Learning Difficulties of Ethnic Minority Students for Construction in Geometry

Hari Prasad Sapkota

Lecturer, Mathematics Education, Mahendra Ratna Multiple Campus, Ilam, Tribhuvan University

Email: hpsapkota11@gmail.com; hari.sapkota@mrmc.tu.edu.np

Abstract

This paper reports the findings of a study that explored the learning difficulties of ethnic students for construction in geometry and analyzed the views and experiences of the students in practicing construction of geometrical figures like triangle and parallelogram with comparing the area of quadrilateral. This study was based on phenomenological research design on exploring the views and experiences of four ethnic minority students. Unstructured interview was used as the main tool for deriving the data from the participants. The collected data were analyzed and interpreted using thematic approach. The results indicated that the students felt conceptual complexity for the learning of geometry. It was found that students had such difficulties due to their irregularity in the geometry classes, teacher's biasness to the below average students, shyness to ask questions to the teachers and emphasis on culturally privileged students over the minority group of students. Moreover, the ethnic minority students have their own problems as they miss their classes because of socio-economic status of their family and they are confined to their household works. Thus, the study implies that the conceptual complexity and socio-cultural reflection in classroom should be addressed in teaching geometry to the ethnic minority students.

Keywords: Construction, conceptual complexity, ethnical minority, discrimination

Introduction

Geometry is a branch of mathematics that deals with shapes and figures. It further discusses the measurement, properties, and relationships of points, lines, angles, surface and solids. Geometry explains how to draw shapes, measure and compare them. Geometrical construction is the basic component of geometry (Ubi et al., 2018). Geometrical construction means drawing lines, angles, shapes, circles and other figures using a ruler, a compass or a protractor. Construction problems are base for theoretical problems. Construction problems in geometry offer a unique and valuable learning experience that goes beyond theoretical knowledge. They foster critical thinking, spatial reasoning, and problem-solving skills, while also helping students develop a deeper appreciation for the practical applications of geometry in the real world. The study of construction problems in geometry at the secondary school level holds significant importance as it serves several educational and cognitive functions (Miyazaki et al., 2019). These problems involve using basic geometric tools like a straightedge and compass to create geometric figures with specific properties.

Construction problems require students to visualize and manipulate geometric shapes mentally. Some students may struggle with spatial visualization, making it challenging for them to envision the steps needed to construct a figure (Naufal et al., 2020). The van Hiele level of geometric thinking indicated that the students at secondary level are in 'formal deduction' level -3. They can apply logical arguments to solve problems and apply the properties of geometric figures to construct (Sharma, 2019). They can construct more complex geometric figures with given conditions and use deductive reasoning to explain why their constructions are valid.

In the mathematics curriculum of Nepal, the construction of geometrical figures by using compass and straightedge is included from basic to higher classes. Simple constructions of angles, triangles, parallelograms and other geometric figures are taught in lower secondary classes. Secondary level geometry lessons are gradually

incorporating geometric shape constructs in connection to other geometric shapes. The construction of triangles and parallelograms with relationships to quadrilateral areas are taught in secondary school curricula.

This study aims to explore and understand the specific learning difficulties faced by ethnic minority students in geometry construction and identify strategies to promote inclusive education in this context. The learners, who are from racial minorities and culturally disadvantaged in society, study geometry by struggling to make concepts of construction of geometrical shapes by comparing other shapes. Culturally disadvantaged students may face several challenges when learning construction problems in geometry (Das & Wilkinson, 2011). These challenges can stem from various socio-economic and cultural factors that impact their educational experiences. Some of the difficulties these students may encounter include limited access to resources, language barriers, lack of prior exposure, low self-confidence, teacher-student cultural disconnection, etc. Educational access of ethnic minority students is comparatively lower than other students due to the cultural transition between home and school (Billy, 2015). This issue is relevant where minorities are staying together in a particular community and the mainstream school culture is different from the culture at home and the community.

