PERIODIC TABLE AS A CONSTRUCTIVIST MODEL OF TEACHING-LEARNING AT THE SECONDARY LEVEL

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The article demonstrates the use of periodic table as constructivist model of teaching-learning to understand the periodic trends among the elements. The focus of the activity is to shift the passive learner from rote memorisation and facilitates them to construct their own understanding of the fundamental concepts such as electronic configuration, atomicity and valency of elements, charges on the ion, recalling the atomic number of elements, etc.

Key words: *Constructivist pedagogy; periodic table*

Introduction

Constructivist teaching is based on the constructivism theory of learning that enhances the active learning of students by creating their own meaning through experiencing things and reflecting on those experiences, instead of receiving knowledge passively through lectures and memorisation [Tan, 2004]. Constructivist teaching uses guided discovery, discussions on thoughts and ideas as well as activities to help students, learning. Using constructivist approach, the teacher fulfils the role of a facilitator to students creating experiences, providing hands-on environment and helps students to better relate the information learned in the classroom to their daily life activities [Huang, 2006 and Mustafa, 2008].

Science is an enterprise of inquiry, knowledge acquisition and exploration. The principal goal of science education is to develop creative and innovative thinking, to inculcate problem solving skills and to acquire understanding of scientific concepts among students. The *National Curriculum Framework-2005* has placed special stress on science education keeping in view its inherent nature. It has emphasised inculcation of learning principles of science through daily life activities and working with hands-on activities and experiments without diluting the conceptual understanding at any stage. It is learner centred rather than teacher centred and promoted teacher as facilitator to inculcate curiosity and creativity among the students to transact the science content effectively through constructivist approach.

Result and Discussion

The learning of chemical elements and their symbols has always been a boring task for students. First, it requires memorisation of a list of over one hundred names and symbols. Secondly, although the learning of the chemical elements and their periodical classification is an important part of the high school chemistry programmes, a practical application for this list of not so well-known terms is not readily found by pupils in their

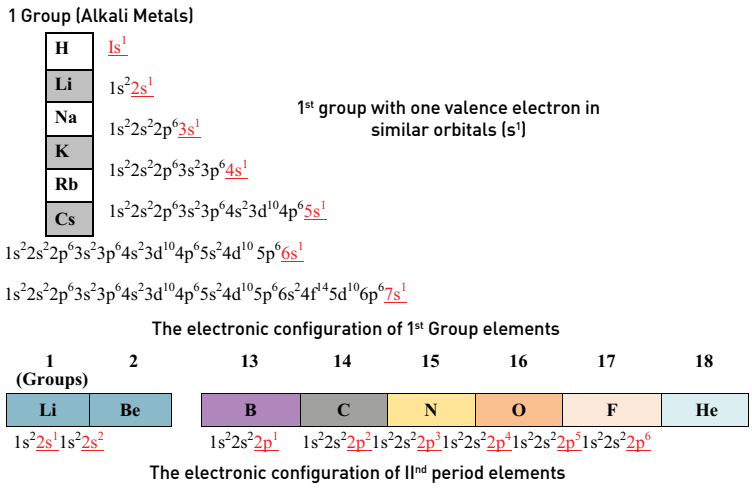
daily life. The periodic system of the elements is a fundamental knowledge at school and for that reason, the students from secondary education should learn the names and chemical symbols of the most important elements [Kathleen, et, al., 2012 and Carla, et al., 2014]. The different teaching methods other than memorisation are not often used in order to learn names and chemical symbols. In this way, educational strategies to help learners in this topic as a historical approach or the use of games have been an area of research nowadays.

The common difficulties among the secondary students are in the understanding of the basic concepts of elements, molecules, compounds, mixtures, atoms and sub-atomic particles and their further application in chemical reactions, stoichiometric relationships, periodicity of elements and transformation of one substance into another. The poor understanding of the fundamental concepts of elemental chemistry has led to the problems in the conceptual learning of related concepts. The difficulties regarding the valency of elements or charges on the ion, recalling the atomic number of elements, writing chemical formula and electronic configuration of elements can be solved by using periodic table as constructivist model of facilitating concepts. To improve the conceptual understanding in elemental chemistry the periodic table has been used as a constructivist model. The elements may be arranged in the periodic manner on the basis of their increasing atomic number, in various periods (rows) and groups (columns) as in the periodic table (excluding the transition elements) and once the elements were arranged, their difficulties can be easily overcome by studying in the constructivist way.

The following concepts may be facilitated.

1. Electronic Configuration and Valence Electrons

The electronic configuration of elements may be written by simply noting the position of element in the periodic table. Each group number of element represents similar orbitals with same valence electrons and the period number of element represents the



energy level for that row. For example Lithium, Li being the elements of first group will have only one valence electron in the last shell, i.e., S^1 and will have the principal quantum number 2 as placed in second period of periodic table. Therefore, the last shell electronic configuration will be $2S^1$

2. Atomic Number of Elements

The atomic number of any element may be predicted by locating its position in the periodic table. While moving from one period to another, the atomic number increases in a particular aspect ratio, i.e.

