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Teachers' And Students' Experiences In Chemistry Learning Difficulties

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Abstract- This study was carried out to determine what teachers and students think about how difficult it is for students to learn chemistry. Based on a qualitative research design, this study looks at the experiences of students and teachers in high school and how they learn about chemistry. Three public schools and their respective six science teachers were chosen on purpose. The data was collected through in-depth interviews with 21 students and six teachers, open-ended questionnaires, three focus group discussions (FGDs), and three classroom observations. The information was then analyzed by manual procedure and with N-Vivo version 11. Students find it hard to understand the idea of a chemical reaction. Learning problems can happen because chemistry is a complex subject, there are not enough suitable teaching materials or methods, or the scope and order of the secondary science curriculum are unclear. The most important results of this study show that students have a negative view of learning chemistry, making it hard for them to learn. So, the Interactive Demonstration Method (IDM) is recommended for teaching and learning chemistry that students will often use daily life.

Keywords- Teachers experience, learning difficulties, chemistry learning etc.

I. Introduction

The knowledge of Science is necessary for school education since all require scientific and technological literacies. Science has been included as a compulsory subject in the school curriculum of Nepal (SSSC). The secondary school science curriculum has been developed in integrated science, providing physics, Chemistry, Biology, Astronomy, and Geology. The school curriculum has introduced Chemistry as a major component of Science. As mentioned in Yadav (2007), Chemistry is the study of the preparation, properties, structure, and reactions of the chemical elements with their compounds and the system they form. Present age is the era of science, and more people are being employed in scientific pursuit that requires the knowledge of chemistry. In many of our ordinary methods, the transmission of knowledge is relatively ineffective in the students' ability to lead difficulties in learning. Learning difficulties is a catch-all term for different kinds of problems in school. It includes general problems with learning and poor academic performance, such as those caused by disabilities, as well as more specific problems like reading, symbols, and math related problems (Buttner & Hasselhorn, 2011). Learning difficulties are a group of

problems that make it hard to learn and use skills like listening, speaking, reading, writing, reasoning, or math (Hammill, Leigh, McNutt, & Larsen, 1987). These disorders are very different from one person to the next.

Many of the students have difficulties in understanding the fundamental concepts of chemistry (Kavanaugh and Moomaw, 1981). The Research report carried out on students' understanding of chemistry concepts has revealed that students have many errors. The concepts studied include equilibrium Banerjee, (1991), phase changes Bar & Travis., (1991), a chemical reaction Barker & Millar, (1999), gases Benson, et al., (1993), stoichiometry Boujaoude & Barakat, (2000), atoms and molecules Griffiths & Preston, (1992), acids and bases Ross & Munby, (1991), and covalent bonding Peterson et al., (1986). Most of the topics of chemistry teaching in which students hold misconceptions are basic to chemistry knowledge. According to Bucat (2004)"Chemistry is a complex and vague field that requires considerable skill and effort to teaching and learning, and requires the joint efforts of chemistry education professionals, subject expert and content specialists in all fields working together to analyze the demands of learning chemistry to find better ways onward" (p. 2). From his observations, Johnstone (1991) presented a helpful idea when he concluded that chemistry could be taught at three levels such as macroscopic, submicroscopic, and symbolic level.

Therefore, in the NCF report the emphasis has been given to conducting explorative, interactive, and innovative teaching-learning activities for effective teaching and learning. Priority has given students attitudes towards learning and other phenomena mobilized local resources that are related to the daily life of students within the local environment, linked co-curricular and extracurricular activities to strengthening the teaching and learning, and removing the difficulties of teaching and learning in Science. But in our practice students have poor performance in science as the teaching-learning is dominated by rote memorization; our schools have not focused on students' attitudes towards learning and difficulties experienced by students and teachers. Thus, the teaching-learning is not related to our daily life. Similarly, the research report shows that the chemistry portion of Science is more difficult than physics and biology (Atagana & Engida, 2014). The students do not take interest in chemistry as they experience difficulties in learning chemical concepts because there is no interaction, demonstration practice, lab exercise, or hands-on and minds-on experiments (Ali, 2012). The teaching and learning of Science are dominated by recitation and rote memorization. The low performance of students in Science is a serious problem in secondary school. Hence, it may be the cause of difficulties in learning chemical concepts. Therefore, situating its scope of exploration in this gap, this study has attempted to explore the teachers and students experience on difficulties in learning chemistry.