In most of the developing countries Cultural, language, and racial domination arise in school environment. Ethnic minority groups face continuous struggles within dominant societies (Razack, 2001). Additionally, schools are shown as places where minority students are marginalized and frequently have lower expectations from teachers. In Nepal, many ethnic groups and indigenous nationalities have struggled with historically rooted *Khas-Arya* culture as the domination of Hinduism the Nepali culture (Lawati 2012, as cited in Khanal, 2017b). Medium of instruction in public schools is Nepali language it is the second language for ethnic students. In mathematics more technical words are used for description and new terminologies are in geometry portion. Geometrical construction is more activity-based work and more interaction between

teachers and students needed. It seems to be less interaction between ethnic students and teacher due to hesitation of students by their language barrier (Salazar, 1997). Naturally they do not want to interact with teachers. I found in my classes most of the ethnic minority students sit on back benches.

Most of the students in rural areas are engaging their household work. They do not have much time to study at school among them ethnic minorities or indigenous students come to school occasionally. They work for financial support to the family, so they missed the classes. Mathematics has sequential problem, if previous lesson missed then students cannot cover the further lesion. I found some students near to my home trying to sketch geometrical figures in their group. They share their geometrical tools but they cannot make proper shape. As a mathematics teacher I discussed about their mathematics class and their participation in school. They share their problems in mathematics especially in geometry, they missed the pervious classes and they could not participate in discussion. Furthermore, they could not construct the geometric shapes. I found the problem for the students is basic concepts and their properties that help to construct the geometrical construction.

There are some studies on how to construct the geometrical structures, shapes and figures. There is a gap on learning experiences of students where they feel difficulties on particular construction of geometrical shape with comparing to other shape in terms of area. In this context I am investigating the lived experiences of four ethnic minority Limbu community (janjati) students. From this phenomenology it delves deeply into the participants' perspectives and gain insights over their difficulties on geometric concepts. This phenomenological study explores the experience of ethnic students in construction geometrical shapes with comparing the areas of other shapes. Four students from rural Limbu (*janajati*) communities who are studying with their household work who studies by sharing geometrical tools to each other are the participant of this study.

Research Setting

This study is based on the students' experiences on specific learning difficulties encountered by ethnic minority students in geometry construction at the secondary school level. Construction at class ten is covering the content that finds the area of triangle and parallelogram comparing to quadrilateral. The research setting for this phenomenological study is based on the in-depth interviews of the students of class ten in mathematics class at Sangrumba secondary school of Ilam district, Nepal. The location of this school is in the rural area at Ilam Municipality, Koshi Province. In this school, the majority of students come from the rural areas and from different ethnic group. In class ten, there are total of 46 students, most of the students (24) are from Limbu (*Janajati*) community and some are Dalit and rests of them are Brahmin and Chhetri, half of the students are girls. The medium of instruction is Nepali. This study is limited by the small sample size of four Limbu students from class ten. Two of them are girls and two boys. The findings of the study are based on the students' experiences in geometry construction.

Methodology

The study is based on the qualitative phenomenological research design which describes 'the meaning of more than one individuals of their lived experiences of a phenomenon, It focuses on describing what all participants have in common as they experience a phenomenon (Creswell, 2007, 53). In this study, the investigator explores the data acquired from in-depth interviews from the students and mathematics teacher about the case to the specific phenomenon. The participants of this study were from Limbu (*janajati*) community (an ethnic minority community of Nepal). This ethnic group, according to the Census 2011, only 1.46% of total country's population and has its own mother tongue *Limbu,* the twelfth largest language in the country with nearly 1.30% of the nation's population speaking the language (Central Bureau of Stastics, 2012). The majority of this ethnic community speaks Nepali as their second language. The literacy rate of Limbu population is 74.69% which seems to be higher than national

average of 65.94%. This ethnic group is located mainly in four hilly districts- Taplejung, Terhathum, Panchthar and Ilam of East Nepal.

