also got married at the age of 22 years. No more information regarding the first five marriages is available to us. But his marriage life was not successful because of the frequent

demise of his wives and offspring. In the conversation with Bramha Lal Shresthas' daughter-in- law Sanu Shrestha (aged 72) she told, "*During the period of his life, he had been married to seven women but unfortunately his wives died one after another accordingly. As his sixth wife left him, he had married with Laxmi Shrestha, who remained in his entire life".*

Susila Shrestha, the granddaughter of Bramha Lal Shrestha and his seventh wife Laxmi Shrestha, during the in-depth interview said "*My grandmother used to say that all five wives except me and children of my husband (Bramha Lal) died because of the ill, old Newari conservative culture and tradition, lack of sanitation and disease which even didn't leave".* However, luckily and fortunately, out of four children his seventh wife begot only one son named Prem Lal Shrestha could live a long life (86 years). Prem Lal, the only survived son, married to a lower caste girl named Laxmi Maharjan, did not live together with father because his father did not accept his inter-caste marriage. But She along with her children died because of diseases prevalent at that time. After Prem Lal's first unsuccessful marriage life by the death of Laxmi Maharjan, he left home and stayed at barrack for 12 years uncared and unconcerned life remembering his wife. As his father Bramha Lal died, he was brought home by his mother in order to take part in his father's funeral. Prem Lal got second marriage to Sanu Shrestha at the age of 62 and Sanu gave birth to three daughters namely, Susila Shrestha, Shanti Shrestha and Roshana Shrestha. Furthermore, he had only one son, Prem Lal who never stayed at home with his father due to their bad relationship between each other. And because of the poor stability of the library his epics could not be covered and published.

Educational and Economic Status

Bramha Lal Shrestha was born in1889A. D. and during that time, Nepal was under the Ranas' regime.According to Jha et al. (2011), Jung Bahadur Rana and his successors were always against to the education for people.

Sidhdhi Lal Shrestha had not any formal degree from any educational intuitions' and similar condition was with Bramha Lal Shrestha. But Bramha Lal used to be a literate person. He could speak and write Nepali, Newari and English properly. He had proper knowledge of Mathematics. Bramha Lal received his first schooling at home from his mother, in classics, and from his father, in Mathematics. Bramha Lal Shrestha was sharp minded intellectual and he could solve big calculation orally. In a question of how could it be possible for a person who had even no formal education but be brilliant in Mathematics? According to Dinesh Raj Pant, who has been in work of searching the Nepalese history as well as History of mathematics, *"It became possible because Bramha Lal Shresthas' father Siddhi Lal Shrestha worked in the house of Mailla Guruju named Hem Raj Pade. So, Bramha Lal Shrestha might get chance to get informal education by the teachers or Gurus there because Sidhhi Lal worked for Hem Raj Pade and he had made a good image there. Pant further expressed more information about Hem Raj Pade as Hem Raj Pade was brilliant and very knowledgeable in mathematics".* Moreover, Hem Raj had managed the well guru (teacher) to teach his sons and grandsons at his home and attracted in collecting varieties of books like religions, astronomy, literature, history, mathematics. He managed the volumes in his personal library. After his death the library had been handed to Nepal Government and now it is named as Nepal National Library which is in Harihar Bhawan, Lalitpur. It is found that Hem Raj Pade's house was a centre of

education at that time. According to Kiran Kumari, *"Bramha Lal used to study the mathematics books and tried to solve mathematical problems whenever he got time".*

Visits

In an only online conversation with Nava Raj Shrestha, Nephew of Bramha Lal Shrestha, via Skype he used to work as an account in Hem Raj Pade, the then Maila Gurujyu who was the main Priest of the King. Pade had got lot of properties that were dispersed in different parts of Kingdom such as Kailali, Kanchanpur, Sorahi in Parsha, Gitanagar in Chitwan, Jagannathpur, Debdaha in Jhapa, Debdaha in Rupandehi, Rautahat etc. (Shrestha N. R., 2014).Accordingly he visited to these places in order to take account. Furthermore, he was quite interested in visiting different places therefore; he visited to other places during his service rest of the above mentioned place too. But no factual information regarding his international visits was handed to the researcher by any of the family members of Bramha Lal Shrestha. As a result, he has mentioned different places of Nepal like Birgunj, Biratnagar etc. in his book.

Rewards

According to Kiran Kumari Pade (Pade K. K., Life story of Bramha Lal Shrestha, 2014), wife of Keshav Raj Pade, Bramha Lal Shrestha didn't receive any award organizationally and governmentally however he used to be praised and was given prizes by Hem Raj Pade and his son Keshav Raj Pade for his honesty, wisdom and dutifulness. In this way he becomes the Mukhiya (Chief).

Influence and motivation to write

Bramha Lal Shrestha used to go to Hem Raj Pade's house following his father. Mathematics and Jyotisha was the Pade family tradition for many years (Pant

S. R., 2004). However, in the time of Basu Dev Pade, Laxmi Pati Pade who was the astrologer and mathematician advised King Prithvi Narayan Shah (Pant S. R., 2008). He wrote about 40 books. Lila Nath Pade was the son of Laxmi Pati, who was also mathematician and astrologer. Lila Nath wrote a book in Siddhant Jyotisha. Descendant of Laxmi Pati Pade, Gopal Pade, was also mathematician and astrologer (Pant N. R., 1980). Gopal Pade wrote the first book of mathematics in Nepali language, called Wyokta Chandrika. Nuru Dutta Pade was the second son of Gopal Pade, who wrote Gorkha Bijagnita, a book about algebra, and Saral Bija Ganita.

Bramha Lal got the company of Pade family members. Accompanying Pade family provided the chance of being educated to Bramha Lal Shrestha. Pade family used to give him some kind of reward in his capacity to solve simple mathematical problem when he was child. Therefore, he had got very good a very good impression over mathematics from the childhood.

Accompanying Pade family and influenced by their teaching, his interest towards mathematics grew deeper. At that time, Pade's house remained as the centre of education for out of Ranas whereas; Durbar High School was the educational centre for Ranas only. Being educated at Pade's family, he too, was influenced and encouraged by his colleagues. His colleagues wrote different books on mathematics and he was also influenced by the environment and wrote books on mathematics. His friends, namely Ganga Prasad Shresthe wrote the book named 'Ganita Sagar', Meru Nath Pade and Kabi Raj Pade wrote 'Saral Bija-Ganita' and Pandit Nuru Datta Pade wrote 'Vichitra Ganita'. All of them were influenced by his guru as well as first Nepali Mathematician named Pandit Gopal Pade. So, he also couldn't remain untouched by his teacher and friends influence to write book. So, he also wrote a mathematical book named 'Vichitra Ganita' which seems to be influenced by the book

of Ganga Prasad Shrestha as his book also contained some of the contents of book named 'Ganita Sagar'.

