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Bachelor Level Students Misconception in Chemistry Education

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Abstract

This study aims to investigate the "Bachelor Level Students Misconception in Chemistry Education" I applied quantitative and qualitative research design (Quan-qual) with the use of descriptive using the data obtained from the set of conceptual questions. The sample consisted of 40 bachelor's secondary major chemistry students in Mahendra Ratna Campus, Tahachal Kathmandu. I used in this study for identifying the misconception about chemistry were through the questionnaire. A set of 30 conceptual questions were given to the Bachelor's second-year students. where the student had to give reasons to identify their source of knowledge, with their answers. Each item of the misconception test consisted of multiple-choice question. My research finding most of the students in chemistry has misconception which has affected the learning of students. This suggests the conclusion that there is some common misconception in chemistry among bachelor's level students. The maximum number of students developed the falsified concept in organic chemistry portion which is followed by inorganic and physical chemistry. Most of the students' source of misconception in science was found to be from their own intrinsic knowledge.

Introduction

The main goal of chemistry classes is to familiarize pupils with everyday events or nature and aid in their understanding of natural processes (Barke et al., 2009). Chemistry is a science full of fascinating events, fascinating experiments, and important information for comprehending daily life, claims (Shehu, 2015). However, because chemistry is such a complicated subject, students must not only comprehend the theories, symbols, and terminology used to teach chemistry concepts, but they must also adapt the teacher's vocabulary and instructional materials so that they are meaningfully represented.

Realizing meaningful learning is the primary goal of teaching and learning strategies. To do that, a pupil must filter within his or her intellect the acknowledgments they have received from the outside world. Fundamental ideas in this setting must be fully understood. In general, it is possible to recognize misconceptions as inaccurate prior information in the way of meaningful learning. Students may make various mistakes while thinking about abstract concepts since grasping a chemical concept necessitates identification at macroscopic and microscopic levels. (Urek et al., 2005; Canpolat et al., 2004; Novick et al., 1981).

Science is the systematic observation of natural events and conditions to investigate facts about them and formulate laws and principles based on these facts (Sagan, 1994). Science is crucial to the long-term survival of our species. Everybody considers science as a prime factor in the development of humankind. So, knowledge ofscience is necessary for modern living. Science is the systematic observation of natural events and conditions to investigate facts about them and to formulate laws and principles based on these facts (Sagan, 1994). Science is crucial to the long-term survival of our species. Everybody considers science as a prime factor in the development of humankind. So knowledge ofscience is necessary for modern living.

The majority of chemistry lessons have misconceptions that have been uncovered. A surprising number of these myths have to do with the abstract concepts employed to explain chemical phenomena at the level of atoms and molecules. The explanatory framework of contemporary chemistry relies heavily on models of the sub-microscopic structure of

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matter. These entities are obviously too little to be observed to be demonstrated to students. As a result, we must provide students with a variety of representations that reflect a portion of the speculative nature of the molecules and ions that we want them to utilize as conceptual frameworks for explanation. Even though we frequently utilize models and graphics to illustrate concepts, these always only provide a poor approximation of what we are trying to convey. These compounds Misconceptions are misunderstandings and misinterpretations based on incorrect meanings. They are due to 'naïve theories' that impede the rational reasoning of students. Science textbooks do not treat the issue of misconceptions directly. Therefore, teachers' dependency on these texts for instruction further minimizes the misconception issue. Because some of these misconceptions occur repeatedly in each grade, concerted efforts must be made by science educators to correct them. Teachers should be aware of the existence of misconception issues in science. Awareness coupled with the development of effective corrective strategies should help expose students to the correct way of thinking about scientific concepts. Students generally make errors that take two forms: conceptual errors and execution errors. Conceptual errors are related to a lack of understanding. Examples are structural which involves failure to appreciate relationships in the problem or to grasp some principles essential for its solution or arbitrary which involves a lack of loyalty to stop the givens of the problem under the influence of previous experiences. On the other hand, execution errors happen when an attempt to carry out some procedure breaks down or is only partially executed. Executive errors arise not from a failure to understand how the problem should be tackled but from some failure to carry out the manipulations required.