II. Materials and Methods

To explore the difficulties of learning chemistry, we used qualitative techniques. It is a method of inquiry that explores the phenomena in their natural setting. we used multi-method techniques to understand, interpret, explain, and meaning-making for them as mentioned in (Acharya, 2017). Kathmandu district and six science teachers and their 21 students were selected as the site and sample for this study. During the study, the real names of the participants have not been disclosed to follow research ethics. The information was gathered through interviews of children, science teachers, through open-ended questionnaires, FGD, and classroom observation. The concept of observation indicates that data should enable the researcher to enter and understand the situation that is being described (Patton, 1999). we analyzed the data manually as

well as N-Vivo version 11 based on word cloud inquiry, codebook, code, and reference relation, code relation with literature diagram, items clustered by word similarities, recordings, transcribes, photos, videos, and memos to the self. Thus, the participants create a world by a series of representations, including field notes, interviews, photographs, recordings, and memos to the self in this study. we interpreted the meaning generated by qualitative data was obtained through my participants. Thus there exist multiple interpretations of social realities from the perspectives of participants and we as a researcher.

III. Result and Discussion

Most of the teacher respondents who expressed that the difficult areas of chemistry learning of students they failed to understand the concepts of chemistry were related to the study of (Ali, 2012; Chavan, 2019; Dwyer & Childs, 2017; Tilahun & Tirfu, 2016; Utami, Saputro, Ashadi, Masykuri, & Widoretno, 2017; Tsaparlis, 2017). Dwyer and Childs (2017) purposed their experience on some of the challenges for teaching and learning in science. These studies also guided the teachers' experience of students learning difficulties in chemistry.

IV. Teachers' Experience of Students Learning Difficulties in Chemistry

The teachers experience on difficulties in learning chemistry were analysed intreprete and discussed based on the following theme:

Difficulty in Learning Chemical Reaction: Kuls' experience in teaching Science

Teachers, students, and teaching contents are the triangular process of teaching and learning. So teachers have directly involved in the teaching-learning process and they have many experiences with the difficulty in learning chemistry. In line of its discussion, Kuls' experiences of teaching science are stated here related to areas of learning difficulties.

> Chemistry is a difficult portion than other areas of science. Fewer students give answers in examination than in another branch of science. So, students have less interest in chemistry. Teachers use science laboratories to some extent and students do not use them properly. A chemical reaction is a difficult unit and the symbols of elements in chemistry have dual meanings. Thus, students memorize the symbols of elements in meaningless ways. The difficulty is not rumored but students feel actual difficulties in chemistry. I start class from the basic level from a symbol, electron, proton neutron, and classification of elements. They experienced difficulty in learning chemistry. Gases are abstract concepts so these concepts are difficult for students. Our teaching is based on rote learning and teachers have less technique to understand the chemical concepts of students. Symbols, valences, electronic configuration, and chemical equations are difficult for students (Interview recorded; 30 July 2017).

The above information about the science teacher's discussion on the experiences of learning difficulties in chemistry indicates that chemistry has several symbols and formulas which are very difficult to understand and not related to other subjects. Students felt chemistry as an abstract subject. Students were confused

about the Latin and English meanings of element and their symbols. Thus, linguistic dualism in symbols also leads to difficulty in chemistry learning.

Chemistry to Everyday Life: Nanis' experience in teaching Science

Teaching methods also play a significant role in teaching and learning in science. Teaching methods are the ways or patterns of teaching implemented in the classroom for desirable outcomes expected from the students. There are two types of teaching methods. They are teacher centered and learner-centered methods. In teacher-centered methods, students are passive listeners and the teacher lies in the center of the teaching-learning process. These may lead to difficulty in learning chemistry. The relationship of teaching chemistry to students' everyday life helps to connect the prior knowledge based on the constructivist perspective outlined previously (Yagar, 1991). For the discussion on the above heading, Nanis' experiences of teaching science are stated here related to areas of learning difficulties.