The researcher tried to highlight the mathematical contribution of Bramha Lal Shrestha in Nepalese Mathematics through his book 'Vichitra Ganita'. His book 'Vichitra Ganita' seems to be influenced by Wyokta Chandrika of Pd Gopal pade and Nepalese translation of Arithmetic by Jadav Chandra Chkravarti. Meanwhile, the books Wyokta Chandrika and Arithmetic of Pade and Chakravarti found to be influenced by Hindu mathematical books Lilavati. So in this regard it seemed relevant to have analysis these books too.

Chapter- V

ANALYSIS AND INTERPETATION OF VICHITRA GANITA

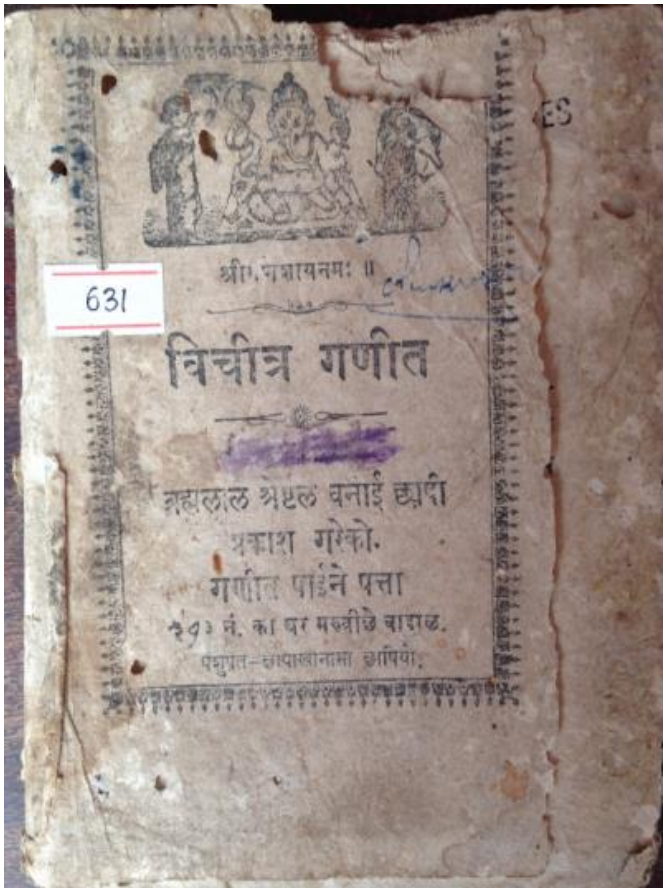
The book named 'Vichitra Ganita' is rarely found in the present time. The book is no more in practice these days, however, the content of the book are still being practised in a reformed manner. 'Vichitra Ganita Part II' is scarce in present situation which book written by Bramha Lal Shrestha and published in 1918 A.D. from Pasupati Press, Kathmandu. This book is preserved at Madan Puraskaar Guthi Patan Dhoka and Asha Archives Raktakali. Bramha Lal Shrestha was born in 1889 A. D. at Marubicche Tole, Kathmandu (Shrestha, 2014).He worked at tahabil (Office) as a private worker of Maila Guruju Hem Raj Pant and his son Keshab Raj Pant until his death (Pant, 2014). Detail biography of Bramha Lal was mention in prior section.

The size of book is 15cm×11.5cm×1.5cm and printed in *Pako Kagaja (*Nepali hard paper) and contained 108 pages except cover pages. In this book we can see many mathematical problems related to unitary method, profit and loss, HCF, LCM, ratio and proportion, simple interest, compound interest, fractions, verbal problems, commission, area and volume etc. randomly. One interesting thing in this book is it has 50 parts and each parts contains eight mathematical questions so there is total 400 mathematical questions in 'Vichitra Ganita'which is very much similar to book named Ganita Sagar of Ganga Prasad Shrestha which was published two year before this and provided answer of each questions so that it look likes practice book which helps students achievements.

There weren't found much information regarding why and how Bramha Lal Shrestha named his book 'Vichitra Ganita', however, present time mathematicians who study about history of mathematics have speculated various possibilities.

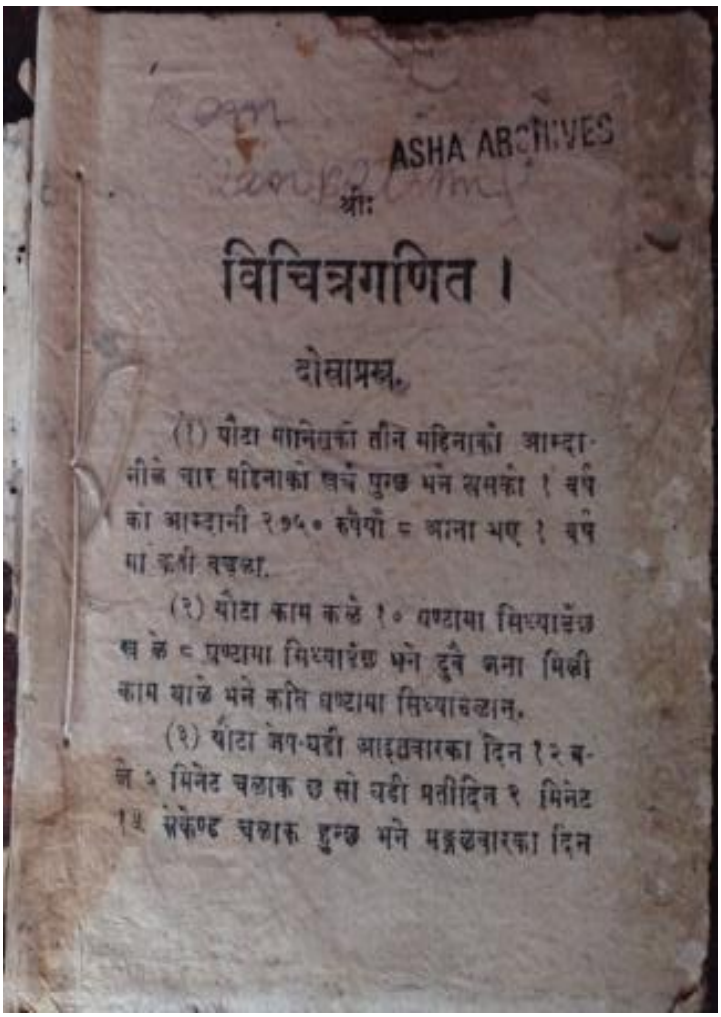
Ram Man Shrestha reasoned it might have named 'Vichita Ganita' because mathematics can be stretched as Arithmetic, Algebra and geometry (Shrestha R. M., 2013). Likewise, Dinesh Raj Pant guessed it could have named so since nature of mathematics couldn't be understood easily (Pant D. R., 2014). In the similar line, being influenced by his friend Nuru Dutta Pade's book 'Vichitra Ganita', Bramha Lal could have named his book 'Vichitra Ganita', could be highly speculated. But the researcher thought the book might be named 'Vichitra Ganita' because the book consists daily basis different mathematical questions with various demonstrations.