- From period II to period III: the atomic number increases by a factor of 8.
- From period III to period IV: the atomic number increases by a factor of 8.
- From period IV to period V: the atomic number increases by a factor of 18.
- From period V to period VI: the atomic number increases by a factor of 18 (Except for p-Block elements)

For example, if one wants to predict the atomic number of element iodine (Symbol I). After finding the position of iodine in the periodic table one could predict the atomic number 53, as the iodine is in the 17 group and V period of the periodic table. Therefore, 8+8+18 will be added to the atomic number of fluorine, i.e., 9.

3. Ionic charges on elements, atomicity of elements and writing of chemical formula

The common ionic charges of particular elements can be found out looking its position in particular period of periodic table. For example, elements of Group 1 like Li, Na, K, Rb, Cs and Fr will possess +1 charge. All the elements of a particular group possess same ionic charge.

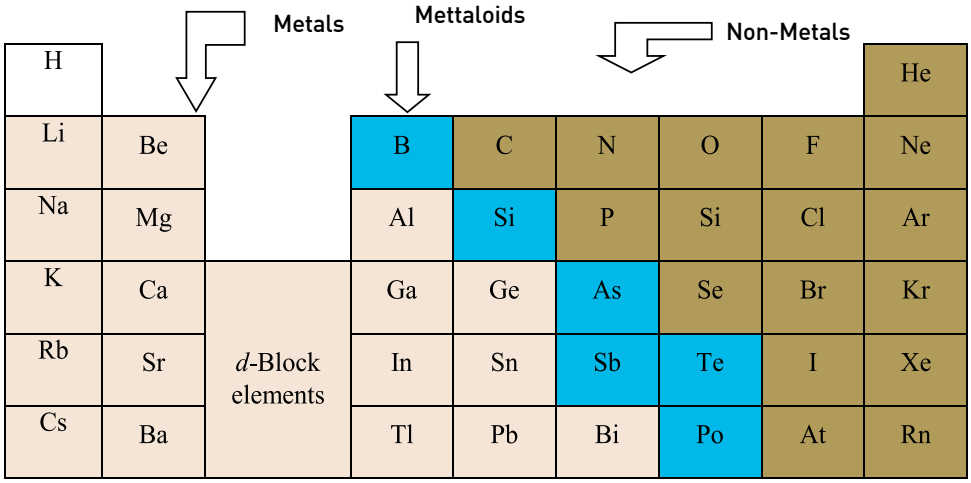
Group →	1	2		13	14	15	16	17	18
Period I	^{1}H								^{2}He
II	^{3}Li	^{4}Be		^{5}B	^{6}C	^{7}N	^{8}O	^{9}F	^{10}Ne
8 III	^{11}Na	^{12}Mg		^{13}Al	^{14}Si	^{15}P	^{16}Si	^{17}Cl	^{18}Ar
IV	^{19}K	^{20}Ca		^{31}Ga	^{32}Ge	^{33}As	^{34}Se	^{35}Br	^{36}Kr
18 V	^{37}Rb	^{38}Sr	*d*-Block	^{49}In	^{50}Sn	^{51}Sb	^{52}Te	^{53}I	^{54}Xe
VI	^{55}Cs	^{56}Ba	elements	^{81}Tl	^{82}Pb	^{83}Bi	^{84}Po	^{85}At	^{86}Rn

Group →	1	2		13	14	15	16	17	18
Charges →	+1	+2		+3		–3	–2	–1	0
	H^+								He
	Li^+	Be^{2+}		B^{3+}	C	N	O^{2-}	F^-	Ne
	Na^+	Mg^{2+}		Al^{3+}	Si	P	Si^{2-}	Cl^-	Ar
	K^+	Ca^{2+}	*d*-Block elements	Ga^{3+}	Ge	As	Se^{2-}	Br^-	Kr
	Rb^+	Sr^{2+}		In^{3+}	Sn	Sb	Te^{2-}	I^-	Xe
	Cs^+	Ba^{2+}		Tl^{3+}	Pb	Bi	Po	At^- ⇕ Diatomic	Rn ⇕ Monoatomic

The common difficulties in writing of chemical formula can also be resolved by looking into the charges of a particular ion

4. Identification of Metals, Metalloids and Non-metals among all the Elements

The metals and non-metals in the periodic table occupy a specific place and separated by a zigzag line. Remembering the position of any element in the periodic table one can identify them as metal, non-metal and metalloid.



Conclusion

The understanding of the basic concepts of elements, molecules, compounds, mixtures, atoms and sub-atomic particles and their further application in chemical reactions, stoichiometric relationships, periodicity of elements and transformation of one substance have been a difficult area for the secondary students. The memorisation based learning of students should be replaced by understanding the fundamentals to assimilate the knowledge. Therefore, taking it as prime concern, the present study was focused on facilitating concepts of science which are traditionally based on the memorising facts and theories and are not involved in the intellectual processes which resulted in the theories. The difficulties regarding the valency of elements or charges on the ion, recalling the atomic number of elements, writing chemical formula and electronic configuration of elements can be solved by using periodic table as a constructivist model of facilitating concepts. The exemplar approach will make the present approach suitable for transiting concepts at the secondary level.

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