> I have been teaching all five sections of science for the last 36. They are physics, chemistry, biology, astronomy, and geology. Students never understand if the chemistry is taught by teacher-centered methods such as carbon, chlorine, calcium, etc. If we tell the definition such as a symbol of elements to the students, it becomes very difficult to learn chemistry, but if we make them through drama or role play they learn better. I make them use imagination. I use the flashcards for the classification of elements and make them arrange the difficult symbols of elements in a similar way. Ninety-nine percentage teachers say that chemistry is difficult due to abstract nature but I feel easy. The characteristics of gas, for instance, can be visualized by using an interactive demonstration. Teaching chemistry can be related to daily life experiences of students. I make them feel many examples of daily life experiences by deep inhalation of oxygen and excretion of carbon dioxide. Among them, some examples likes? Do you have a taste of lemon? Have you used chlorine to purify the water? Are you familiar with turmeric? Have you eaten a tomato, have you used soap for cleaning purposes etc. There are many teaching methods, among them investigation, learning by self-investigation, inquiry, heuristic, demonstration with interaction, problem-solving, and project method, I like most (Interview recorded; 4 August 2017).

Nani's experiences indicate that chemistry is a difficult part of science at the secondary level. Students feel chemistry as abstract and complex subject. The teaching of chemistry has no direct connection to the students' daily life experiences. And it is usually not using learner-centered methods. Therefore, it becomes difficult to learn chemistry. Many areas of chemistry like the symbol of elements, some gases, and the characteristics of gases are difficult areas in chemistry.

Lack of Link in Prior Knowledge: Pradips' experience in teaching Science

The prior knowledge is related to the constructivist philosophy of learning as well as the learning theory of constructivism. It is the central idea of teaching and learning. Human learning is constructed that the learners gain new knowledge based on previous learning. This prior knowledge affects what new knowledge of an individual will construct as the new learning experiences (Phillips, 1995). For the discussion of this heading, Pradips' experiences of teaching science are stated here to the areas of learning difficulties in chemistry.

> The results of science at school show that students have low achievement in chemistry. All chemistry is difficult and chemical reaction is more difficult for students. They do not understand the chemical formula. I make them understand by easy way to teach. Lack of link in prior knowledge is a barrier to learning chemical concepts. Teachings are done by creating interest and matching the level of students. Teaching methods are also important for creating a conducive environment in the teaching-learning process. Chemical reactions are abstract things but they can be visualized by interaction with demonstration teaching. Nothing of chemistry is possible without demonstration. Teachers have less ability to understand the chemistry concept based on daily life. Examples are not related to daily life and our teaching is based on rote learning. So chemistry learning is difficult for the students. There is a lack in the vertical linkage of courses among grades 6 to 9 of science subject, but the existing curriculum is improved than the prior ones. I start class from basic knowledge of chemistry including some daily life examples of soap, detergent, ash, salt, oil, Coke, Fanta, sugar, lemonade, and different forms of the mixture which give the prior learning experiences to the students (Interview recorded; 7 August 2017).

Pradip's experiences of teaching science show that the teachers have less ability to connect the students' prior experiences with the situation of new learning of chemical concepts. It leads to the difficulty of learning chemistry. Not relating chemistry to daily life, chemistry teachings based on rote learning, lack of vertical linkage in science curriculum are the obstacles of chemistry learning. Symbols, valency, chemical equations, chemical reactions as well as whole areas of chemistry are difficult for learning at the secondary level.

Teaching is More Theoretical: Rabindras experience in teaching Science

The science subject is both theoretical and practical in nature. Many hands-on and mind-on activities could be implemented for the effective teaching and learning of chemistry. Exam orientated teaching based on rote memorization; less focus on practical and demonstrative activities are the serious problems of our school teaching. For the discussion of the above lines, Rabindras' experiences of teaching science are stated here to the areas of learning difficulties in chemistry.