As already discussed it contained fifty parts, but in the cover page stars with remembrance of god Ganesha with his picture as it was usual in those days as well as till now before the creation of any good proceedings. See picture of cover page;



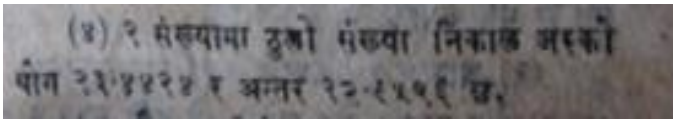
(Source:Asha Saphukuthi) (*Front page of 'Vichitra Ganita')*

Shrestha offered pliminary information about books such as name of book- 'Vichitra Ganita', name of writer-Bramha Lal Shrestha, address of writer house number 373, Marubicche Bahal and Pasupati Press as a publisher in cover page. But he presented his book without any background, preface, content and others so that the researcher was unable to claim more about this book. First part of the books started from the word 'Shree', Hindus used this word normally in the beginning of excellent works. Then he posed eight questions in first part related to unitary method, HCF, LCM, chain rule, fraction etc. and continues this process up to last part that is chapter fifty.



(First p*age of 'Vichitra Ganita')*

'Vichitra Ganita' mainly dealt with what we describe as 'Arithmetic' in today's mathematical parlance. It consisted of 400 mathematical problems written in Nepali. In the actual work, the Algebra section was quite mixed with Arithmetic. In fact, 'Vichitra Ganita'did not contains much of algebra, at least not explicitly. He added certain elements of Algebra such as finding an unknown quantity subject to certain constraints using the method of supposition.



(Verbal problem in Vichitra Ganita32.4)

It means; find the greatest number in which sum of two numbers is 23.4424 and difference is 22.6596. Mathematically,

Let, x be a greatest and y be least numbers then

$x+y = 23.4424$ ……. (eq.1)

$x-y = 22.6596$ ……. .(eq. 2)

By adding equations 1 and 2 we get, $2x = 46.402$

$x = 23.201$

Hence the greatest number is 23.201.

Moreover, Shrestha wrote this work by selecting good parts from Chakravarti's Arithmetic and Pade's Wyokta Chandrika and adding material of his own. 'Vichitra Ganita' became quite popular in Nepal during the time it was first composed exercise book of mathematics. The next part of this review examines some of the key features of 'Vichitra Ganita'. The researcher had divided the review itself into 11 chapters namely:

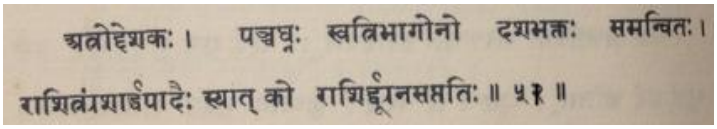
- Fraction and Decimal
- HCF and LCM
- Square and Square Root
- Cube and Cube Root
- Percentages
- Ratio and Proportion
- Unitary Method
- Profit and Loss
- Chain Rule
- Simple interest and Compound interest
- Area, Perimeter and Volume
- Simultaneous equations

This is a logical division as per modern mathematics and not to be mistaken as the division made by Bramha Lal. In the actual work, the Algebra section is quite mixed with Arithmetic. In fact, 'Vichitra Ganita' does not contain much of algebra, at least not explicitly. Hence, this division which the researcher had made is an artificial one and is for convenience only.

Fraction and Decimal

Pade defined fraction as; when a quantity is composed of one or more equal parts of the unit, its measure is called a factional number and simply fraction (Pade G. , 1883). This definition more or less as the definition of fraction provided by Bhaskaraacharya in his book namely Lilavati. But, it seems that Bhaskaracharya did

not know about decimals. However, he knew about fractions and made an extensive study of them. Lilavati largely deals with what we call as `Arithmetic' (Banerji, 1927) and it consists of 279 verses written in Sanskrita in poetic form as,

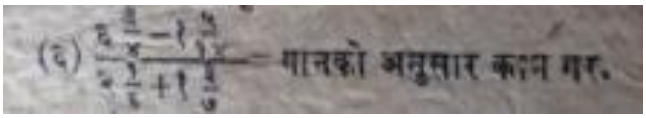

अत्रोद्देशकः। पञ्चघ्नः स्वत्रिभागोनो दशभक्तः समन्वितः।
राशिर्वंशार्द्धपादैः स्यात् को राशिर्द्यूनसप्ततिः॥ ५१॥

(Lilavati verse 51)

It means, what is that number, which multiplied by five, and having third part of the product subtracted, and the remainder divided by ten, and one third, a half and a quarter of the original quantity added gives two less then seventy.

Since various high standard schools and other public schools had followed Lilavati as textbook and up to high grades. So it is found that there was a great influence of Lilavati in 'Vichitra Ganita'. Bramha Lal also presented problems related to fraction and decimal as;

A man left $\frac{1}{3}$ part of his property to his first son, $\frac{1}{4}$ part of his property to second son and remaining property to his daughter. If she got 4000 more than sum of two brothers then find the total property of a man (Shrestha B. L., 1918). Shrestha presented other problems as,

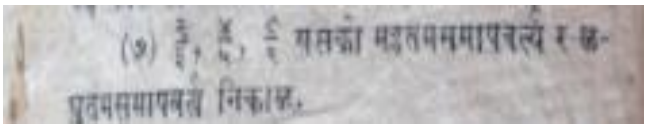

(६) $\frac{6\frac{3}{4}-1\frac{5}{14}}{2\frac{1}{6}+1\frac{3}{7}}$ मानको अनुसार कति भए.

(*Fraction in 'Vichitra Ganita'7.6)*

It means, simplify: $\frac{6\frac{3}{4}-1\frac{5}{14}}{2\frac{1}{6}+1\frac{3}{7}}$

HCF and LCM

Shrestha gives different operations on fractions and after that he presented some problems related to HCF and LCM. He also knew about Least Common Multiple (LCM) and Highest Common Factor (HCF) which are needed for various operations on fractions.



(HCF and LCM in 'Vichitra Ganita'3.7)

It means, find the HCF and LCM of $\frac{2}{3}, \frac{4}{5}, \frac{8}{9}$.

Shrestha presented different level of questions like knowledge, skill, application etc. Firstly he presented some problems to measure knowledge of fraction than he posed some problems to measure student's skill and application as, five bells toll at interval of 3,5,7,8 and 10 seconds respectively, beginning together; after what interval of time will them again toll together? (Shrestha B. L., 1918)

Three man journey 10, 15, and 18 miles in a day respectively; find the list distance which would occupy each of them a complete number of days?

Square and Square Root

In 'Vichitra Ganita' there is few problems (only three) related to square and square root. One of them was written as,

A king arranged his armies in square then there are one hundred armies were remaining and again he planed total number of armies by adding one in each row and column then forty one armies need to complete the square form. How many armies were there?

