MISCONCEPTION: A NEGATIVE INFLUENCE ON THE PERFORMANCE OF SS3 CHEMISTRY STUDENTS

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Abstract

This paper investigated twenty chemistry concepts using Basic Chemistry Misconception Identification (BCM) tool as instrument. One hundred (100) responses were received from two senior secondary school students chosen randomly in Minna, Niger State, Nigeria. Degrees of misconception were identified with their extent as scores. The highest level was on the effect of the change in pressure on the position of equilibrium 55.6% the lowest level was on the electron with 5.5%.HO: which states that there is no significant difference on the performance of students with low and high degrees of misconceptions was rejected. By extension it was identified that misconceptions might have negative influence on the performance of high/low achievers. Consequently, misconceptions have a negative performance on SS3 students.

Keywords: Misconception, Negative-influence and Negative achievement.

Introduction

Tobias (1987) reported that generally in learning of science, there are several types of misconceptions. An effective chemistry teacher is believed to first identify the type of student misconception before the student can be helped (Robert, 2000). It is an essential component to first identify the nature of students misconception before the problem can be overcome (Robert, 2000; Poster *et al.,* 1982). Preconceived notions of the everyday activities mostly are rooted right from childhood, especially when exploring knowledge from their immediate surroundings, they tend to structure ideas in an attempt to explain some phenomena in their own terms and also share their explanations (Terry *et al.,* 1985; Tobias, 1987; Wandersee *et al.,* 1994). The explanations are carried on and even passed to higher levels. In some children a good percentage of assumptions used in explanations are wrong preconceptions and therefore are misconceived (Robert, 2000).

Carter and Brick-House (1989) reported that many students say that chemistry is difficult. These perceived difficulties are part of the context in which these students develop chemical concepts and problem solving skills. Basically the theoretical content of chemistry has been reported by Nahum *et al.,* (2004) as best seen as a set of models. In the same vein Gilbert (1998) claims that models play a major role in all science disciplines however the models appear to be giving students' problems. Nahum *et al.,* (2004) describes the environment students find themselves as macroscopic world of matter in which chemistry is never perceived to be related to their immediate surroundings. In addition, John Stone, (1991); Gabel, (1996); Tsapalis, (1997); Robinson, (2003); Nahum *et al.,* (2004) reported that students do not easily transit; canonically from macroscopic to microscopic environmental imaginations. Chemical concepts are naturally abstracts and students find it difficult to explain chemical phenomena and even some terminologies, using widely embraced concepts (Nahum *et al.,* 2004). However, Gabel (1996) has reported that "The complexity of chemistry has implications for the teaching of chemistry today and that chemistry is a very complex subjects from both the research on problem solving and misconception and from our own experience students posses these misconceptions not only because chemistry is complex, but also because of the way the concepts are taught".

Aim and Objectives

This study seeks to achieve the following:-

(i) Correlate the mean scores of low and high achievers,

(ii) Find the levels of misconceptions of low and high achievers,

(iii) Correlate levels of misconceptions in chemistry concepts with the performance of Senior Secondary 3 students.

Hypothesis

HO: There is no significant difference on the performance of students with low and high degree of misconception.

Research Methodology

Final year senior secondary school students (SSS 3) were the population targeted in this research. Two senior secondary schools were chosen randomly from Minna, Niger State capital, Nigeria. A total of one hundred and ninety three (193) students consisting of ninety (90) boys and one hundred and three (103) girls were drawn from the two schools to serve as samples.

The instrument used for the research was Basic Chemistry Misconception Identification Instrument (BCMI). This consists of twenty (20) questions from basic chemistry concepts. The basic chemistry concepts include: atoms, molecules, compounds, mixtures, cations, anions, atomic number, mass number, electron, element, Le-Chartelier's principles, chemical equilibrium, equilibrium constant, effect of change in pressure on the equilibrium position of an esterification reaction in aqueous state, effect of change in pressure on the equilibrium position of an inorganic reaction in gaseous state, effect of increase in temperature on the equilibrium position of the reaction in gaseous state, effect of increase in concentration of iron on the equilibrium position of the reaction, expression for equilibrium constant, exothermic and endothermic reaction. The instrument was content validated by three specialist; one science education specialist, two chemistry teachers (one from college of education and one from secondary school). Finally, the format and content of the instrument were written as suggested by the validators. The reliability of measuring instrument was determined using test-retest technique. The items were administered to the students who were not participants in the main study. The reliability coefficient of the instrument was found to be 0.82. Thus, the instrument was adopted for the study.