> Chemistry is a difficult area of science subject. Chemistry teaching in our context is more theoretical. Chemical reaction, atomic structure, the balance of

> chemical reaction is more difficult. Lack of skill of the teacher to deliver the prior knowledge for students related to chemistry. The teacher has less focus on chemistry teaching in the lower classes. The area of chemistry is abstract due to symbols or symbolism. Teaching the Latin names of elements is difficult. They were written SOCl for sodium chloride in the state of NaCl in the examination. Reaction and gases are abstractive so it is difficult. Our traditional teaching patterns are also defective. To make it easy more focus on teaching area of chemistry in lower classes should be given. More focused on interactive methods and lab demonstration will help students understand chemistry. Teaching-learning is highly focused on the view of examination other than learning. Students have made them learn easy, they have to engage in an interactive demonstration in the chemistry classroom (Interview recorded; 1 September 2017).

Rabindras' experiences of teaching science reveals that the practices of our traditional teaching are based on rote learning and it enhances the theoretical teaching-learning in chemistry. It also shows that the students have less ability to connect the prior experiences with the new learning situation in chemical concepts. It leads to the difficulty of learning chemistry. Teachers have less focus on teaching chemistry at the lower level, and teaching is only exam-oriented. The students are confused with Latin and English representations. Chemical equations, chemical reactions, atomic structure, balancing chemical reactions were more difficult for learning chemical concepts at the secondary level.

The above information of the science teacher discusses the area of learning difficulties in chemistry. It has several symbols and formulas which are very hard due to linguistic dualism like Latin and English language. The abstract nature of chemical reactions and characteristics of gases made students feel difficulties in learning chemistry. One of the participant teachers Hari said:

> Chemistry is a difficult subject. The symbols, valency, electronic configuration, chemical reaction, the balance of chemical reaction, atomic structure, some gases are the difficult areas of chemistry due to the abstractive nature of the subject matter, less interest of students towards science, symbolism, more memorable text, less focus, less concentration due to lecture, lack of preconception in chemistry learners, students write the symbol of sodium SO, potassium PO and sodium chloride SOCl in the exam because of the symbolic dualism Latin and English symbols, less use of laboratory method and interactive demonstration, teaching is exam centered no other than meaning full learning, lack of concept linkage in the curriculum, less use of a learner-centered method like experimental method, lack of the concept knowledge in teacher. Our teaching is based on rote learning and meaningless memorization. Lack of concretization of chemistry

> concepts and lack of experienced teacher is the major factor that affects the teaching-learning of chemistry (FGD note; 11 September 2017).

The information in Haris' experiences of teaching science also indicates that chemistry is a difficult area of science. Various areas of chemistry like symbols, valency, electronic configuration, the chemical equation, chemical reaction, balance of chemical reaction, atomic structure, and some gases are the difficult area of chemistry was explored through Haris' experiences of teaching chemistry.

V. Students Experience and Learning Difficulties in Chemistry

Chemistry is one of the important branches of science; it facilitates the learners to identify what happened around them. Because chemistry topics are generally based on the structure of matter, it proves a difficult subject for many students. The chemistry curriculum commonly includes many abstract concepts, which are central to further learning in both chemistry and other sciences (Taber, 2002). These abstract concepts are essential because further chemistry concepts and theories cannot be easily learned if these supporting concepts are not appropriately grasped by the student (Coll & Treagust, 2001). For the discussion on areas of learning difficulties in chemistry experiences by students, the supportive views of respondents on this problem are as follows:

> I live in Pani dhara. My room is 15 minutes far from the school. There are 7 members in my family with me. My father is a Veterinarian (Pashu Chikitsak) and my mother is working in the field. Chemical reaction, valency, molecular formula, and crisscross method of writing the molecular formula are difficult concepts for me. Noise in class is a hindrance to learning science. I have not followed the reading schedule. The experimentation method and interaction followed by a demonstration make me understand the chemical concept. I have no interest in reading science. I want to make myself a businessman in the future (Interview recorded; 7 August 2017).