Cube and Cube Root

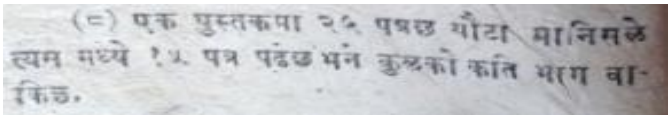
As similar to square and square root, Shrestha presented few problems (only two) related to cube and cube root in his book.

(Cuberoot in 'Vichitra Ganita'26.8)

It means, what is the cube root of 93162981941037?

Percentages

A percentage is a number or ratio expressed as a fraction of 100. It is often denoted using the percent sign, "%". It was found that Shrestha presented 12 problems of percentages without the use of symbol of percentages in his book namely 'Vichitra Ganita' although he gave different problems for percentage.



(Percentage in Vichitra Ganit14.8)

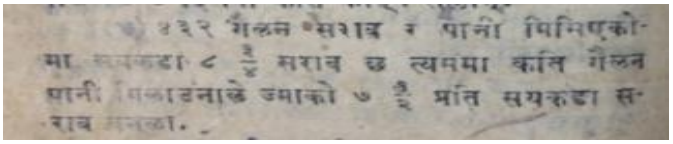
It means, there are 25 pages in a book and a man completed 15 pages among them. What is the reaming percentage of book? Some of problems related to percentage were listed below.

A man spends Rs. 3250 in a year, which is $66\frac{2}{3}$ percent of his yearly income; find his income.

If the duty on imported sugar be decreased by 25 percentage, by how much percentage must a man increase his consumption of that article so as neither increases nor decreases his expenditure?

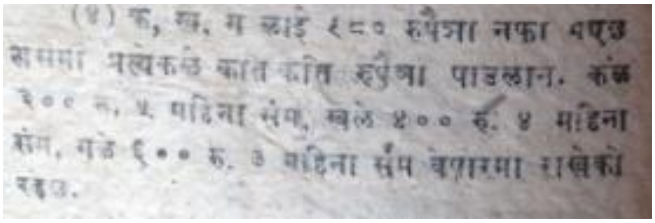
Ratio and Proportion

Bhaskaracharya extensively treats direct and inverse proportions. He cites several problems where the rule of three is applicable. This holds only for direct proportion and Bhaskaracharya explicitly mentions this and the inverse proportion relation also (Barj, 1965). This topic reviews the problems of 'Vichitra Ganita' on ratio and proportion. A "ratio" is just a comparison between two different things and proportions are built from ratios. It is found that 44 problems of 'Vichitra Ganita' dealt with ratio and proportion. Bramla Lal included ratio which is quite similar to modern mathematical text books and they are always in prose form and quite dry. Although, solutions wasn't provided in book but these example was straight forward.



(Ratio in 'Vichitra Ganita'21.4)

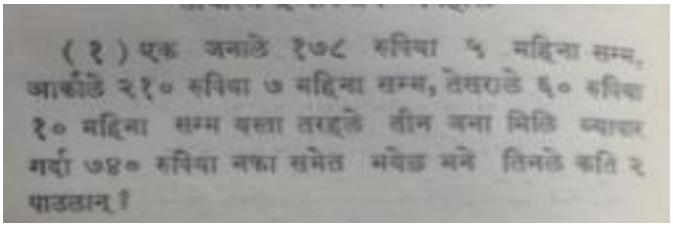
It means; in 432 *Gallon*, there contain $8\frac{3}{4}$ percentages Alcohol. If it reduces in $7\frac{1}{2}$ percentages, than how much water will be added?



(Ratio and proportion in 'Vichitra Ganita'30.4)

It means, *Ka*, *Kha* and *Ga* inter in the partnership; *Ka* puts in Rs. 300 for five months, *Kha*, Rs. 400 for four months and *Ga*, Rs. 600 for three months. They gain Rs. 980, how should profit be divided?

In the book, It was found that he had borrowed some problems from Pade's Wyokta Chandrika which was verified by following figure entitle, Ratio and Proportion in Wyokta Chandrika.


(१) एक जनाले १७८ रुपिया ५ महिना सम्म,
आर्कोले २१० रुपिया ७ महिना सम्म, तेस्रोले ६० रुपिया
१० महिना सम्म बसी तरहले तीन जना मिली व्यापार
गर्दा ७४० रुपिया नफा समेत भयेछ भने तिनले कति २
पाउलान् ?

(Ratio and proportion in Wyokta Chandrika p. 100)

It means, three persons inter in the partnership; first puts in Rs. 178 for five months, second, Rs. 210 for seven months and third, Rs. 6 for ten months. They gain Rs. 740, how should profit be divided?

Chain Rule

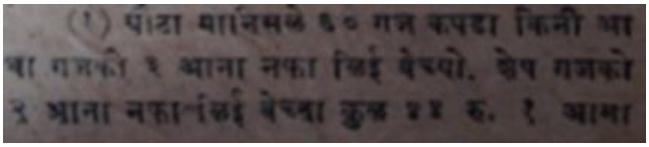
It also contains 13 problems related to chain rule further he described the method of equating goods. Shrestha's chain rules included several verbal forms. For example, If 25 rupees are worth 64 shillings, 20 shillings are worth 25 franks, and 240 franks are worth 47 dollars, how many dollars are equivalent to 40 rupees?

If 4 chickens cost as much as 4 ducks, 6 ducks cost as much as 3 geese and 7 geese cost as much as 5 turkeys, what is the price of a chicken when a turkey costs Rs. 8?

Profit and Loss

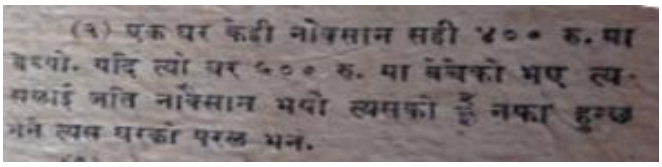
He added 35 problems related to profit and loss. The terms 'Profit' and 'Loss' are used in business transaction. In order to connect mathematics with daily life Shrestha might include problems related to profit and loss in his book. In this book

there is several problems related to estimation of profit and loss, not absolutely, but in the relation to the cost price, that is, as so much percent on the cost price etc.



(Profit and loss in 'Vichitra Ganita'22.1)

It stand for, A man bought 60 *Gaja* cloths. But half of its sold with three *Aana* profit and he sold rest of cloth at two *Aana* profit per *Gaja* making Rs. 44 and one *Aana* . What was the cost price of cloth?



(Profit and loss in 'Vichitra Ganita'5.5)

It means, a house was sold with Rs. 400. If it was sold with Rs. 500 then $\frac{2}{5}$ of loss will be profit. What is the cost price of house? Other problems related to profit and loss was presented follow.

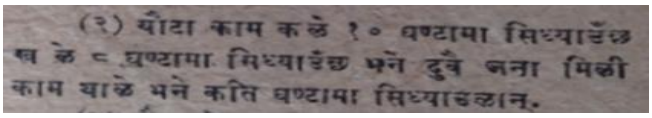
A tradesman buys sixty *Gaja* of cloth and sells half of this with 3 *Anaa* profit in a *Gaja* and remaining selling with 2 *Aana* profit per *Gaja.* If he gains total 44 *Anaa*, find his cost price.

