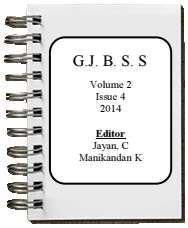
Guru Journal of Behavioral and Social Sciences
Volume 2 Issue 4 (Oct – Dec, 2014)
ISSN: 2320-9038 www.gjbss.org



Chemistry Vocabulary attainment among Higher Secondary Students

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Received: 30 Oct 2014
Revised: 18 Dec 2014
Accepted: 20 Dec 2014

Keywords:
Chemistry terms, Chemistry concepts, Science Vocabulary Text difficulty.

Abstract

In the context of growing empirical evidence to lack of clear understanding of the language of the science content, undesirable student outcomes including difficulty in learning science and a lack of interest with their science content area, and chemistry being particularly loaded with specialized terminology of its own, this study analyzed the vocabulary in higher Secondary School chemistry textbooks published by NCERT. Forty eight terms were identified and categorized into four broad areas namely Inorganic chemistry, physical chemistry, Thermodynamics &Electo Chemistry and Organic chemistry. Difficulty with select words was studied through a sample survey among a random sample of 200 class X11students of chemistry in higher secondary schools. Meanings of prefixes like diazo, ampho, syn and photo, and suffixes like oid (eg.,actinoid), were not recognised by majority of students. Meanings of terms like ferromagnetic, solvate, and aprotic also were not recognised by majority.

Chemistry is loaded with terminology and concepts. Many of the words used in Chemistry originated from classical language, like Greek and Latin, roots. Only if one knows the meanings of the roots of words, one can better comprehend and remember the chemistry concepts. Thus, word learning in chemistry or in any other science can be approached with equal importance as conceptual learning, since words are labels for concepts. Technical Words or vocabulary are symbols of concepts that help learner to connect concepts one another to form rich conceptual networks.

It is a well-established code in educational theory and practice that one of the keys to understanding a subject is to understand its language (Postman &Weingartner, 1971). Teaching and learning without language is inconceivable. Any discipline has its own way of knowing. Though science is an empirical subject, it too cannot escape the importance of language in communicating and learning it. Truly, one of the important features of science is the richness of the words and terms it uses (Wellington & Osborne, 2001). Thought in this way, what one knows about science cannot be separated from scientific terms and concepts one could understand, use, analyse and if need be put together. This might be one reason why most of the achievement of students who do complete the higher secondary school science courses is measured by how well they acquire information and facts". It is another concern that such assessment practices have their own flip sides like encouraging the practice of memorization, rote learning of science and static beliefs" rather than "dynamic belief" former being associated with negative attitudes toward science and the idea that science is not very relevant (Songer & Linn, 1991). Suffice is realise that whetherwe teach scientific vocabulary or not, such information and facts often heavily laden with technical vocabulary is to be leant by the learner not only to score better in science, but to comprehend science better, and thereby to develop a liking towards the discipline.

Despite the acknowledged significance of science vocabulary learning, scientific vocabulary instruction has played a subordinate role in teaching scientific concepts to inquiry-based instruction and hands-on scientific activities that are generally recommended in teaching science. The suggested reason for this being science learning historically been seen as an active

meaning- making process, while language acquisition been viewed as a passive meaning taking process (Yore, Craig and Maguire 1998). Hence, science vocabulary is to be taken more seriously by schools.

In view of the lesser importance given to teaching of science vocabulary, the major source of learning them for students is science textbooks. However, many students experience difficulties in using the science content textbooks. Owing to the increasing emphasis on construction of knowledge, and activity centeredness in learning use of textbooks by students also is on decline. Teachers find it frustrating and sometimes helplessness in making their students more fascinated with science books. Vocabulary load in science textbooks also presents a great challenge to middle school and secondary readers (Harmon, Hedrick, & Wood, 2005).

Objective

1. This study is to find out the understanding of the meaning of the identified chemistry terms among the higher secondary students.