Mins' experience of learning science indicated that chemistry is a difficult area of science. Our teaching-learning is teacher-centered. As a result of the teacher-centered method, noise in Mins' classrooms and they have not learned chemical concepts. He has no interest in reading science and he wants to make a businessman in the future. Chemical reaction, valency, molecular formula, and crisscross method of writing the molecular formula were the difficult areas of chemistry explored by the mins' experiences of learning science. For the supportive views of the Mins' learning difficulty in chemistry, Kabitas' experience is as follows:

> My name is Kabita Chulagain. My school is 5 minutes far from the room. I have six family members with me. Chemistry units are more difficult than other branches of science. I am a regular student at my school. Reaction, classification of elements, crisscross methods is difficult for me. We are using a science lab but not properly using it skillfully. I participate in classroom discussions while teaching science. It is interesting when classroom teaching is related to our daily life. I memorize the symbol, but I do

> not know how science is going on in our daily life. I confuse valency and symbols like nitrogen and oxygen in terms of the scientific way (Interview recorded; 11 August 2017).

Kabitas' experiences of learning difficulties in chemistry have shown that the units of chemistry were more difficult than other branches of science. Chemical reaction, classification of elements crisscross method to writing the molecular formula was a difficult area of chemistry for the chemistry learner. The rote learning tradition is not connecting them to the daily life experiences of a child. Thus, they were confused about the concept of valency and symbols like nitrogen and oxygen in terms of scientific ways. Similarly, Nirmala has different experiences among the all responses of the participants. The Nirmalas' experiences of difficulties in learning chemistry are as follows:

> As a student, she said to me "my school is 25 minutes far from the room. I have 6 family members with me. My mother works in baby care. I separate 15 minutes to study science. My study is based on the schedule. Nepali and social subjects I like the most because both subjects are based on our language. I have no interest in science because I have no time for hard work to read science. It can make it easy by laborious reading and writing" (Field note, 2017).

The student's interest in the subject matter plays a vital role in learning chemistry. It decreases the reading frequency of students and makes them too difficult in learning. The language of reading materials and conversation mode of teaching also leads to difficulty in learning. Those dimensional areas of difficulties in chemistry were supported by the Nirmalas' experiences of learning science. The Jubins' views are supportive of the Nirmalas experience in learning science is as follows:

> My name is Jubin Singh. My house is Bajhang. I live in Narayan tar. My room is 15 minutes far from the school. I have 4 family members with me. My study is based on temperament but not based on a schedule. I will study hotel management (HM) in the future. I have opened the hotel in Bajhang and attracted tourists toward Bajhang. I generate the income from the hotel. (Interview Recorded; 1 September 2017).

Jubins' experience indicated that education is not connected to the daily life problem of the people. He has no interest in reading science due to the difficult subject. Similar to Jubin many students have not chosen science at a higher level also. He wants to study HM and opened a hotel in his home town Bajhang. His future thought concerned with the income generated from the establishment of a hotel in Bajhang districts. On the opposite of the Jubins views, Pasang has a reading interest in science.

> My name is Pasang Sherpa. I live in Tinchuli. My room is 10 minutes far from the school. I have 5 family members with me. My mother was dye. I study science according to my schedule. I have an interest in reading in science. I will study the nursing course after the SEE examination. I have interested in the care of sick people in hospitals. (Interview Recorded; 1 September 2017).

Pasang's views show that she wants to study nursing due to her interest in the care of sick people in the hospital. Her future thought is concerned with the income generated from the establishment of a job in nursing. Her response was concerned with the income source. It represents the study of science should be directly connected with a solution to the problems of people in daily life. Thus, this helps create an interest to study the chemistry portion in science. Likewise, Bhaskar and Ram Krishna also had similar experiences on the difficulty in learning chemistry. Ram Krishnas' views are as follows:

> My name is Ram Krishna Khatri. I live in kirtipur. Kalanki jam is made me late to school sometimes. My room is one hour far from the school. I have 8 family members with me. My house is Ramechhap. My father works in India and my mummy works in the field. I feel chemistry is a difficult portion of science. Chemical reaction, acid-base and salt, reaction part, and Gases are difficult areas of chemistry for me. A lab demonstration is useful for us. I will study management after the SEE examination. I am studying at home with my brother. (Interview Recorded; 7 August 2017).

