Problems Faced by Diploma Engineering Students in Learning Chemical Reaction

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Abstract : The purpose of this paper is to identify problems faced by the students in chemical reaction learning who had completed their school education from public and institutional schools. In addition, to the analysis of relationship between both group of students in terms of Chemistry- I result, learning chemical reaction, partial method and oxidation number method. For this survey study design, total 400 participants had been sampled, and purposively determined with 200 from each schooling group. Three hypothesises were formulated and tested to analyze relation between public and institutional schooling group participants in context of prescribed variables. The findings indicated that there were no significant difference between the groups and had weak correlation between tested variables. The study enlighted that chemistry teaching strategy can be improved and it can be truly begin to find the solutions of problems faced by students in classroom teaching. The author hopes that this paper will contribute for minimize discriminated the attitudes of society towards Public and institutional schools for their children's education. Similarly, it will motivate the teachers for applying the student- friendly teaching manner, and will guide the concerned bodies reform chemistry course.

Key Words: Reaction, partial method, oxidation number, balancing equation.

Introduction

Human beings have sought knowledge concerning chemical phenomena, perhaps since their existence. For example, we can argue that Palaeolithic humans learned chemistry when they discovered and mastered the use of fire in their daily life activities (Cobb & Goldwhite, 1995). Even if one fails to accept that early humans were 'chemists,' from prehistoric times, have acquired knowledge about manipulating substances for their survival such as pottery, antiseptics, preservation, painting, and unfortunately for weaponry. Despite this long period of experience with chemical changes, detailed understanding of chemical reactions largely remained a mystery until the 20th century, when scientists came to view the nature of matter in terms of particles (Leicester, 1965). Chemistry, being a abstract subject nature, is considered as difficult subject. However, chemistry and chemical phenomena have closely related to our daily life events. All most daily event processes are the result of chemical reaction. The physiological systems of human beings, kitchen process, industrial productions, medicines and drugs for medical purposes, and so on everywhere there is the major roles of chemical reaction. To understand the those all daily practices, one have to be have a clear concept of chemical reaction. Therefore, the chemistry

students must have the well understandings of chemical reaction which is considered as the key concept for the chemistry subject. Having long years experiences in chemistry teaching for the study level, the author have found that chemistry achievement of students is weak in every year. The students complain is that chemistry subject is as an unnecessary course load for egineering programm and they have no interest to study chemical properties of substances. Their class room and laboratory work performance is found passive and not satisfactory. As the result, majority of students ignore the questions related to the chemical reaction in both internal and final exam.

Students have faced numerous problems in learning chemistry globally. The preliminary findings have suggested general learning problems in balancing redox equations and stereochemistry (Zoller, 1990), symbolic representation of chemical equations, reactions mechanisms and models (Treagust, Chittleborough, & Mamiala, 2003). Similarly, instruction medium influences the learning process of chemical reaction (Nkopodi & Rutherford, 1990). These studies highlighted problems in learning chemical reactions as linguistic medium of instruction, ionic mechanism of reaction, roles of chemical bondings, concept of endothermic and exothermic reaction, low interest of students towards chemical reaction and pedagogical strategies. However there is no group study among the learners related to the chemical reaction problems. In this context, I was motivated to study the problems faced by students from public and institutional school education examination (SEE) holders in the study level. The study may helpful and guide them in comfortable learnng. There are various aspects of chemical reaction learnings as chemical reaction concept, balancing the equation by partial and oxidation number method. There is still no research answers to the questions as what are the problems in balancing chemical reaction by the partial and oxidation number methods for the students? What are the correlation and significance difference between SEE schooling type of students and problems in learning chemical reaction? Further more these contexts drived the author to study the topic issue in chemical reaction among the study level students. Therefore, the purpose of this research study is to identify students' learning problems in chemical reaction. Similarly, is to analyze the correlation between the group of students passing SEE from public and institutional schools in terms of results of Chemistry-I and problems related to chemical reaction, partial method and oxidation number method. The author hopes that this study can be implimented to improve class room mangement and chemistry teaching strategies because the study have traced out major problems of in chemical reaction learning which can be focused during planning and implimenting the teaching strategies.