A clock sold for Rs. 40 at a loss of 20 percent. At what price must he sells to gain 15 percent?

Shyam bought a horse and a camel for Rs.500. he sold them to attend 20 percent profit on horse and lose 20 percent on camel. Calculate his cost price of each item if he gained 2 percent.

Unitary Method

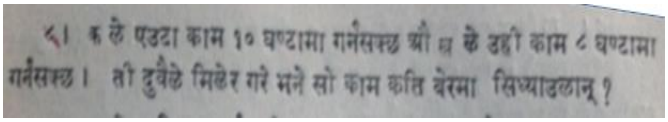
Generally unitary method means technique of carrying out a calculation to find the value of a number of items by first finding the cost of one of them. It sets the tone of the work not as an abstract piece but rather one of practical significance in day-to-day applications. Some problem of the unitary method had been presented below.


(२) कौटा काम कले १० घण्टामा सिध्याउँछ
ख ले ८ घण्टामा सिध्याउँछ भने दुवै जना मिली
काम गाले भने कति घण्टामा सिध्याउलान.

(Unitary method in 'Vichitra Ganita'1.2)

It means, *Ka* can complete a work in ten hours and *Kha* can complete in eight hours. In what time will they do it if they work together?

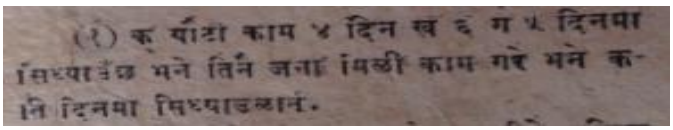
And it was found that above problem was in Nepali translation of mathematics book Arithmetic of Jadav Chandra Chakravarti which was published in 1883 A.D.


९। क ले एउटा काम १० घण्टामा गर्नसक्छ औ ख ले उही काम ८ घण्टामा
गर्नसक्छ। तौ दुवैले मिलेर गरे भने सो काम कति बेरमा सिध्याउलान्?

(Unitary method in Arithmetic140.8)

Arithmetic was the most prominent mathematics book during last decade of 19th century as well as 20th century in India as well as Nepal which was published more than seventy editions. According to Jadav Chandra Chakravarti this book was published in 1890 A.D. with the view of providing a book for class use Schools and Colleges, which shall fit the capacities of the young beginner and at the same time meet the requirements of the advanced student (Chakavarti, 1920). Pant stated that in Nepalese schools this book had followed as textbook and up to high grades and this book had maintained the standard and was taught by teachers appreciating it (Pant S.

R., 2004). Consequently through this reason it was claimed that Bramha Lal might be influence by Jadav Chandra Chakravarti. Furthermore, it was seem that Shrestha had been graded questions of unitary methods simple to complex, like he presented a problem of unitary method having inverse proportion of two variables in second question of first part which was presented above and he presented a problem of unitary method having inverse proportion of three variables in first question of second part as,



(Unitary method in 'Vichitra Ganita'2.1)

It means, Ka can complete a work in 4 days, which Kha can do in 6 days, and Ga can do in 5 days; in what time will it be filled by all three in action together? Moreover, he posed some brain storming questions latter as;

> A man contracts to construct a house in 200 days and employed 50 workers on it immediately. In $\frac{2}{5}$ of days, the work is completed only $\frac{1}{6}$ part. What additional number of worker must be employ to fulfil the contract? (Shrestha B. L., 1918)

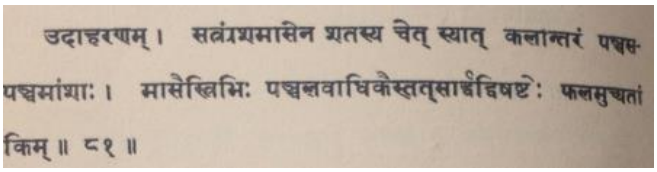
To cap it all, Shrestha had prepared this chapter named unitary method in the view of pedagogical principle like problems were graded from simple to complex, problems are design to explore and developed creative and critical thinking, problems are based on the surrounding and tried to connect mathematics to real life context. Additionally, it was found that there were enough examples in the book of present time and it can be verified by citing an example;

A man contracts to construct a school building in 20 days and he employs 16 men on it immediately. At the end of 12 days the work is only half done. What additional number of man must he employ to fulfil the contract? (Sharma, et al., 2067: 42)

Two pipes A and B can fill a tank in 8 hours and 12 hours respectively but the pipe C empties the tank in 6 hours. If all the tanks are opened together at the same time, when the tank is empty, how long will it take to fill the tank? (Sharma, et al., 2067)

Simple interest and Compound interest

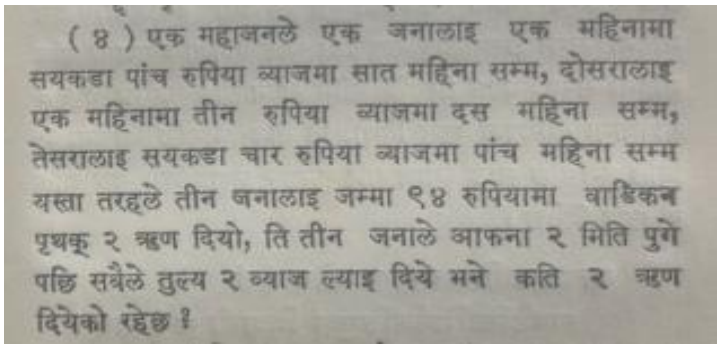
BhaskaracharyaII dealt with simple interest with apparent ease but he does not say anything about compound interest in Lilavati. In Lilavati, verse 80 and verse 81 are related to interest and one of them presented in poetic form as,


उदाहरणम्। सत्रंप्रथमासेन शतस्य चेत् स्यात् कलान्तरं पञ्चस-
पञ्चमांशाः। मासेस्त्रिभिः पञ्चलवाधिकैस्तत्सार्द्धद्विषष्टेः फलमुच्यतां
किम्॥ ८१॥

(Lilavati Verse 81)

It means, if the interest of a hundred for a month and one third be five and one fifth say what is the interest is of sixty-two and a half for three month and one fifth?

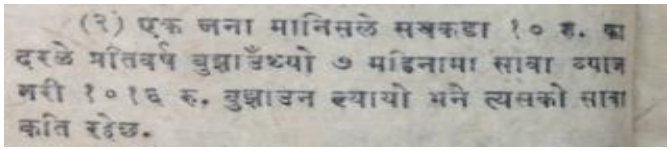
Similar to Lilavati, Gopal Pade aslo dealt with simple interest as well as compound interest with apparent ease. It is found that there was a great influence of Lilavati in Wyokta Chandrika as well as 'Vichitra Ganita'.