The four participants of my study are studying at grade ten on rural area of Ilam district at Sangrumba Secondary School. They are below average students in their class. According to their class nine result they scored lower marks than the pass mark. The family of two students among them was staying close to my house in my village. So, I had an early familiarity with these children as we all being as a neighbour. Being myself a mathematics teacher I watch all the activities of their homework. One day they were feeling difficulty for constructing geometrical problems. I had an informal talk with them about the mathematics class, their teacher and their learning style. The idea of this study came to my mind, when they were discussing and using the same instruments for construction and they were on dilemma for the concept of basic ideas. This situation aroused my curiosity, so I listened to their problem in learning. To my wonder, they shared how they were struggling to meet the average students also their teachers and their peers behaved them in the classroom. As I started helping their problem and become more interested to learn their learning struggle, they shared other friends in the same community were also facing the same problem. In this way, I came in contact of all four students. I listened to their problem and gradually I talked to them, mostly individually, about their lived experiences of learning difficulties in mathematics especially geometrical construction in their classes.

In this study, the data were based on the in-depth interviews of the students concerning their classroom experiences, teaching learning activities, access of time and resources, home environment of the students, etc. focusing on the holistic experiences of the students what they face the classroom situation and outside the class regarding to learning environment. During the interview of students, I tried to maintain the natural environment, so I did not use any field notes and other recordings. Instead, I wrote descriptive notes of their interviews as soon as possible in my notes, which included their

experiences on classroom, home environment and their surroundings. The interviews were verified by other participants and clarified by sequential interviews which formed the dialogue and emerging themes. The themes were analyzed and interpreted by using the thematic analyzing approach (Braun & Clarke, 2006). Transcribing raw data, generating initial cods, searching for themes, defining and naming themes, and analyzing were followed formulating the results.

Results and Discussion

The results of the study are mainly based on the student' experiences on learning mathematics especially in difficulties on construction of geometrical shapes that are comparison to the area of other. In this study, I focused on the construction of triangle and parallelogram to the equal area of given quadrilateral. The discussion with students about their mathematics learning activities and learning difficulties such as conceptual capacity, home environment to study, socio-cultural imbalance to study, classroom appearances, class activities, class work, and completed mathematical tasks. After collecting data and making the codes and sub codes the main themes were made. So, the study focuses on two main thematic areas. The results of the two thematic areas (conceptual complexity and socio-cultural reflection) are stated separately and some discussions have been also made.

Conceptual Complexity

Constructing triangles and parallelogram with comparison to area of quadrilateral is a big deal for the students. The concepts of triangle, parallelogram and quadrilateral and also the relation between areas of those figures only guide to construct the required figure. Pre knowledge about the construction make easy to construct any geometrical figure. Students' active attention and teacher's co-operative guideline make teaching learning very interesting. In public schools of Nepal, less frequently, teaching learning activities involves students in classroom activities. There is a lack of teaching materials, technical tools, and teaching aids, as well as a lack of training for teachers to apply such

an approach in teaching mathematics (Panthi & Belbase, 2017). Selected students experienced less opportunity in classroom activities for construction. All four students share their experience "we cannot construct the geometrical shapes, angles and areas of any figure because we don't have the basic concept of construction." This indicates that the lack of pre knowledge about geometrical construction students feel complex to construct geometrical figures. They also shared they missed such classes on geometry portion in previous classes. In classroom they stay with their homogeneous and ethnical group of below average score. So, no one of their classmate guide to construct the figures. One student shared that in class eight and nine they missed some lessons because of COVID pandemic. Some lessons of geometry had not been taught on those classes. Students' fear is about the question on the final examination. One compulsory question is included from construction. Without clear concept the question from this chapter cannot be done.

The obvious problem was the teacher's behaviour towards the superior and domineering students; the weaker students were not included in classroom activities, and their complaints were not supported. The phenomena shows that the ethnic minority students feel shy, they hesitate to ask question, among them most of the students were below average. One student shared his bitter experience that "teacher only engages with talented students and asks questions only to them; we don't understand the process and afraid to ask question to the teacher." This indicates that poor students wanted to learn but teachers did not co-operate with them. Teachers being biased against poor students, they cared for those who are brilliant, talkative and smart in class. This type of unfair discrimination discourages the poor and dominant students to make clear concept about the topic what they learn. The basic concepts were not clear for them who were back benchers, ethnical minorities or weak in mathematics.