The randomly selected schools from which the samples of the study were drawn were first visited by the researcher to obtain permission to use the schools for the study. The students in each school were randomly selected after proper introduction and explanation on the purpose of the test. The instrument was then administered to the students the following day. The responses of the students were collected and scored. A correct answer was scored 3 points while misconception and wrong answer were scored 2 and 1 respectively. A response was scored as correct if it is the same as stated in the marking scheme or anybody of words that conveys the same meaning as the correct answer. A response that was misunderstood was taken as a misconception while a response that was irrelevant was taken as wrong answer. The sample students were further split up into two. The high achievers, students with minimum misconception and low achievers; students with high degree of misconception. The scores of the two split half from the bases of finding the mean, standard deviation and t-test (Jimoh, 2002; Evan *et al.,* 2003).

Results

The methods adopted to analyze the raw scores are percentage, group means, deviation and t-test. The percentage was used to answer the research questions, while the t-test was used to test for the hypothesis of the study.

Table 1: Representation of levels of misconceptions identified

Basic chemistry concepts	Misconception identified	N	X	**ΣX**	%
Atoms	Atoms can be seen with powerful instruments.	11	22		24.4
	Atoms move so have live	03	16		17.8
	Every atom has their respective electrons.	09	18		20.0
	Atoms are like cells with membrane and nucleus	09	18	90	
	Nuclear reactions in atoms are like reproduction in animals.	09	16		17.8
Molecules	Molecules exist singly generally.	09	18		18
	Molecules of solids are harder than molecules of liquid and in terms are harder than those of gases.	11	22		22
	Molecules of solids appear to be bigger than those of liquids.	13	26	100	26
	Molecules of solid have cubic shape while molecules of liquids are round in shape.	17	34		34
Compounds	Compounds are always serving as reactants.	10	20		22.2
	Compounds are mixtures of different elements.	15	30		33.3
	Compounds are made up of two or more immiscible substances.	07	14		15.6
	Compound are generally salts	08	16	90	17.8
	Every chemical is a compound	05	10		11.1
Mixtures	Combination of two or more different elements	09	18		22.5
	Addition of two more substances.	11	22		27.5
	Any mixture that is easily separated.	08	16	80	20
	Addition of two or more different compounds.	12	24		30.0
Cations	Cations are negatively ions	08	16		53.3
	Cations move faster and stronger than anions.	07	14	30	46.7
Anions	Anions are positive ions.	07	14		47.7
	Anions are faster and stronger than cations.	08	16	30	53.3
Atomic Number	Number in periodic table.	10	20		22.2
	Number derived from the main groups of periodic table.	10	20		22.2
	The total number of protons and neutrons in atoms.	10	20	90	22.2
	The total number of proton and electron in the nucleus.	15	30		33.3

	The total number of electron and protons.	13	26		6
Mass Number	The number of neutrons present in an element.	12	24	100	24
	The number of element derived from atomic number.	11	22		22
	The number represented by A.	14	28		28
Electron	Any substance negatively charged and can move.	19	38		27.3
	Total number of changes in elements.	23	46		41.8
	The charge present in substance.	10	20	110	18.2
	Any particle that can bear charge in atoms.	03	06		05.5
Elements	Any substance that can not be divided unless by chemical means.	11	22		24.4
	Substances that can take part in chemical reaction.	11	22		24.4
	Any substance that can not be split into simpler ones in chemical reaction.	14	28	90	31.1
	Any substance that cannot exist alone.	09	18		20.0
Chartelier's Principles	Energy of a reversible reaction attains specific equilibrium under given condition.	15	30		22.22
	Effect of temperature, pressure concentration change is always cancelled in reaction.	10	20	90	22.2
	Equilibrium position does not depend on state of reaction.	20	40		44.4
Chemical Equilibrium	Gibbs free energy is the same as chemical equilibrium at zero temperature.	15	30		27.3
	State attained when reactions are balanced.	13	26		23.6
	A process not a state.	10	20	110	
	A system which total sum of reactants is equal to products.	17	34		30.9
Equilibrium Constant	Expresses constant Equilibrium position.	25	50		41.7
	Depicts values of constant system in equilibrium.	15	30		25.0
	Expresses quantity of catalyst used in reactions.	20	40	120	33.3
Effect of change in pressure on equilibrium position (gases)	Taking the effect as the same as that of temperature.	25	50		55.6
	Opposite application of the change in equilibrium position.	20	40	90	44.4
Effect of change in pressure in equilibrium position (Liquid)	Liquids state taken as gaseous state.	48	96		60.0
	The states in chemical reaction as often ignored.	32	84	180	40.0
Effect of the increase in temperature on equilibrium	Equilibrium alone is used for equilibrium position.	25	50		41.7
	Prediction of effect in opposite direction.	35	70	120	58.3
Effect of the increase in	Prediction of effect in opposite direction.	40	80		61.5
	Taking concentration for temperature.	25	50		38.5

concentration product on equilibrium position				130	
Expression of equilibrium constant	Expression by exchanging the numerator for denominator.	15	30	50	60.0
	Taking equilibrium constant to be mistaken for chemical equilibrium.	10	20		40.0
Exothermic reaction	Expressed as exothermic reactions.	10	20	20	100
Endothermic Reaction	Expressed as endothermic reaction.	10	20	20	100