The understanding pupils have that the earth and the sun are related is a well-known illustration from elementary school. As they mature, adults tell children that the "sun is rising and setting," giving them the impression that the sun moves over the world. Teachers tell students that the planet spins in class, years after they have already developed their own mental models of how things function. The next challenging task for students is to replace an intuitively appealing mental model that they have formed based on their own observations with a less appealing alternatives (NRC, 1997). Students' acquisition of scientific knowledge is hampered by misconceptions (Behera, 2019). It might be difficult to dispel long-lasting misconceptions about a subject or topic matter (Abenes et al., 2020). In chemistry, there are many different kinds and forms of matter that give rise to misconceptions. Researchers discovered that misconceptions in chemistry, or "school-made misconceptions," were brought on by students as well as by unsuitable teaching strategies and resources. (Barke et al.,2009). Plans and initiatives must be put in place to dispel myths so that participants may comprehend the idea of chemical matter accurately. As each student creates his knowledge, understanding, and concepts according to his abilities and experience, Uce et al. (2019) state that it will be challenging to eliminate misconceptions by direct teaching approaches. Instead, it is vital to determine misconceptions and then eliminate these misconceptions.

Research Philosophy and Methodology

The methodological framework for examining the misconception of organic chemistry in science classrooms was laid out in this chapter. This was accomplished by detailing the study's research paradigm, where and how the study was conducted, where the inquiry was directed, and how the data was analyzed and interpreted. A research paradigm (Denzin et al., 2005) is a foundational belief system or worldview about reality and knowledge that provides the researcher with a wide overview and research direction (Khanal, 2012. The interpretive/constructivist paradigm will be used in this investigation. This study was taken into account a variety of socially constructed realities. The contact with the participants helps to construct knowledge. The design of this study may alter during the data collection procedures.

a) I used both quantitative and qualitative research design (Quan-qual) with the use of descriptive using the data obtained from the set of conceptual questions. The sample consisted of 40 bachelor's secondary major chemistry students in Mahendra Ratna Campus, Tahachal Kathmandu. I used in this study for identifying the misconception about chemistry were through the questionnaire. A set of 30 conceptual questions were given to the Bachelor's second-year students. where the student had to give reasons to identify their source of knowledge, with their answers. Each item of the misconception test consisted of multiple-choice question with common or suspected misconceptions was used as the distracters of the question so that the misconceptions could in some sense be summarized. Multiple-choice reasons to identify the source of misconception which required studentsto give their reasons for the answer they had chosen in order to analyze their misconceptions; and an open option for students to respond to, if their answers were none of the options given for the purpose of identifying more possible sources of misconceptions held by the students.

I used the data analyzed process by descriptive, logical, and statistical devices with the use of SPSS 20 version software. The misconception in science and sources of misconception were analyzed according to students' responses with the use of percentages and mean. The comparison of students' misconception according to gender and type of school were

analyzed using statistical tools such as mean, standard deviation, variance, and t-test.

Results and Discussion

The main objective of this study is to find out the misconception in organic chemistry among bachelor-level students in science education. The survey instrument consisted of 30 questions which were based on the of Bachelor's level chemistry curriculum for second-year students. Questions were according to the o researcher's own perception about of conception. Responses from the students studying in the bachelors second year were taken and the result were analyzed thoroughly, detailed analysis and interpretation of misconceptions of students in organic chemistry.