Through self-practice and self-reflective activities, students were able to maintain their attention on in-depth learning throughout the courses (Karaali, 2015) and make

students clear about the concept on geometrical construction. Guidance at home is also an essential part for learning. It shows the guideline for students' performance. Most of the students treat mathematics as a difficult subject. They may have less time to practice at home, one student shared "actually we do not have clear concept at school then what to practices, how to solve and to whom ask question. To discuss with friend, he/she is also on the same problem. Other talented friends did not help us." This shows that the main complexity of construction is deal with the clear concept about construction. The problem for construction is based on the concepts and properties of geometrical shapes. Students knowingly or unknowingly missed the prior knowledge of construction. The teacher also accepts that the students do not understand the basic concepts of construction. He argued that "those students who are weak in mathematics always absent in mathematics class so, they missed the things what I taught in class. They should be aware to be present in each class." This indicated that class bunk is one reason for the conceptual complexity.

Socio-cultural Reflection in Classroom

The students are from different social, cultural, economic and ethnical background in the selected school. School is a miniature society (Dewey, 2001), so the level of students as their caste, gender, socio-economic, cultural and environmental activities reflect on the classroom. Nepal's multicultural society is hierarchical and divided along the lines of caste, ethnicity and language and its school system, including curriculum and pedagogy, is influenced greatly by the dominant language and culture (Khanal, 2017a). Many students from ethnical minorities cannot express their experiences and difficulties to the peers and teachers because of hesitation. Minority cultural background and ethnical students have domination from the so called upper cultural students in classroom. They feel regret when they do not understand the description of mathematical concepts. One student shared "I did not understand some words used by teacher, in one class I used to ask for detail description of the question in geometry class. My *Brahmin* friend teased

me and said 'you *Limbe* did not understand those easy words' then I felt so regret and left to ask any question to the teacher." This shows that the domination culture was developed from their society and it still reflects in the classroom. As Khanal says the curriculum, peer culture, and language of schools have all been used to reinforce and manifest the symbolic violence towards minority children in school. Socially the ethnic minority students feel domination and they cannot fight with this type of discrimination. Also, they cannot say anything to their teachers, so teachers have no idea about this type of simple but dangerous discrimination.

Regular class attendance is essential requirement for the mathematics students because of the nature of mathematical courses. Mathematical courses are designed as sequential form, if the student missed the previous class, then he/she cannot understand the further concept. I have seen in my village some parents are not aware to send their children in school. One student shared "I did not attain my first class of construction chapter because I had to go to work in my neighbour"s field as my parents borrowed some money for that work." It indicates that their economic status also affects their study. The participants were sharing their geometrical instruments for construction geometrical figures, when I met two of them at first time on their home. They also share their reading material, one of them has geometrical instrument and other has book they shared each other because of not enough money. The mathematics teacher shared the actual situation in the classroom:

> In class ten there are total of forty-six students, but nearly thirty to thirty-five students only present in class each day. Among them only twenty-five students are regular others come alternatively. Some of them go to work for money to support the family, some of them for household work. Then, how can they do mathematical problem? Also, geometry is more conceptual part, to construct geometrical shapes students should have pre knowledge but most of the students missed the pre classes.

This indicated that teacher was doing his best but socio-economic status, cultural context and tradition of family, the students did not attain their classes regularly. Mathematics is a sequential structured course; especially the geometrical part of mathematics is sequential in vertical and horizontal form. If the students miss one of their classes, then the connection will break and students may not understand the mathematical concept. The ethnical minorities' students had missed their classes because of socio-economic status of their family. The priority of those children was their household work, fulfillment of economic problem of family, presence in cultural tradition. These socio-cultural factors affect the learning of mathematical problems.