(४) एक महाजनले एक जनालाइ एक महिनामा सयकडा पांच रुपिया व्याजमा सात महिना सम्म, दोसरालाइ एक महिनामा तीन रुपिया व्याजमा दस महिना सम्म, तेसरालाइ सयकडा चार रुपिया व्याजमा पांच महिना सम्म यस्ता तरहले तीन जनालाइ जम्मा ९४ रुपियामा बाडिकन पृथक् २ ऋण दियो, ति तीन जनाले आफना २ मिति पुगे पछि सबैले तुल्य २ व्याज ल्याइ दिये मने कति २ ऋण दियेको रहेछ ?

(Interest on Wyokta Chandrika)

It means, a man distribute Rs. 94 three persons in such a way that first, at 5% per month for seven months, second at 3% per month for ten months and third at 4% per month for five months. If he received same amount of interest on three different cases ten find how much did he lent to each.

But Shrestha offered problems related compound interest also. All together he presented 26 problems related to simple interest and compound interest. Some of problems are as follows,


(२) एक जना मानिसले सयकडा १० रु. का दरले प्रतिवर्ष बुझाउँथ्यो ७ महिनामा साबा व्याज सरी १०१६ रु. बुझाउन ल्यायो भने त्यसको साबा कति रहेछ.

(Simple interest in 'Vichitra Ganita’20.2)

It means, a man borrowed a sum of money at the rate of 10% p. a. amounts to Rs. 1016 in seven months. Find the sum of money. And solution of above question is given below:

Here, Given

Amount (A) = Rs. 1016

Rate (R) = 10% p.a.

Time (T) = 7 months = $\frac{7}{12}$ year

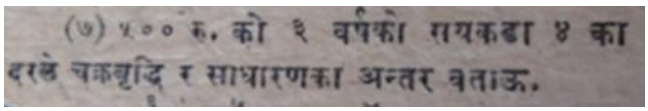
Now, we have

Principal (P) = $\frac{A \times 100}{100+TR}$

$= \frac{1016 \times 100}{100+\frac{7}{12}\times 10}$

= 960

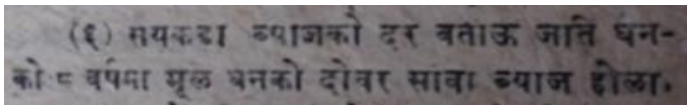
Hence, the sum of the money is Rs. 900. Next,


(७) ५०० रु. को ३ वर्षको सयकडा ४ का दरले चक्रवृद्धि र साधारणका अन्तर बताऊ.

(Interest in 'Vichitra Ganita'7.7)

It means find the difference between compound interest and simple interest on Rs. 500 at 4% p. a. for 3 years. Moreover, it was initiated that there were sufficient examples in the book of current period and it can be demonstrated by mention an example;

For what sum of money the amount will be Rs. 2500 in two years at the rate of 10% per annum? (Hada, Amagain, & Rana, 2012)


(६) सयकडा ब्याजको दर बताऊ जति धन-को ८ वर्षमा मूल धनको दोबर सावा ब्याज होला.

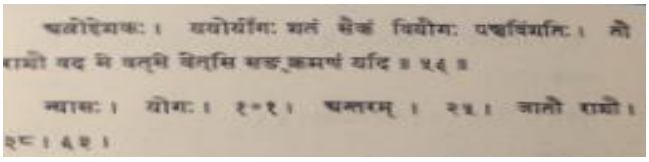
(*Interest in 'Vichitra Ganita'28.6*)

It means at what rate percent per annum will a sum of money double itself in eight years? And this type of question is practise nowadays also and it verified

through an example as, if a sum of money double itself in 20 years find the rate of interest (Khatako, 2011).

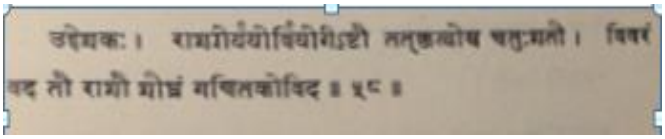
Simultaneous equations

Bhaskaracharya dealt with the quadratic equation and it seemed he knew about the elementary algebraic identities. But he did not explicitly use any language for mathematics. This may be the biggest handicap of Hindu mathematics (Boyer, 1968). As already discussed, there is great influence of Hindu mathematics on Nepalese mathematics. There are certain problems which deal with elements of Algebra such as finding an unknown quantity subject to certain constraints using the method of supposition. Shrestha might be used Lilavati as resource book while he wrote 'Vichitra Ganita' because Bhaskaracharya dealt about simultaneous equation in Verse 56 as



(Lilavati verse 56)

This means, tell me the numbers, the sum of which is a hundred and one and the difference, twenty five; if thou know the rule of concurrence dear child. And Bramha Lal dealt similar problem in 32.4 as, the sum of two numbers is 23.4424 and their difference is 22.6596, find the numbers. Moreover, Bhaskaracharya posed verbal problem in verse 58 as,



(Lilavati verse 58)

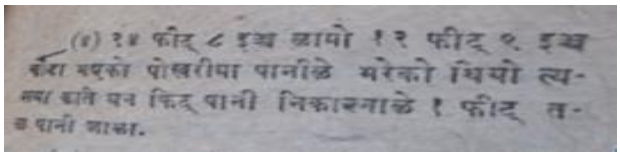
It means, tell me quickly, skilful calculator, what the number they are, of which the difference is eight and difference of squares four hundred. And mathematically it means,

Find the values of x and y where, $x - y = 8$ and x^2-y^2= 400.

By solving we can get x =29 and y = 29.

Area, Perimeter and Volume

There are certain problems which deal with mensuration (measurement of various geometrical objects) like area, perimeter, volume of room, pound, road, house etc. He also gives practical applications of finding the cost for painting, marbling in a particular shape (cuboids) and its area calculation. It had been illustrated as the verbal form given below:



(Area and volume in 'Vichitra Ganita'36.4)

It means, a pond having 24ft. 8 inch length and 12 ft.9 inches width had filled with water. How much cube ft. water should be drawn to lower height by one foot?

In Vichitra Ganita the researcher can't see systematic rule in the arranging He presented only the mathematical problems specially mathematical problems related to Arithmetic but he didn't describe the algorithm for them. So, the book seems as a practice book. Bramha Lal has cited some Mathematical Problems from Gopal Pade's Wyokta Chandrika. In addition, some content has been taken from Arithmetic of Jadav Chandra Chakravarti and some content has been created by the author himself.

The book has got great significance in the present time because it provided the basis as well as reference for the present day's teachers to devise mathematical books. The books had been undertaken in order to supply a demand for an easy introduction to elementary mathematical concepts for Nepalese students. At that time in Nepal, few mathematics books in Nepali languages had hitherto been published on Mathematics and desired to prepare new treatise on Mathematics which contained the mathematical problems almost in verbal forms. Despite being the old book, it had got the content of present time textbook.