The misconception of chemistry students in Inorganic chemistry

Table-1, Item wise misconception of chemistry students in inorganic chemistry

Theme of Questions	No. of students with prevalent Misconceptions in inorganic chemistry				
	Government Campus	Community Campus	Overall		
	Total	Total	Male	Female	Total
1) the correct order of acidity	10	8	12	6	18 (31%)
2) The composition of Aqua regia	18	12	16	14	30 (51%)
3) The correct formula of the complex formed in the brown ring test of nitrates	12	12	12	12	24 (41%)
4) A solution of A contains 7 g/L $MgCl_2$ and solution B contains 7g/L of NaCl. At room temperature, the osmotic pressure of	17	17	19	15	34 (58%)
5) The metal which cannot be obtained by the electrolysis of the aqueous solution of its salt is	8	10	11	7	18 (31%)
6)Echo in a small room	7	4	8	3	11 (19%)
7) Which among the following is most reactive	16	13	20	9	29 (49%)
8) K_2MnO_4 can be converted to $KMnO_4$ using all of the following except	18	17	19	16	35 (59%)
9) What are the elements in group 18 is	14	10	16	8	24 (41%)
10) Which statement correct about halogens	20	18	24	14	38 (64%)
Mean	14	12.1	15.7	10.4	26
Percentage	44%	45%	46%	42%	44%

Table -1 shows that in inorganic chemistry, 26 (44%) students in average had misconceptions in the given questions. Both the Government campus and the community **campus had almost same level of misconceptions in inorganic chemistry i.e. 44% and 45% respectively. The level of misconception was found greater in male students (46%) than that of female students (42%). The result showed that inorganic chemistry had also some prevalent misconceptions deeply rooted among students. As suggested by the theory of constructivism, students construct the concepts of inorganic chemistry by linking with their own existing knowledge. The conceptual change theory also has revealed that in order to attain a new concept, the existing schema of thoughts should cooperate with the new thoughts. In context of inorganic chemistry, these theories need tobe applied to generate a correct conceptual understanding of students. The** cognitive structurealso plays an important role to settle the deeply rooted misconceptions as well as correct conceptions. Hence, teacher and educators should engage in discussions to remove misconceptions of students.

Sources of Misconception in Inorganic chemistry

Table-2, Sources of Misconception in Inorganic chemistry:

Sources of misconceptions	Question No.										
	1	2	3	4	5	6	7	8	9	10	Mean
i) You learned the answer from the teacher.	3	4	6	5	3	3	6	3	1	6	4 (15%)
ii) You learned the answer from the text Book or other sources.	4	7	5	9	7	2	3	5	3	4	4.9 (19%)
iii) You had an intrinsic knowledge About the answer.	7	11	7	13	7	4	14	13	10	17	10.3 (39%)
iv) You selected the answer randomly.	4	8	6	7	1	2	6	14	10	11	6.9 (26%)
v) other reasons	0	0	0	0	0	0	0	0	0	0	0
Total no. of students	18	30	24	34	18	11	29	35	24	38	26.1

Table-2 shows the sources of misconception in inorganic chemistry. Among the 5 options given tofind the source of misconception, 39% of the students with misconception in physic, had chosen the third option. Most of the student's source of falsified concept in physics was from their own intrinsic knowledge which they assume to be right. They have some kind of deeply rooted thinking in their mind for every concepts and it is very hard to replace with the correct scientific knowledge. In average, the least chosen source of misconception was from the teacher. Teacher gives information but they are not found to be wrong source of information.The students may have got very few alternative sources of knowledge from teachers. The greatest no. of students having misconception was found to be in question no.10. They have mentioned their source of knowledge in this question to be from their own intrinsic knowledge. This misconception has aroused due to their own preconceived thoughts. The least chosen (15%) source of misconception in question no.10 was knowledge gained from the teacher. Students may not read books to understand the concepts but they rely more on teachers or their own source of intrinsic knowledge.