Review of the Literature

My study was related to analysis of problems faced by learners in context of chemical reaction. Specifically, it attempted to explore on difficulties related to the laerning in chemical reaction concept, equation balance by partial and oxidation number method between public and institutional schools SEE holders. Focusing such areas, this study presented the discussion about literatures related to my study. A number of research works on chemical reactions, have contribution to the analysis of learners' difficulties with chemical reactions and the nature of the subject, were reviewed as given below;

Yarroch (1985) conducted a research among fourteen high school chemistry students from two different schools and interviewed in depth on how they balanced simple chemical equations, which technique was convenient for balancing the equations, and how they represented the balanced equations with diagrams. The study found that all the students were able to successfully balance the four equations presented to them. However, seven of the twelve students were not able to construct diagrams that were reasonably consistent with the notation of the balanced equation. And, the same students were found with poor concept of chemical subscript and balancing rules. The five students who were able to make consistent diagrams also possessed good concepts of subscript and the balancing rule. The study indicated that the learners had conceptual and subscript writing problems. However, the study did not explore the problems related to the partial and oxidation number method.

De Vos and Verdonk (1986) reported that learners have the identification and understanding problems in exothermic and endothermic chemical reactions. The study found that learners referred the burning of a candle as an endothermic reaction because heat is needed to initiate the burning process. However, the study is silent towards the balancing techniques of chemical equations.

Gabel (1993) suggested that the teaching of particulate nature of matter may help learners to develop a better understanding of process of chemical reactions. In a chemical change, atoms rearrange to form new molecules with chemical bonds, whereas in a physical change, no bond is broken or formed. The study reported that the concept of chemical bonding is the key point for the understanding of chemical reaction and it is the problem for the learners.

Tsaparlis (2003) reported that more than half of Greek tenth-grade students (ages 15-16) were unable to categorise chemical reactions or physical changes correctly when presented the phenomena such as rusting, boiling, bleaching, and freezing. Students' confusion is also observed when terms related to physical change such as melting, change of physical state and evaporation are used in describing chemical reaction. This study indicates the conceptual problems in learning chemical reaction.

Gómez Crespo and Pozo (2004) in a cross-age study involving Spanish seventh-graders (ages 12-13), ninth-grader (ages 14-15), eleventh-grader (ages 16-17), and final-year university students, found that the trans-mutation notion of chemical reactions was held by less than 20% of students, and diminished as the educational level increases. This event exposed that chemical reaction unit of the chemistry repels the students from their learning interest. This study indicated that there is counselling problems for learning chemical reaction.

Baahi & Ampiahi (2012) suggested students' inability to write correct chemical equations in the Senior Secondary School Certificate Examinations. This study probes these difficulties. This study employs a cross-sectional survey using both quantitative and qualitative methods. The sample used for the study consisted of 334 science students in the 2008/2009 academic year drawn from all schools offering elective science in the New Juaben Municipality of the Eastern Region of Ghana. The instruments used for data collection were achievement tests and interviews. The findings of this study were students' inability (a) to balance equations of combustion reactions involving hydrocarbons; (b) to predict correct products of reactions

due to difficulty in writing the correct formulae of the products predicted; and (c) to translate reactions in statement form into symbol equations. This study recommends that secondary school teachers provide more exercises related to these difficulties to students and that they make time for students to explain or discuss their answers.Thus, the problems were balancing equation, prediction of product and translation in symbolic form.

Nasar, Yahaya, Ibrahim & Hasan (2015), reported that the symbolic representations, which involve chemical formula, subscript, coefficient and other algorithm related knowledge have been prevalent problems in learning chemistry. Visualization is a logic solution in order to relate the microscopic part to its symbolic representation. This in turn should improve learner conceptual and algorithmic understanding. This study investigated the possibility of using the latest trend in chemical reaction teaching, visualization, which is augmented reality. The study indicated the pedagogical problems in chemical reaction learning.