Method

Analysis of manifest content of chemistry textbooks

The study began by analysing higher secondary school chemistry textbooks (of National Council of Educational Research and Training) during 2014 to identify Chemistry related terms included in them. The manifest content of chemistry text books of higher secondary school classes were analysed to identify terms that fails to immediately communicate meaning to the students for variety of reasons related to language aspect of the terms. The terms are broadly classified under four major content areas, viz., Inorganic Chemistry, Physical Chemistry, Thermodynamics and Electro Chemistry, and Organic Chemistry (Table 1).

Table 1

List of identified chemistry terms from secondary school chemistry textbooks

Organic Chemistry	Physical chemistry	Thermodynamics and electrochemistry	Inorganic Chemistry
Spectrophotomete	Homogeneous Catalysis	Syn Elimination	Cyclo Hexane
Static Electricity	Amphoprotic	Anti Ferromagnetic	Polyhydric
Photo Electric Effect	Solvate	De Halogenation	Free Radical
Spectrometer	Syn Elimination	Orthocompond	Diazo
Monomers/Polymer	Hydrosol	Anions	Diazo/Methane
Adsorption	Homoploymer	Thermolysis	Methyl Alcohol
Peptase	Thermionic Emission	Isobar/Isotone	Acetone
Tetrode	Anhydrouscopersulphate	Hydrogen	Dihydric
Thermostat	Electrophile	Allotrope	Propanal
Actinoid	Thermophorosis	Tetra Valent	Diene
Aprotic	Calorimer	Equilibrium	Carbocation
Atomic Fission	Homogeneous Catalysis	Chromophore	Chromo

Chemistry vocabulary test

Difficulty with select words was studied through a sample survey amonga random sample of 200 class X11students of chemistry in higher secondary schools. For that the investigator prepared an achievement test in chemistry vocabulary.Test consists of 48 objective type questions, 12 from each sub topics and have a duration of 40 minutes.

Participants

The population of the study is higher secondary school students of Kerala. The sample selected for the study are 200 higher secondary students of Malappuram district from one governmentand government aided school.

Results

The proportion of students answering an item correctly indicates the difficulty level of the term on which the item is constructed. The more students got the item right, the less difficult the term was. The exact interpretation used for percentage of students who could recognize the meaning of the chemistry terms are indicated in table 2.

Table 2

Percentage Range Difficulty Index Interpretation

Percentage Range	Interpretation
1 % to 50%	Hard terms
50%-75%	Terms with Moderate difficulty
76%-100%	Easy

The 48 terms can be divided into four areas. On chemistry vocabulary test, 50 percentage of the terms are hard to students. The remaining 50 percentage of terms are equally distributed to moderate and easy difficulty. Difficulty index of hard chemistry terms in terms of percentage of students who could comprehend the term is given in Table 3.

Table 3

Hard terms in four areas of school chemistry with facility index

Area	Term	Facility Index
Inorganic Chemistry	aprotic	38.5
	actinoid	33.5
Physical Chemistry	phototropism	44.5
	amphoprotic	44
	solvate	38
	syn elimination	37.5
Thermodynamics and ElectroChemistry	thermodynamics	32
	anti ferromagnetic?	28
Organic Chemistry	diazo	29
	diazo/methane	35

Among the 48 items 10 terms are found most difficult for students to understand. Maximum number of difficult terms comes under the portion of physical chemistry. They are photo tropism, amphoprotic, solvate and syn-elimination and they have high difficulty index 44.5, 44, 38 and 37.5 respectively. Among the above words syn elimination is an example for a word with prefix and the rest three have both prefix and suffix. All the three other units include most difficult two each in number. Difficult words coming under the portion of Inorganic Chemistry are aprotic(DI =38.5) and actinides(DI =33.5). Thermodynamics and anti ferromagnetic are two difficult words that comes under Thermodynamics and Electro Chemistry had difficulty index 32 and 28 respectively;diazo(DI =29) and diazo methane(DI 35) from the Organic Chemistry were also hard to students.