The misconception of Chemistry students in Organic Chemistry

Table-3, Item wise misconception of Chemistry students in organic Chemistry

Theme of Questions	No. of students with prevalent misconceptions in Organic Chemistry				
	Government Campus	Community Campus	Overall		
	Total	Total	Male	Female	Total
11) Organic chemistry is defined as the chemistry	6	12	13	5	18 (31%)
12) Catenation is the ability of carbon atoms	23	19	23	19	42 (71%)
13) Hydrocarbons are compounds containing	20	19	20	19	39 (66%)
14) The general molecular formula of alkenes	14	15	12	17	29 (49%)
15) Which of the following statements is not true about hydrocarbons	14	15	14	15	29 (49%)
16) Which of the following is an aromatic hydrocarbon	13	12	11	14	25 (42%)
17) A family of organic compounds which follows a regular structural pattern	10	15	17	8	25 (42%)
18) The process of linking together small organic molecules to form a chain of repeating unit is referred to	13	9	13	9	22 (45%)
19) The existence of two or more compounds with the same molecular formula but different structural formulas is termed	19	13	18	14	32 (54%)
20) The main chemical property that differentiates methane from ethene is	13	15	12	16	28 (47%)
Mean	14.5	14.4	15.3	13.6	29
Percentage	45%	53%	45%	54%	50 %

Table - 3 reveal that, in organic chemistry, 29 (50%) students had misconception in the given question. In average, 53% of private school students were found having misconception whereas only 45% of community school students were found having misconception in chemistry. The situation about neutrality of atom had the greatest number (42%) of students with misconception. Both the community school and private school students had difficulty with the above question. Nevertheless, both genders had the misconception in the same question.

Organic Chemistry is a subject based on concepts, many of which are abstract and are therefore hard to grasp and learn especially when the students are put in a position to believewithout observing. On the other hand, students are basically familiar with a number of relevant concepts as a result of their previous learning (Roschelle, 1995). The potentially present preconceptions about the world itself can be reflected in the organic chemistry lessons and can sometimes grow into misconceptions. This might be the reason for having high number of students with misconception in organic chemistry. Teachers and educators should act as facilitatorin helping students to construct valid concepts and eliminate misconceptions with proper guidance.

Sources of Misconception in organic Chemistry

Table - 4 shows the number of students with their sources of misconception in organic chemistry. Most of the students (36%) had chosen their source as random selection in. In fact, the 4th option does not really mean any source, but it is an option chosen without having any preconceived knowledge from any source. This might be due to the abstract nature of chemistry. The correct conceptual understanding of student is very hard to construct and hence they answer the questions randomly. Neither the teacher nor the book has sufficient description needed to construct correct concept among students. The least chosen source of misconception (15%) was from teacher and book. It proves student usually do not perceive wrong concept from teacher and books. The greatest no. of students having misconception was found in question no.12. In this question, most of the students had revealed their source of misconception to be their own intrinsic knowledge.Furthermore, the least chosen source of misconception in this question was found to be book i.e. a smaller number of students had misconception from book.

Table-4, Sources of Misconception in organic Chemistry:

Sources of misconceptions:	Question No.										
	11	12	13	14	15	16	17	18	19	20	Mean
i) You learned the answer from Teacher.	5	7	6	3	5	3	2	7	3	2	4.3 (15%)
ii) You learned the answer from the text book or other sources.	3	4	7	2	5	4	5	3	6	4	4.3 (15%)
iii) You had an intrinsic knowledge About the answer.	5	19	14	9	8	9	6	7	10	12	9.9 (34%)
iv) You selected the answer Randomly.	5	12	12	15	11	9	12	5	13	10	10.4 (36%)
v) other reasons	0	0	0	0	0	0	0	0	0	0	0
Total no. of students	18	42	39	29	29	25	25	22	32	28	28.9

Misconception of Chemistry students in Physical Chemistry

Table - 5 shows that, in physical chemistry, 21 (35%) students had misconceptions in the given questions. 41% of community campus students were found having more misconception in physical chemistry while 29.3% of government campus students were found having misconception. The construction of knowledge by students in physical chemistry is easier as they can relatethe concepts used in chemistry with their life experiences. Hence misconceptions in physical chemistry are lower in comparison to other disciplines of chemistry. However, there is still some misconceptions prevalent among students. The multiple factors contribute in varying degrees to the acquisition and retention of student misconceptions in physical chemistry. It is imperative that we as educators identify sources of student chemistry related misconceptions, identify or developstrategies to reduce or eliminate such misconceptions, and implement these strategies at the appropriate junctures in students' cognitive development.