Adu-Gyamfi & Ampiah (2019) explored students' "Learning Difficulties in Oxidation-Reduction Reactions at the Senior High School Level; As Part of a Major Research Project". The study project was a four-stage design-based research, using qualitative and quantitative methods. At the preliminary stage which is reported in this study, 213 third year students were sampled. All samples were selected through stratified and simple random sampling procedures. The students responded to a two-tier diagnostic test and interviews on conception of oxidation-reduction reactions. In analysing the data, descriptive statistics and themes were used. The findings showed that students had conceptual difficulties in the form of alternative conceptions and other difficulties such as conceptualising oxidising agents using the combined concept of oxidation and ionic charge. It was therefore recommended that Chemistry teachers should deploy the most appropriate pedagogical content knowledge that could help students conceptualise very well the concept of oxidation number and not to confuse it with ionic charges of particles involve in chemical equations. Hence, this study indicated teaching materials and oxidation number method problems in chemical reaction learning.

From the analysis of previous studies, it is found that difficulties faced by learners in chemical reaction learning were misconception, chemical reaction identification, writing subscript, ionic concepts, bonding concepts, balancing equation, prediction of product and traslation in symbol, understanding patterns, counselling and motivation to the students, oxidation number method problems, pedagogical, and use of teaching materials. In this regards, all the studies were in the general problems related to the chemical reaction learning. It is necessary to identify the problems in specific way and it will be effective to address them in class room chemistry teaching, which is the gap between previous study and this paper. The study is focused to identify specific problems related to the type of balancing chemical reaction.

Theoretical Framework

The study followed three learning theories as productive thinking, theory of human nature and theory of opportunity.

Wertheiemer's productive thinking theory states that learning arises from problems. Productive thinking is the process of solving the problem by grouping the problem and discovering its necessary forms or properties.

Similarly, recentering inspires one to solve the problem fundamentally through one's own style of thinking. Identifying the problems and then remove those problems is an important and wide field of research in chemistry education. From this point of view, in this study, problems were identified in chemical reaction and those problems were discussed.

According to the Vygotsky's "Theory of Human Nature" human being is always a dynamic and a part of world of time, context and place. They learn through problems. Similarly, students can learn through opportunity. This phenomena is called "Theory of Opportunity". Learners can learn new concepts by active participatory interaction and providing opportunity as according to their capacity and ineterest (Wertsch,1983). Therefore, identifying the problems in chemical reaction exerts pressure to the students and teachers for effective learning activities. Similarly, a teacher can provide interaction opportunity for class room discussion about the chemical reaction and let them to share their knowledge to others for better understanding the topic. Hence, the theory of human nature and theory of opportunity can be implemented in chemical reaction learning process study.

The paper was studied theoretically following the given diagram for the operation of study.

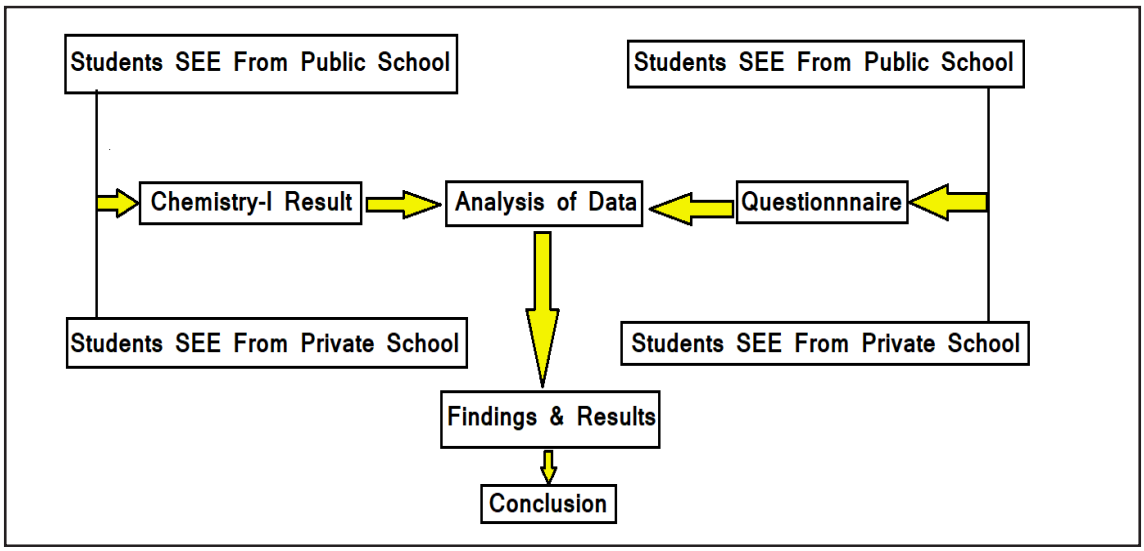

Figure 1: Theoretical Framework of the Study.