There were enough examples in the book of Arithmetic and enough questions for practice. This shows that student's knowledge can be developed by practice. It seems that students can self- evaluate their learning because the answers to the questions are at the end. In the book, there are both general and specific questions. This means it is not easy to answer for which level of students the book is prepared. This is also not clear for which grade the book is for. To the researcher's greatest surprised yet sadness, though the book was written in Nepali language, there weren't found *Purnabiram* on completion of a sentences rather there were used full stop instead. Nepali words have been used for questions in examples and practice. For variables, we can see Nepali sounds and alphabets. This shows that the Nepali-speaking students can benefit from the book. In the book, there are Nepalese cities (*Biratnagar, Birgang, Nepal* to denote *Kathmandu, Tudikhel*), Nepali units of measurement (*Mana, Pathi, Aana, Ropani, Mann, Auns*) and practical problems, which shows the formation of original questions by the author.

The book had followed the scientific way of presenting the each question from easy to difficult, concrete to abstract. It had been seen that this book tried to develop and kept latest pedagogical principals on mathematics. All sorts of questions are

gathered together in a same place where as the book is strong in providing answers too to facilitate the students. Shrestha had used his own verity of symbols of words of typical Nepali languages. This book which is far different than what the language used in the present books of mathematics. The questions had been given in arbitrary forms so it is useful. To quote the weakness, all sorts of questions are gathered together in a same place where as the book is strong in providing questions and their answers too to facilitate the students. In winding up, characteristics the book can be drown as,

- Contained 50 chapters and 400 mathematical problems.
- Focus on arithmetic, mensuration and simultaneous equations were included.
- Answer based rather than process.
- Seems as practice book.
- Provide a solid base for the growth of individual learning.
- It is seems to developed form of first part of 'Vichitra Ganita’.
- Book is small in size but letters is sufficient to read.
- It contains the problems to modern curriculum of classes nine and ten.
- It is no declared that for which propose text book had been written.
- There is no declared for which level.
- It contained various areas of arithmetic but not specified content wise chapters.
- Answers are given at last of book but not calculation process.
- No one problem of geometry and algebra only focused on arithmetic.
- The problems are based on daily activities.
- At the end of book answers are provided for the growing of individual learning.

Chapter V

SUMMARY, FINDINGS, CONCLUSIONS AND IMPLICATIONS

This chapter encapsulated all the major finding in precise form on the basis of analysis and interpretation of the data. It also dealt with implications, which are made on the basis of summary and conclusions discovered form the study.

Summary

In the history of Nepalese mathematics, the first book of mathematics written in Nepali language is found to be Wyokta Chandrika and it was based on the Lilavati of Bhaskacharya (II). Wyokta Chandrika was best textbook of mathematics. From 1883 – 1914 A.D., Pd. Gopal Pade had written four editions of this book. Through the highly appreciation of Gopal Pade, Ganga Prasad Shtrstha, Bramha Lal Shrestha, Nuru Dutta Pade, Kabi Raj Pade,wrote books of mathematics in Nepalese language. During this periphery Bramha Lal Shrestha wrote the book named 'Vichitra Ganita' and published in 1918 A.D. He was born on December 22, 1889 at Marubicche Tole, Basantapur in Kathmandu. He was sharp minded intellectual and he could solve big calculation orally in childhood. He was guided by *Mailla Guruju* named Hem Raj Pade and others mathematics teachers in Pade's house. Accompanying Pade family and influenced by their teaching, his interest towards mathematics grew deeper. He was inclined by the environment and wrote books on mathematics. Likewise, he was influenced and encouraged by his colleagues too. His colleagues namely Ganga Prasad Shresthe wrote the book named 'Ganita Sagar', Meru Nath Pade and Kabi Raj Pade wrote 'Saral Bija-Ganita'.

Findings

Through the study of biography of Bramha Lal Shrestha, his contemporary and analysis of Vichitra Ganita the following results are the major finding of the study:

- He was inspired with the educational environment in his surroundings, the good company with his colleagues and the works in accountancy in the office. The inspiration and his prolonged attention in every terms of mathematics made him to write the book of mathematics.
- Bramha Lal could not get opportunity to study under the essential role of the teacher in his life however in a company of his colleague. He had gained adequate knowledge in mathematical terms which became very co-operative to prove the well known Constructivism Theory.
- Vichitra Ganita contains lots of questions related unitary method and simultaneous equations for the reason that he worked in *Tahabil* as the role of *Mukhiya* (Accountant) which provide his motivation toward practical problems especially unitary method and simultaneous equations.
- It was found that Shrestha used the local terms in measurement like *Mana, Pathi, Aana, Ropani, Mann, Auns* etc. are used which has also provided evidence the use of ethno-mathematical concepts.
- In 1910s, practical mathematics was practised which was mainly based on daily activity.
- It was found that the book provides a solid base for the growth of individual learning. Moreover, it contains the mathematical problems which are still in modern curriculum of nine and ten class of Nepal.

Conclusion

In conclusion, the book 'Vichitra Ganita' is no more in practice these days, however, the content of the book are still being practised in a reformed manner. The book was medium in size, containing 109 pages. The book was published in Nepali Paper (*Pako Kagaj*). The letters inside the books were visible, large enough to see, understandable, compressive and written in Nepalese languages with few *Sanskrita* languages as well. Some vocabulary are not today's fashion however, these can be understood. It started with remembrance of god *Ganesha*, as it was customary in those days and till now before the beginning of any auspicious events. Moreover, contained fifty parts fashion during those days. he presented several problems related to decimal and its operations like addition, subtraction, multiplication, division and its reverse process, converting of decimal numerals into fraction and vice-versa, square, square root, cube, cube root of decimal numeral. He further contained about ratio, proportion, tax, commission, unitary method, sequence and series.

To cap it all, 'Vichitra Ganita' is seems to develop form of first which is small in size but letters is sufficient to read. Along with Shrestha focused on arithmetic although mensuration and simultaneous equations in addition to, we cannot see a problem of geometry. It seems as practice book for the reason that it is answer based rather than process and answers are given at last of book however calculation process were not given. Furthermore, it contains the problems to modern curriculum of classes nine and ten. Although there is no declaration that for which propose text book had been written and if it was prepared for academic purpose we can get acknowledged for which level.

By means of publishing the book, he had played the great role in the development of mathematics. On the basis of the study, interview and analysis

Bramha Lal's contribution in Nepalese Mathematics through his book could be drawn as follows:

- It was a practical mathematics since it was based on daily activities.
- It bridged the gap between ancient and modern mathematics.
- It was presented simple to complex form.
- It supplied the lack of mathematics book in Nepali language.
- It emerged and stood as a resource materials for practices.
- It provided the basis and reference to write mathematics book nowadays.
- It enhanced a culture of writing mathematics book in Nepalese language.

Last but not the least, his book had been proved as a milestone in the scenario of Nepalese mathematics.

Recommendations

This is a biographical and content analysis related study. According to the finding and conclusions drawn from the study the recommendation for the further study has been drown. The following are some of recommendation of this study:

- 'Biography of Bramha Lal Shrestha and his contribution in Nepalese mathematics' suggests that the further studies of Nepalese mathematicians and their contributions in different aspects.
- It is suggested that the individual study of Nepalese mathematicians is needed for recognition of Nepal in the international context of mathematics.
- It is important to search and documenting the mathematical creations of Nepalese peoples.

