

Multimedia Based on Scientific Approach for Periodic System of Element

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Abstract. This study aims to describe the application of interactive multimedia on the concept of the periodic system of elements. The study was conducted by using the *one-shot case study* design. The subjects in this study were 35 high school students of class XI IPA. Results showed that the stages of observing, questioning, data collecting (experimenting), and communicating are all considered very good. This shows that multimedia can assist students in explaining the development of the periodic system of elements, ranging from Triade doerrainer, Newland Octarchic Law, Mendeleyev, and the modern periodic, as well as atomic radius, ionization energy, and electronegativity of an element in the periodic system.

1. Introduction

The periodic system is one of the many chemical concepts that require students to memorize [1]. The high nature of abstraction causes students to tend to learn and love the concept profusely. To understand it, a correlation of contextual phenomena with aspects of symbolic language is required. Based on the results of research, this concept tends to be delivered by the method of memorization [2]. Teachers have not yet developed high-order thinking skills, especially generic science thinking skills [3]. The development of generic science skills can be optimally developed if the students are actively engaged in observing the given phenomenon and skillfully using the tool [4]. However, the material nature of the periodic system can not be observed directly. So we need tools to convey the concept.

In order for the given phenomenon to be delivered in the learning process and can stimulate the mindset, feelings, attention and willingness of students, an interactive multimedia can be used [5]. Implementation of multimedia in the learning process is believed to be able to improve students' learning outcomes [6]. Multimedia plays an important role in delivering course material using a variety of media, that will provide a positive contribution to the learning outcomes of students [7]. The use of instructional media that provides visualization of scientific concepts can use interactive multimedia so that it is able to accomodate students in training the science generic skills [3].

It is necessary to develop the generic skills of science on the concept of the periodic system of elements, using the learning process, by using visualization aid and appropriate learning approach. In this paper, the multimedia implementations based on the concept of scientific pendektatan periodic system of elements is reported.



2. Methods

The study was conducted by using *one-shot case study* design. The subjects of this research were 35 students of class XI IPA-3 SMAN 1 Sukakarya Bekasi.

3. Results and discussion

Based on the results of research on the application of interactive multimedia in students' chemical learning, can be seen in Figure 1, as follows:



Figure 1. Viewing Phase (*Observing*) by groups

Based on Figure 1 above, the average ability of students to observe interactive multimedia which contains the development of the periodic system of elements ranging from Triade doberrainer, Newland Octarchic Law, Mendeleev and modern periodic, as well as the periodic properties of the elements are categorized excellent with an average value of 83,0.

Students' ability in explaining the basis of complication of the modern periodic system as shown in Fig. 2 below:

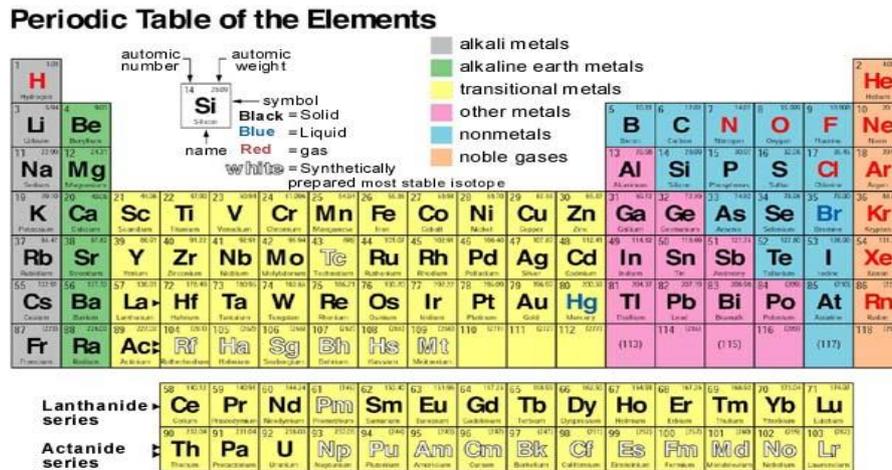


Figure 2. Modern Periodic System

Based on figure 2, the compilation of the modern periodic system is based on the increase of atomic number and mass number. Henry Moseley puts elements based on the increase in the number of protons. This is due to the elements having different atomic masses, but having the same number of protons [8]. The students' ability in explaining the basis for the preparation of modern periodic systems is categorized less by an average value of 55. This is because students have not been able to explain the modern periodic system compiled based on the atomic number increase and the similarity of properties. Period is arranged based on the increase of atomic number; whereas groups, is arranged on the basis of similarity [9].

The result indicator of the interactive multimedia on the implementation of data collecting stage, can be seen in Fig. 3, as follows:

Al =	S =	Ca =
Ga =	Se =	Sr =
In =	Tc =	Ba =

Figure 3. Data collecting stage (*Eksperimenting*) berdasarkan kelompok

Based on figure 3, students are given the opportunity to write down the mass of the elements that exist in a given image. Based on the results of student answers, the average score is 72.2 with good category. Not all students can answer the mass of Al element is 26,98sma, S 32 sma, Ca 40 sma, Ga 69,72 sma, Se 78,96 sma, Sr 87,62 sma, In 114,82 sma, Tc 1127, 60 sma and Ba 137.34 sma [10].