Conclusion

This phenomenological study raises a critical issue of conceptual difficulties of construction on geometry by the culturally or ethnically backward students. In secondary level mathematics course of Nepal, the problems on construction like 'construct the triangle or parallelogram with comparing the area of given quadrilateral' are mentioned. To solve these types of problem the basic concept of geometry is required. Most of the students do not have basic concepts on construction of geometry. Students from ethnical minorities have conceptual complexity for construction of geometry because of missing pre-classes, negligence of students; teacher's less support to below average students and their home environment. They were engaged most of the time in their household work and absent in their classes. The main reason for complexity of construction on geometry is class bunk and irregularity in classroom attendance. The geometrical part of mathematics is sequential in vertical as well as in horizontal form. The ethnical minorities' students had missed their classes because of socio-economic status of their family. The priority of those children was their household work, fulfillment of economic problem of family, cultural conditions. The socio-cultural activities were reflected in the classroom. The culturally different students were dominated by the so-called upper

cultural students. In mathematics class they feel shy to ask question to the teacher about construction in geometry.

References

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology, 3*(2), 77-101. https://doi.org/http:/doi.org/10.1191/1478088706qp063oa

Creswell, J. W. (2007). *Qualitative inquary and research design: Choosing among five approaches* (2nd ed.). Sage Publication.

Dewey, J. (2001). *Democracy and education*. Pennsylvania State University

Karaali, G. (2015). Metacognition in the classroom: Motivation and self-awareness of mathematics learners. *Problems, Resources, and Issues in Mathematics Undergraduate Studies, 25*(5), 439-452. https://doi.org/10.1080/10511970.2015.1027837

Khanal, P. (2017a). Falling prey to the dominant culture? Demystifying symbolic violence against ethnic minority students in Nepal. *Pedagogy, Cultura and Society, 25*(3), 457-467. https://doi.org/10.1080/14681366.2017.1280841

Khanal, P. (2017b). Falling prey to the dominant culture? Demystifying symbolic voilence against minority students in Nepal. *Pedagogy, culture & Society, 25*(3), 457-467. https://doi.org/https://doi.org/10.1080/14681366.2017.1280841

Miyazaki, M., Nagata, J., Chino, K., Sasa, H., Fujita, T., Komatsu, K., & Shimizu, S. (2019). Curriculum development for explorative proving in lower secondary school geometry: Focusing on the levels of planning and constructing proof. *Forntiers in Education, 4*(31), 1-9. https://doi.org/10.3389/feduc.2019.0003

Naufal, M. A., Halim, A. A., Osman, S., Abu, M. S., & Ishlam, H. (2020). Van Hiele level of geometric thinking among secondary school students. *International*

Journal of Recent Technology and Engineering, *8*(6). https://doi.org/10.35940/ijrte.F7541.038620

Panthi, R. K., & Belbase, S. (2017). Teaching and learning issues in mathematics in context of Nepal. *European Journal of Educational and Social Sciences*, 1-31. https://doi.org/10.20944/preprints201706.0029.v1

Razack, N. (2001). Diversity and difference in the field education encounter: Racial minority students in the practicum. *Social Work Education*, *20*(2), 219-232. https://doi.org/10.1080/02615470120044310

Salazar, R. S. (1997). A social capital framework for understanding the socialization of racial minority children and youths. *Harvard Educational Review*, *67*(1), 1-41. https://doi.org/10.17763/haer.67.1.140676g74018u73k

Sharma, S. (2019). Use of theories and models in geometry education research: A critical review. *Waikato Journal of Education*, *24*(1), 43-54. https://doi.org/https://doi.org/10.15663/wje.v24i1.644

Central Bureau of Statistics. (2012). *National population of housing census 2011*, Nepal Government.

Ubi, E. E., Oding, A. U., & Igiri, O. I. (2018). Geometry viewed as a difficult mathematics. *International Journal of Science and Research Technology*, *3*(11), 251-255.