- It is essential to conduct the research on the Nepalese history of mathematics and extent it to nation's development.
- It is found that the scientific preservation and protection of the classical mathematical documents in different libraries is needed.
- It is suggested to use of new technology for the preservation and development of classical mathematics.
- It is suggested to the scientific study on changing pattern of Nepalese mathematics curriculum in the international context of mathematics education is needed.

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APPENDIX A

Bramha Lal Shrestha and His Contribution in Mathematics

Sample Interview Questions for His Family Members

All Information will be kept confidential.

As you know, I'm interested in Bramha Lal Shrestha who wrote a book named 'Vichitra Ganita' about 100 years ago. In a minute I'm going to ask you….

I. Please explain early childhood of Bramha Lal Shrestha.

II. Describe his family life in detail.

III. Briefly recount birth, birth of his siblings.

IV. Do you know about the difficult period of early life; Death of his mother, death of his father and his illness any else.

V. His mother and father's death and its impact on his further life.

VI. Please explain in fact his enrollment, he was involved in and the medals awarded to his or any celebration of his respect.

VII. When you look back his life are there any movements which you would identify as turning points? What are they?

VIII. Mention his Marriage.

IX. Please say me about his family life in detail, including the bouts.

X. How you feel about his ability? Please explain in detail how you emphasize memories recalled by his work.

XI. Can you tell me what he was like for him to grow up in mathematics?

XII. Do you have any idea who supports his writing in mathematics?

APPENDIX B

Bramha Lal Shrestha and His Contribution in Mathematics

Sample Interview Questions for Who Know Him

All Information will be kept confidential.

As you know, I'm interested in Bramha Lal Shrestha who wrote a book named 'Vichitra Ganita' about 100 years ago. In a minute I'm going to ask you….

I. Please describe his personality.

II. Please explain about his enrollment in here.

III. Do you know about the difficulties period of his life?

IV. Please mention his educational status.

V. Do you have any idea who supports his writing in mathematics?

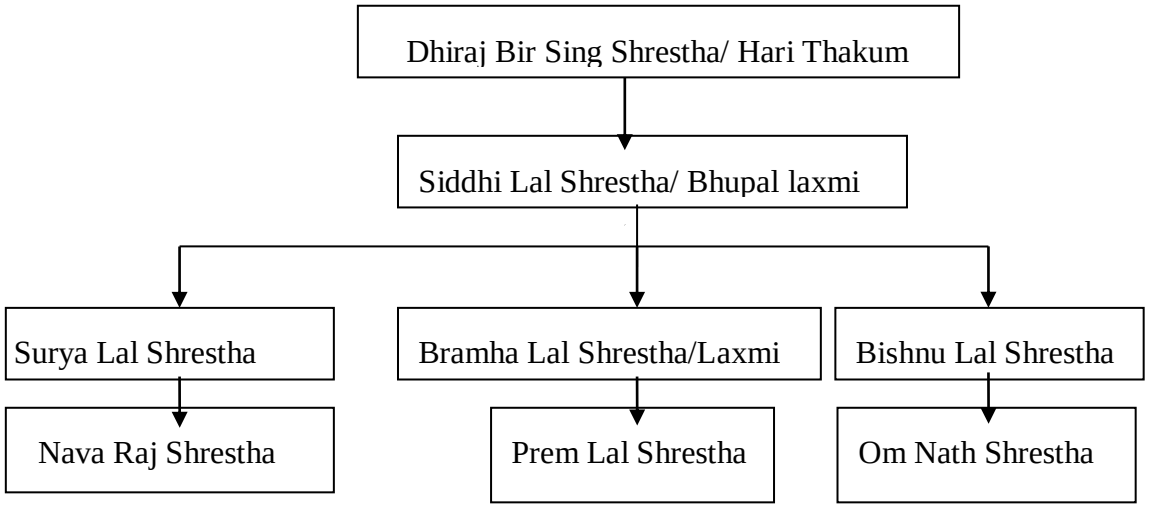
VI. Please explain in detail how you emphasize memories recalled by his works.

VII. When you look back on his life, are there any movements which you would identity as turning points? What are they?

VIII. Can you say me anything else which are sporadic in our above discussion.

APPENDIX C

Genealogical tree of Bramha Lal Shrestha



APPENDIX D

Classification of problems of 'Vichitra Ganita' on the basis of content

Chapters	Eraction & Decimal	HCF& LCM	Square & cube	Percentage	Ratio & Prop.	Unitary method	Profit & Loss	Chain Rule	Interest	Verbal problems	Mensuration
		7			4,8	1,2,3		5		6	
	6,7	3			5	1,2,8			4		
		7				3,4,5,8			1,6		2
	6			8	5,7	1,2,3				4	
						1,2,3,7,8	5			4,6	
	2	5			6	1,7				3,4,8	
	8	1			6	3,5			7	2,4	
					4	1,2,6		5	8	3,7	
	2	5				1,7,8				6	3,7
		8			1,4,6	5,7			2,3		
	1	6			4	2,3	5			8	7
	2,5				3,6		4	8		1	
	6		2			4,5	7	1		3	8
	1			5,8	4,7	2,3				6	
	7	4,6		8		1,2,3		5			
	3	4			1,8	2,3,5				6,7	

	5	4			1,8	2			3	6	7
	3,5			1	7		4,8		6		2
	1,5					4,6,7					2,3
	4		8			1,3,6			2,7		5
	5,8				4,1	3,7				2,6	
	5,6	8				3	1,4			2	7
	2,5	1				7,8			4	3	6
	5,8				3	1,4,6,7					2
	3,8				2,6		1,5,7			4	
	1,3	5	8	6	2	4	7				
		3				2,4,5,6	8			1	7
					2,5	3,4,8		7	6		1
						2,4,5	6,8		3,7		1
	8			6	4	2,3,7			1,5		
	2,8					1,4		5		6,7	3
					7	1,3,5		2		4,6,8	
	3					2,5,7,8	6			1,4	
	4,2	5		6				8	3	1	7
		7			1	3,5,6	4			8	2

	3,8			7	5	1		6	2		4
						1,4,5	3,7	6	2	8	
	8	4		5		1,6,7	2		3		
	6,8				5	1,3	4,7	2			
	1,7				5	6	3		2	4	8
	8				4,7	1,2,5			3	6	
	4,5,6				3	1	2,7			8	
			8		2,7	3,5,6	4			1	
				5	4	2,6,8	1			3,7	
	4			3	7	2,5	6,8			1	
	3,8					1,6,4	5		2	7	
					7	1	3		4,6	5,8	2
	4,5,6					1	2			3,7,8	
			6		5	2,3	4	8		1	7
	8				6	2,3,4	5,7			1	
Total	**55**	**19**	**5**	**12**	**44**	**117**	**35**	**13**	**26**	**50**	**23**

Remarks:1-8 are question numbers of Vichitra Ganita