Table-5, Item wise misconception of Chemistry students in Physical Chemistry

Theme of Questions	No. of students with prevalent Misconceptions in Physical Chemistry				
	Government Campus	Community Campus	Overall		
	Total	Total	Male	Female	Total
21) Which of the following aqueous solutions containing 10 g of solute in each case, has highest m.p.?	7	13	8	12	20 (34%)
22) How many Faradays of electricity is needed to completely reduce 1mol of permanganate ion in acid medium	13	14	15	12	17 (29%)
23) Value of Henry's constant K_H	18	15	17	16	33 (56%)
24) Acetone reacts with HCN to form cyanohydrins. It is an example of	13	11	16	8	24 (41%)
25) Which of the following conditions favors the existence of a substance in the solid state	16	12	18	10	28 (47%)
26) If the ΔH value is less than zero than reaction will be	12	14	14	12	26 (44%)
27) Mathematical form of first law of thermodynamics is	6	12	11	7	18 (31%)
28) ΔH of a system can be calculated by which of the following relationship	4	8	10	2	12 (20%)
29) A reaction has values of ΔH and ΔS which are both positive. The reaction	3	10	7	6	13 (22%)
30) When enthalpy of reactants is higher than the product then the reaction will be	2	3	1	4	5 (8%)
Mean	9.4	11.2	11.7	8.9	21
Percentage	29%	41%	34%	36%	35%

Note: Complete questions are given in the appendix.

Sources of Misconception in Physical Chemistry

Table-6 shows the sources of misconception in physical chemistry part according to students' response. Most of the students (40%) had chosen their source of misconception to be their intrinsic knowledge. It is obvious because physical chemistry is a branch of chemistry which students can relate with their life related application. Physical chemistry is much more systematic in their reasoning for agreeing or disagreeing with the ideas hence chemistry education itself is reinforcing these intuitive waysof thinking. The least chosen source of misconception (14%) was found to be from teachers.

Table-6, Sources of Misconception in Physical Chemistry:

Sources of misconceptions:	Question No.										
	21	22	23	24	25	26	27	28	29	30	Mean
i) You learned the answer from teacher.	2	2	3	3	4	3	3	3	5	1	2.9 (14%)
ii) You learned the answer from the text book or other sources.	3	7	7	2	3	3	2	1	1	2	3.1 (15%)
iii) You had an intrinsic knowledge about the answer.	9	13	15	13	13	9	3	3	3	2	8.3 (40%)
iv) You selected the answer randomly.	6	5	8	6	8	11	10	5	4	0	6.3 (31%)
v) Other reasons	0	0	0	0	0	0	0	0	0	0	0
Total no. of students	20	27	33	24	28	26	18	12	13	5	20.6

Conclusions

In conclusions, most of the students in chemistry has misconception which has affected the learning of students. This suggests the conclusion that there is some common misconception in chemistry among bachelor's level students. The maximum number of students developed the falsified concept in organic chemistry portion which is followed by inorganic and physical chemistry. Most of the students' source of misconception in science was found to be from their own intrinsic

knowledge. It is therefore impractical to even consider remedial treatments based on this foundation. Because we must first focus on raising awareness and giving appropriate emphasis. As a result, those with experience in science education and research must work to raise awareness of the dangers associated with the dominance of alternative beliefs. However, the most important parties (policy makers, curriculum specialists, educational evaluation and competency specialists, and authorities) should pause, consider my results, and take some time to gather their thoughts.

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