The next step, students are given questions based on Figure 4 below:

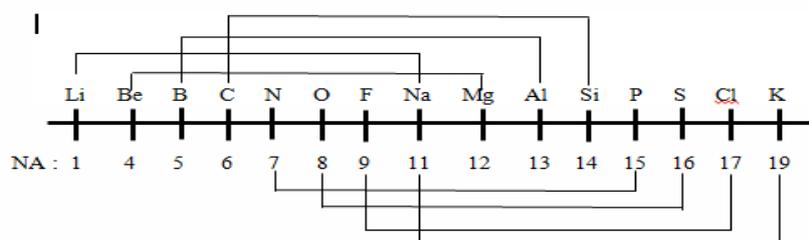


Figure 4. Grouping elements based on atomic periods that have similar properties

Based on figure 4, the students are given the opportunity to write down the atomic number of each element in sequence. The average ability of students in answering the question is 100, in which, is on the very good category. Students are able to sort Li = 3; Be = 4; B = 5; C = 6; N = 7; O = 8; F = 9; Na = 11; Mg = 12; Al = 13; Si = 14; P = 15; S = 16; Cl = 17; K = 19, each sequence of existing data, is to declare the properties of elements based on 1 class.

The next question is what basis did Mendeleev sort elements in his periodic table? It is as shown on Fig 5 below:

Group	I	II	III	IV	V	VI	VII	VIII
1	H=1							
2	Li=7	Be=9,4	B=11	C=12	N=14	O=16	F=19	
3	Na=23	Mg=24	Al=27,3	Si=28	P=31	S=32	Cl=35,5	
4	K=39	Ca=40	?=44	Ti=48	V=51	Cr=52	Mn=55	Fe=56, Ce=59, Ni=59
5	Cu=63	Zn=65	?=68	?=72	As=75	Se=78	Br=80	
6	Rb=85	Sr=87	?Yt=88	Zr=90	Nb=94	Mo=96	?=100	Ru=104, Rh=104, Pd=106
7	Ag=108	Cd=112	In=113	Sn=118	Sb=122	Te=125	J=127	
8	Cs=133	Ba=137	?Di=138	?Ce=140				
9								
10			?Er=178	?La=180	Ta=182	W=184		Os=195, Ir=197, Pt=198
11	Au=199	Hg=200	Tl=204	Pb=207	Bi=208			
12				Th=231		U=240		

Figure 5. The table according to Mendeleev periodic system

The students' ability to explain Mendeleev's reasons in compiling the periodic table as shown in Figure 5 was averaged 88.9, in which, is on the excellent category. It is possible for students to explain that the reason of Mendeleev put the elements in the periodic table in order, was based on the observation of 63 elements known at the time, which was, the properties of the elements are the periodic functions of their relative atomic mass. It means that, if the elements are arranged according to the increase of their relative atomic mass, then certain properties will be repeated periodically.

The question of the periodic nature of an ionizing energy element is based on the following picture 6:

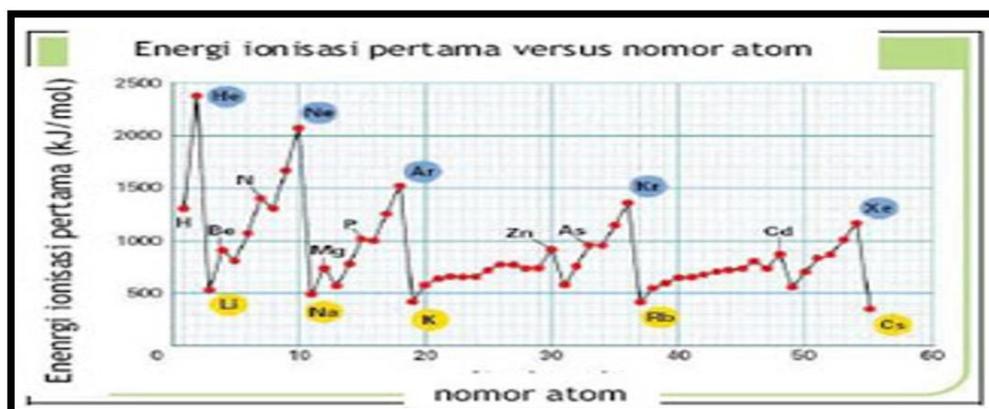


Fig 6. The ionization energy elements with an atomic number of 1 to 18

Questions refer to Figure 6 above is, which group elements in the periodic system that are at the points of the main peak graph? Write the symbols and electron configurations of those elements! The average student grades obtained were, between, 94.5 and 83.4 with very good category. It can be seen from the students' answers, Group VIIIA, that: He, Ne, Ar, Kr dan Xe, ${}_{2}\text{He} = 1s^2$, ${}_{10}\text{Ne} = 1s^2 2s^2 2p^6$, ${}_{18}\text{Ar} = 1s^2 2s^2 2p^6 3s^2 3p^6$, ${}_{36}\text{Kr} = (\text{Ar}) 3d^{10} 4s^2 4p^6$, ${}_{54}\text{Xe} = (\text{Kr}) 4d^{10} 5s^2 5p^6$. Class IA is Li, Na, K, Rb dan Cs, ${}_{3}\text{Li} = 1s^2 2s^1$, ${}_{11}\text{Na} = 1s^2 2s^2 2p^6 3s^1$, ${}_{19}\text{K} = (\text{Ar}) 4s^1$, ${}_{37}\text{Rb} = (\text{Kr}) 5s^1$, ${}_{55}\text{Cs} = (\text{Xe}) 6s^1$.

The next question is, students are asked to sequence the electron affinity of several elements according to Table 1 below:

Table 1. Sort the electron affinity of some elements

Period	IA	IIIA	IVA	VA	VI	VII
1	H					
2						
3						
4						
5						

Based on table 1 the average ability of students in ordering electron affinities in one class and period is, 61.1 and 66.7, in which are on, sufficient and good category. It is because students still need to improve their understanding that the affinity of electrons in one class, tends to decrease from top to bottom, while the electron affinity in one period, tends to increase from left to right [11].

The next question is the student are asked to show the electronegativity of some elements according to the group and period on the periodic table and which elements have the greatest electronegativity? It is based on table 2 below:

Table 2. Electro negativities of some elements according to the category and period

Li 1,0	Be 1,6	B 2,0	C 2,6	N 3,0	O 3,4	F 4,0
Na 0,9	Mg 1,3	Al 1,6	Si 1,9	P 2,2	S 2,6	Cl 3,2
K 0,8	Ca 1,0	Ga 1,8	Ge 2,0	As 2,2	Se 2,6	Br 3,0
Rb 0,8	Sr 1,0	In 1,8	Sn 2,0	Sb 2,0	Te 2,1	I 2,7
Cs 0,8	Ba 0,9	Ti 2,0	Pb 2,3	Bi 2,0	Po 2,0	At 2,2
Fr 0,7	Ra 0,9					

Based on table 2 the average ability of students in showing the electronegativity of some elements in one class and period is 94.5, which is in the very good category. It is because students have been able to explain in the periodic table, that the fluorine element is set to have electronegativity of 4 (largest), in which is in the top right corner. The element of francium that has the lowest electronegativity is 0.7 is at the bottom left in the periodic table.

In the associate phase, students discussed the observations result of the interactive multimedia by outlining the grouping of elements according to the chemists who discovered and developed the periodic system of elements, and an average value of 94.5 students in excellent category was obtained. The ability of students in communicating by presenting the results of discussions that have been done. So this stage is categorized very well with the average value of 80,2.

4. Conclusion

Interactive multimedia application of the concept of elements' periodic system of using the scientific approach at the stage of observing (*observing*), propose stage (*questioning*), the stage of collecting data (*experimenting*) and communication stage (*communicating*) are categorized as good, while the associate stage (*associating*) is categorized as very good. This means that students have been able to explain the development of the periodic system of elements ranging from Triade doberrainer, Newland Octarchic Law, Mendelejev and modern periodic, as well as atomic radius, ionization energy and electronegativity of an element in the periodic system.

References

- [1] P N W Hafidha 2014 *Augmented Reality Sistem Periodik Unsur Bandung*

- [2] D M Aryana 2016 *Penerapan Multimedia Interaktif untuk Mengembangkan Keterampilan Generik Sains Siswa Pada Konsep Sistem Periodik Unsur Melalui Pendekatan Saintifik Bandung*
- [3] Liliyasi 2007 *Scientific Concepts and Generic Science Skills Relationship In The 21 st dalam Century Science Education Bandung*
- [4] M Arifin 2000 *Strategi Belajar Mengajar Kimia Bandung: Jurusan Pendidikan Kimia FPM*
- [5] Y Munadhi 2008 *Media Pembelajaran Sebuah Pendekatan Baru Jakarta: Gaung persada*
- [6] M A Ramdhani and E R Wulan 2012 The Analysis of Determinant Factors in Software Design for Computer Assisted Instruction *International Journal of Scientific & Technology Research* **1** 69-73
- [7] H M Ali Ramdhani 2015 The Criteria of Learning Media Selection for Character Education in Higher Education” *International Conference of Islamic Education in Southeast Asia Malang*
- [8] R Chang 2005 *Kimia Dasar Konsep-konsep Inti Edisi Ketiga Jilid 1 Erlangga*
- [9] Keenan and Charles W 1984 *Kimia untuk Universitas Jakarta: Erlangga*
- [10] Keenan, Kleinfelter, Wood dan A H Pujaatmka 1984 *Kimia Untuk Universitas Jilid 2 Bandung Erlangga*
- [11] R Chang 2005 *General Chemistry: The Essential Concepts The McGraw-Hill Companies*