Table 4
Moderately difficult terms in four areas of school chemistry in terms of facility index

Area	Term	Facility Index
Inorganic Chemistry	Alloys	71
	Static electricity	64
Physical chemistry	Hydrosol	62.5
	Homoploymer	74.5
	Thermionic emission	71.5
	Anhydrouscopersulphate	73
	Electrophile	67.5
Thermodynamics and electrochemistry	Hydrogen	71.5
	Equilibrium	67.5
	Isobar/isoton	64.5
	Thermolysis	64.5
	Anions	56
	Orthocompond	55.5
	De halogenation	58
Organic Chemistry	Chromo	57.5
	Free radical	71.5
	Carbocation	54.5
	Diene	74.5
	Propanal	63.5
	Dihydric	67
	Acetone	69.5

Number of moderately difficult terms is 21 out of 48. moderately difficult terms included in the units Physical Chemistry And Thermodynamics and electro chemistry are 7 each. Hydro, equi,iso, therm, an, ortho, de, diene, rad, chromo are the prefixes and gen, tone, bar, lysis, nal, ene are suffixes reported. In Thermodynamics and Electrochemistry ortho compound and dehalogenation are terms with prefix. Five among them are from the units of Physical chemistry. The rest belongs to Inorganic Chemistry. The prefixes involving in these two units are allo, stat, hydro, homo, thermi, unhydrous, electro. Sol, mer, phile are suffixes used in these units.

Table 5
Easy terms in four areas of school chemistry with facility index

Area	Term	facility Index
Inorganic Chemistry	Photo electric effect	75.5
	Spectrometer	91
	Adsorption	81.5
	Monomers/polymer	81.5
	Peptase	82.5
	Tetrode	82
	Thermostat	82
Physical chemistry	Homogeneous catalysis	77.5
	Calorimetry	80
	Thermophorosis	83
Thermodynamics and electrochemistry	Allotrope	79
	Tetra valent	76.5
	De hydrogenation	81
Organic Chemistry	Methyl alcohol	80.5
	Polyhydric	77.5
	Cyclohexane	83.5

Among the 48 identified words 16 are easy. Seven of them belongsto Inorganic Chemistry. Physical Chemistry, Thermodynamics and Electrochemistry share 3 number of words each. Among them spectrometer (DI =91), cyclohexane (DI =83.5), thermostat (DI =82.5), tetrode (DI =82), methyl alcohol (DI =80.5) are reported as easiest. Photo, spectro, ad, mono, tetro, homo, thermo, allo, poly, cyclo are the prefixes containing this section and meter, stat, sorption, ode, genous, phorosis ,trope, mer, are the suffixes identified by the majority of the sample.

Conclusion

Most difficult terms in chemistry are fromPhysical chemistry. Among them 9 words have difficult prefix and the rest 3 have difficult suffix. Anti ferromagnetic, diazo, thermodynamics, syn elimination are the most difficult words. Antiferromagnetic is the most difficult word from among the 48 tested. Meanings of prefixes like *diazo, ampho, syn, photo* and suffixes like *oid* (eg.,actinoid) were not recognised by majority of students. Meanings of terms like ferromagnetic, solvate and aprotic were also not recognised by majority. In the units Thermodynamics & Electrochemistry and Physical chemistry moderately difficult terms are identified by the students. Spectrometer is the word in which most of the students identified and 91% students correctly answered to this question. Most of the easy questions are from the area of Inorganic Chemistry.

More than 1/3rd of students failed to recognise the meaning of prefixes like ortho, chromo, de, and suffixes like ol, al, lysis in chemistry terms. Meaning of terms like carbocation, anions, static electricity, and isobar/isotone were also not recognisable for 1/3rdof science students. More than ¼ of students failed to recognise the meaning of terms like dihydric, electrophile, equilibrium, alloys, thermionic emission, hydrogen, fission, anhydrous, homo polymer and diene. Organic chemistry, along with inorganic chemistry, which abounds with special terms have lesser number of terms with unclear meaning for the students than physical chemistry. This suggests that explicit instruction in classroom or reading materials will help students to learn chemistry vocabulary better.

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