Methodology

This study was based on the quantitative survey design and tested three null hypotheses:

a. **H0**: There is no significant difference chemistry-I result in terms of SEE pass out students from institutional and public schools.

b. **H0**: There is no significant difference between learning problems in chemical reaction, partial method and oxidation number method in terms of SEE pass out students from institutional and public schools.

c. **H0**: There is no significant difference between chemistry-I result, problems in learning chemical reaction, partial method and oxidation number method.

The sample

400 participants were selected from the second year, second semester students studying in various departments at the three-year diploma engineering level at the Korea Nepal Poly-technical Institute, Butwal, Agro Politechnical Institute Mathura, Arghakhanchi and Lumbini Engineering College, Bhalwari, Rupandehi. The are an institutional and affilicated organization of Council for Technical Education & Vocational Training (CTEVT), Nepal. The number of total student population of this study from the selected institution, year and semester is 1200. The intentional-simple random sampling method was used for population sampling.

First, a separate group of students SEE pass out from institutional schools and public schools was formed. Then 200-200 students from each group were selected using a simple random sample selection method by using three digit random sampling table. Thus, in selecting the population sample, the learning ability, gender and other social and cultural variables of the participating students were ignored.

The Instrument

A sample of a questionnaire set with four parts was prepared for the participants in this survey study. The first part of the questionnaire was designed to collect personal information, SEE passed school type and other personal details. In the second part, six items were prepared to collect information on the problems related to the learning of chemical reaction. Similarly, the third section included 5 items related to the problems balancing chemical equations by partial method. The last and fourth sections contained 6 items related to the problems balancing chemical equations by oxidation number method.

Each respondent was instructed to read the statements of each parts of the quetionnaire and put a tick in the brackets, except in part one, against the most appropriate answer to the question asked. The respondents were requested to tick the learning problem related to the statement based on their opinion in the matching box. The total number of items used in the questionnaire was 17 and were all used to draw information from the respondents. The questionnaire was designed to measure participants' problems related to the various skills of chemical reaction. The problems of learnig concept had 6 items and nominated as 1, 2, 3,… 6. Similarly, from partial method 5 and oxidation number method had 6 problems which were nominated as nominal variables before performing treatments with SPSS apart from obtaining the frequency tables. The validation of questionnaire tool was maintained by expert evaluation. Using the 17 items, the reliability of questionnaire's was calculated to be 0.815, which is highly reliable (Cohen, Manion & Morrision, 2011), with a Cronbach's test against an alpha value of .05, implying that the probability of not committing type 1 error was 95 per cent.

Data Analysis

All analyses were performed using the Statistical Package for Social Science (SPSS). To address the hypotheses, frequency distributions and other descriptive statistics including means, standard deviations and percentages were used. Descriptive statistics describe basic feature of the data under study in simple summaries (Vogt et al., 2014). Independent sample t-tests were performed to data used to address the first and second hypotheses because there was need to determine whether differences between variables existed. Independent sample t-test compares means'

differences between two independent samples). For the third hypothesis, Pearson product Moment Correlation Coefficients was determined to test relationship between the variables.

Results and Discussion

The problems faced by participants while practicing chemical reaction was displayed in table 1. According to the table and diagram, participants who had faced the problems of chemical reaction were identification of reaction (30 %), endo and exothermic reaction concept (25%) and singnificance of chemical reactio (22 %). Further more, least number of respondents (5%) had the problem of making more informative to the reaction and the problem of identification of reaction was the problem of highest number of respondents (30 %). From the table 1, identification of reaction, endo and exothermic reaction concept and significance of chemical reaction were the major problems faced by participants during chemical reaction practice works.