Where N is the number of students, X as score ∑X as total sum of scores and percentage (%) of each identified basic chemistry concept. Table 1 above shows the summary of misconception identified on each of basic chemistry concepts. Thirteen out of twenty concepts investigated have percentage of misconception that is significantly classified to be of high degree as each have percentage of misconception 40% and above. The concepts include: Molecules, Compounds, Mixtures, Mass Number, Electron, Element, Le Chartelier's principles, Chemical equilibrium. Equilibrium constant, effect of change in pressure on equilibrium position (liquid), effect of increase in temperature on equilibrium position and effect of increase in concentration of product. While seven of the basic chemistry concepts, atoms, cations, anions, atomic numbers, expression of equilibrium. Constant, exothermic and endothermic reactions have percentage of misconceptions classified to be of low degree as their percentage of misconception are less than 40% (Jimoh, 2002; Evans *et al.,* 2003, Bailey and Garratt, 2002). The two parallel trends are not surprising because, basically concepts that are taught by repeated canonical lecture formal where there exist limited involvement of students to the learning process rather than the statement instructional mode of lecture which is reported to be more effective with respect to achievement of learning activities (John stone, 2000, Bailey and Garrant, 2002). The above trend observed from the research further reinforced the findings of Akinsola and Igwe (cited in Mohammed, 2005) that the chemistry terminologies such as molecules, compounds, mixture, mass number, electron, element, Chartelier principles, chemical equilibrium, equilibrium constant sort to explore from the students strong conceptual metal models, consequently the high degree of their percentage of 40% and above. However, the concepts like atoms, cations, anions, atomic number, and expression do not to a large extent require strong conceptual mental model from students' therefore low degree of misconceptions less than 40%. These varying degrees are corroborated by the report of Pavelich *et al.,* (2004) that students often solve scientific problems in a course but have very poor mental model understanding on the concept, which fundamentally shows the low achievement of learning for the knowledge transferred from teachers and these opinions are reinforced by Jimoh, (2002); Orji, (cited in Mohammed, 2005); Evan *et al.,* (2003); Mulfold and Robinson (2002) on their studies of misconception of different science concepts.

Table 2: t-test comparisons of law and high degree misconceptions students

Group	No. of students	Df	X	SD	t-cal	t-critical
Low degree misconception students (High Achievers)	55	98	52.3	12.8	16.4	1.66
High degree misconception students (Low Achievers)	45		18.9	7.1		

Conclusion

Table 2: Presents the t-test comparisons of low and high degree misconceptions students. The mean score for the high achievers (Low degree misconceptions students) was 52.3 and that of the low achievers (high degree misconception students) was 18.9. The calculated t-value of 16.4 is greater than the t-critical value (1.66). This indicates that there is statistically significant difference between the mean scores of the high achievers (52.3) and low achievers (18.9) at the 0.05 level (t-16.4, df – 98, P < 0.0). Hence, HO, which state that there is no significant difference on the performance of students with low degree and high degree of misconception was rejected. Consequently, there is significant difference on performance of students with low degree and high degree of misconception. It could be deduced from the result that subscript on basic chemistry concepts have a negative effect on the performance of students. This is in line with the findings of John stone (1991), Novak (1998); Taber (2000); Kousathana and Tsaparrlis (2002); Pavelich *et al.,* (2004) on the their research as there exist key fundamental concepts that are prerequisite to main to main topic which if ignored could be responsible for gross degrees of misconception amongst students.

The calculated t-value of 16.4 is significant at 0.05 level (P = 0.05) indicating that the research hypothesis that, there is no significant difference between the mean scores of low degree misconception (high achiever) and high degree misconception (low achiever) students was rejected. The implication when the mean score for the high achievers (52.3) and that of the low achievers (18.9) are compared in addition the critical t-value (1.66) compound with calculated t-value 16.4 shows clearly remarkable statistical significant difference between the two groups. Consequently there is significant difference on the performance of students with low varying level of misconception, the low achievers and the high achievers. It could therefore be implied that misconception on basic chemistry concepts has a negative effect on the performance of students. This in no small measure shows that the presence of misconception on particularly the basic fundamental terminologies in all aspect will affect the assimilation of the more advanced part of the subject. This result reinforced the findings of Lythcott (1990); Gabel (1996); Kelvin (1996); Perkin (1995); Hewson and Hewson (1991); Robert (2000) and Novak and Godwin (1984) that misconception on the fundamental terms if not cleared are usually passed from lower level to even higher levels. Le Chartelier's principle in practical classroom learning activity, bugs students owing to its limited character constrain, vagueness and ambiguity in its formulation, consequently the principles is widely misapplied. Therefore the result of this research is not surprising that the application of Le Chartelier's principle having highest misconception percentage of 84.2%. hence, it has become necessary to recommend the replacement of Le Chartelier's principles with a more plausible, easy, and functional approach like Equilibrium law.

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