Ramakrishna's view indicates that school distance from the room and family environment also plays a supportive role in learning. It seems that Ram Krishna has not managed the school distance and the traffic jams of kalanki also affect his school time. In his experience, he has felt that chemistry is a difficult portion of science. Chemical reaction, acid, base, salt, reaction part, and Gases are difficult areas of chemistry. Like Ram Krishna, Lalita Surel her science class noisy due to traditional teaching methods. She has not understood the chemistry concept because of the noise. Her experience in learning difficulties of chemistry is given below:

> My name is Lalita Phutawal. I live in Ratimate. My room is 20 minutes far from the school. I have six members in my family with me. Baba and mummy are farmers. I read the notes of science dictated by the science teacher. Noise in classroom teaching is a barrier to learning. 'Classification of the elements" unit is difficult for me. Generally, I do not follow the timetable to study at home. My study is based on temperament. (Interview Recorded; 7 August 2017)

The unit "classification of elements" in chemistry is a difficult area that was experienced by Lalita while learning science. This unit of chemistry consists of symbols, valency, electronic configuration, and periodic table at the secondary level of science subject. On the discussion of difficulty areas of chemistry, Susmitas' views of learning science are as follows:

> My name is Susmita Nagarkoti. I live in Gairi Gaun. My room is 15 minutes far from the school. I have 4 family members with me. My father works in a vehicle and my mother works at home. I study according to time table in my home. "Classification of elements" among the twenty units is difficult for me. Teaching way is good nowadays. We are weak in the study. Lab demonstration with class interaction can reduce the learning difficulty in chemistry.

(Interview Recorded; 13 August 2017)

Susmita's experience shows that student-related difficulties like less focus on readings, less interest in the chemistry subject, and family environment are also a predictors of learning chemistry. "Classifications of elements" out of twenty units was the difficult area of learning chemistry in the part of Susmitas' experiences of learning science.

Most of the views of respondents indicated that chemistry is a difficult part of science subject. Among them Kailashs' experiences of science learning at the secondary level are as follows:

> My name is Kailash Ghale. I live in Panch chuli. My school is five minutes far from the room. I have no schedule for reading. I have six members in my family with me. Nepali is an easy subject for me. Chemical reactions and mathematical problems are difficult areas of chemistry. Noise in class is a barrier to my learning chemistry. I interchange my sit to reduce the noise effect and maintain concentration. (Interview Recorded; 7 August 2017)

Similar to other respondents, the chemistry part of science is difficult for Kailashs. Nepali subject is easy to learn for him due to his interest in the subject matter. Most of the learning experiences show that chemistry learners have negative responses to chemistry. Similarly, Kailash has also less interested in learning chemistry due to a negative attitude. He tried to control the noise during his time in classroom learning but he can't manage it. Chemical reactions and mathematical problems are difficult areas of chemistry in his learning experience in science at the secondary level.

VI. Conclusion

The analysis and interpretation of information obtained from the questionnaires, interview, classroom observation, FGD, and experience of the teachers, students, and researcher it was concluded that the elements, symbols, valency, atomic structure, electronic configuration, the chemical equation, crisscross method of writing compounds and molecules, chemical reaction, some gases, characteristics of gases, and numerical related problems were the difficult areas of chemistry sector of science subject. Similarly, there was less focus on laboratory work, lack of prior knowledge to the students, traditional teaching method and understanding of the chemical concept, lack of language and communication skill, chemistry and their abstract concept, complexity in the level of conceptual understanding of chemistry, family environment, and their educational background, gap of linkage among the basic level to the secondary level of the science curriculum, negative perception of students towards chemistry, and chemistry anxiety were explored as the causes of learning difficulties. It was also found that the provision of laboratory work, provision of learner-centered teaching strategies in a science classroom, the link of chemistry to everyday life, use of the proper language of chemistry by teachers, use of relevant teaching-learning materials, improvement in our schools' assessment system, provision of qualified and experienced science teachers, and minimize the gap of horizontal linkage in the science curriculum were the possible solutions of learning difficulties in chemistry sector of science education.

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VIII. References

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