Table 1: Problems Faced by Participants in Chemical Reaction Learning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Symbolic Writing	30	7.5	7.5	7.5
	Identification of Reaction	120	30.0	30.0	37.5
	Endo & Exothermic Reaction Concept	100	25.0	25.0	62.5
	Hit & Trial Method	40	10.0	10.0	72.5
	Significance of Chemical Reaction	90	22.5	22.5	95.0
	Making more informative to the Reaction	20	5.0	5.0	100.0
	Total	**400**	**100.0**	**100.0**	

The next purpose of this study was analysed by testing formulated hypothesises as given below;

a. H0: There is no significant difference between chemistry-I result in terms of SEE pass out students from private and public schools.

Independent samples t-test was done to determine whether there is a significant difference between chemistry-I result in terms of SEE pass out students from private and public schools. The results were as shown in Table 2 and Table 3.

In Table 3, the Levene's test for equality of variances has Sig value of .578 ($p>0.05$) for chemistry I result, which is greater than .05 (alpha value). The null hypotheses for testing for homogeneity, 'there is homogeneity of variance', is therefore accepted null hypotheses. This confirms that sample groups were obtained from populations which have equal variances (Quinn & Keogh, 2002). In other words, chemistry achievement in terms of SEE pass out students from public schools is the same as that of private schools. The mean for the chemistry I is slightly higher in private school students (2.7) than in public schools. But this difference is not statistically significant. Many studies agreed that performance of prvate students is better than the that of public students (Kollu, 2006).

Table 2: Group Statistics Analysis of Chemistry-I Result.

	Type of SEE Passed School	N	Mean	Std. Deviation	Std. Error Mean
Chemistry-I Result	Public School	200	15.25	8.595	1.922
	Private School	200	17.95	8.121	1.816

F		Levene's Test for Equality of Variances		t-test for Equality of Means						
		Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower	Upper	
Chemistry I Result	Equal variances assumed	.315	.578	-1.021	38	.314	-2.700	2.644	-8.053	2.653
	Equal variances not assumed			-1.021	37.878	.314	-2.700	2.644	-8.053	2.653

Table 3: Independent Samples Test Correlation with Result Variable

Olasehinde & Olatoye (2014) reported that secondary school students' of private schools students performed significantly better than their public school counterparts, but there is no significant difference between public and private senior secondary school students' achievement in biology and chemistry. Similarly, Thapa (2011) concluded that achievement of private school is statistically significant in explaining student's SLC performance. The student from a private school has 9.50 points higher score in her SLC exam as compared to a student from public school, keeping socio-economic factors constant. But this survey found out that chemistry acievement of public school pass out students had slightly below than the private school pass out students. This indicates that the performance of students is significantly independent to the what type of schools they completed their school education. In higher education they can perform equaly.

b. **H0**: There is no significant difference between problems of learning in chemical reaction, partial method and oxidation number method in terms of SEE pass out students from private and public schools.

The students of SEE pass out from private and public schools have similar problems in oxidation number method (m = 5.60), in context of learning concept private shool pass out students (m = 3.30) had slightly less value than public school (m = 3.55). The partial method problems of private students also had slightly less value (m = 5.05) than the public school pass out students (m = 5.55). The data indicated that there is slightly less difference to compare the learning problems faced by private pass out students as well as public pass out students.

The results for the independent t-test are in the Table 4 and Table 5. From the analysis, there is no significant between problems of learning in chemical reaction, partial method and oxidation number method in terms of SEE pass out students from private and public schools. The Levene's test for equality of variances from the table 5 has Sig values 0.919 ($p>0.05$) for learning concept problems of chemical reaction, 0.993 ($p>0.05$) for partial method and .099 ($p>0.05$) for oxidation number method.

Table 4: Group Statistics Analysis with Variables

	Type of SEE Passed School	N	Mean	Std. Deviation	Std. Error Mean
Problems of Learning in Chemical Reaction	Public School	200	3.55	1.572	.352
	Private School	200	3.30	1.720	.385
Problems of Partial Method	Public School	200	5.55	2.946	.659
	Private School	200	5.05	2.929	.655
Problems of Oxidation Number Method	Public School	200	5.60	3.515	.786
	Private School	200	5.60	2.415	.540

These all three statements have p value greater than 0.05, i.e. $p > 0.05$, are greater than 0.05 hence the null hypothesis is accepted. This means the students from private schooling and fro public schooling have similar and equal problems of learning chemical reaction and balancing methods.

Table 5: Independent Samples Test, Correlation with Variables.

F		Levene's Test for Equality of Variances		T-test for Equality of Means						
		Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower	Upper	
Problems of Learning in Chemical Reaction	Equal variances assumed	.010	.919	.480	38	.634	.250	.521	-.805	1.305
	Equal variances not assumed			.480	37.697	.634	.250	.521	-.805	1.305
Problems of Partial Method	Equal variances assumed	.000	.983	.538	38	.594	.500	.929	-1.381	2.381
	Equal variances not assumed			.538	37.999	.594	.500	.929	-1.381	2.381
Problems of Oxidation Number Method	Equal variances assumed	2.865	.099	.000	38	1.000	.000	.954	-1.931	1.931
	Equal variances not assumed			.000	33.666	1.000	.000	.954	-1.939	1.939

c. **H0**: Chemistry-I result, problems in concept of chemical reaction, partial method and oxidation number method are not correlated.

The Pearson product moment correlation coefficient was determined to measure the degree of relationship between variables. Table 6 gives information on levels of relationship between chemistry-I result, problems in concept of chemical reaction, partial method and oxidation number method.

All the P-values are not less than .005 (sig = .000) implying that the null hypothesis hence,'Chemistry-I result, problems in concept of chemical reaction, partial method and oxidation number method are not correlated' can not be rejected. There is a very weak relationship between chemistry I result with learning concept of chemical reaction (Pearson, r = -.021), partial method

problem (r = .023), and oxidation number method (r = .068). But, learning concept problem of chemical reaction is mederately possitive partial method problem (r = .523) and oxidation number method problem (r = .787). The relationship of partial method problem with oxidation number method problem is strongly positive (Pearson, r =.787).

Table 6: Correlations Analysis Within the Variables

		Chemistry I Result	Problems of Learning in Chemical Reaction	Problems of Partial Method	Problems of Oxidation Number Method
Chemistry I Result	Pearson Correlation	1	-.021	.023	.068
	Sig. (2-tailed)		.897	.888	.679
	N	400	400	400	400
Problems of Learning in Chemical Reaction	Pearson Correlation	-.021	1	.523**	.538**
	Sig. (2-tailed)	.897		.001	.000
	N	400	400	400	400
Problems of Partial Method	Pearson Correlation	.023	.523**	1	.787**
	Sig. (2-tailed)	.888	.001		.000
	N	400	400	400	400
Problems of Oxidation Number Method	Pearson Correlation	.068	.538**	.787**	1
	Sig. (2-tailed)	.679	.000	.000	
	N	400	400	400	400
**. Correlation is significant at the 0.01 level (2-tailed).					

Conclusions implication

This study concluded that the problems faced by participants were identification of reaction, endo and exothermic reaction, concept and significance of chemical reaction as the major problems during practice works. To address the first and second hypotheses, descriptive statistics including means, standard deviations, percentages and independent sample t-tests were used to determine whether differences between variables existed. The findings indicated that there is no significant difference in chemistry-I results,chemical reaction learning, partial method and oxidation number method between in terms students from different category of schools. The results further showed that institutional group of students had slightly less problems in context of learning in chemical reaction. This means they have better understanding than the that of public school group students. According to the test of third hypothesis, the three variables, chemical reaction, partial method and oxidation number method were correlated and the partial method problems were strongly positvely related to the oxidation nunmber method problems. Hence, it was verified that there is strong corelation between the problems faced by both group of students in respective terms.

The study paper is ralated to the problems in chemical reaction learning and lighted out some facts that there is weak relation between chemistry subject achievement and learning concept in chemical reaction. This means preparation of chemical reaction unit is not must. Similarly, the strogly positive relation between partial method and oxidation number method problems indicates

that one concept of them will be helpful to another. Therefore, the implication of this study will be to set teaching strategy in classroom and investigate the influencing factore in learning concept of chemical reaction, teaching strategy of chemical reaction and as citation for up coming researchers. Furtherm more, it will also help for the improvement of chemistry curriculum for the relevant course.

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