Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.5, No.36, 2014
www.iiste.org

Model Visualization of Atomic Quantum Numbers Three Dimensional on Physics Lesson in Class XII Science High School (SMAN 10) Padang West Sumatra Indonesia

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Abstract
Physics as a science is a major corner stone in the development of technology that physical theories require a high degree of precision. Knowledge of physics consists of many of the concepts and principles that are generally abstract. Physics is a subject that requires a relatively high intellect so most students have difficulty studying. Many difficulties faced by most students is the interpretation of various concepts and principles of physics because students are required to be able to interpret the knowledge of physics and its application in daily life properly and not vague or ambiguous. This situation is exacerbated by the use of learning methods that are less precise physics.This research aims to the problems of physics concepts and principles of quantum numbers of atomic models that abstract becomes real and can be perceived by students as a learning experience guiding students visualize models with atomic quantum numbers in three dimensions in the learning process .The results of the study are students better understand the concepts and principles of three dimensional model of the atom, and can put electron configuration in the electron orbit in accordance with the rules of quantum numbers, Pauli principle prohibition, Hund and Aufbau. From the questionnaire given to the students and observation and test show a good understanding of the concept occurred with an average value of 92.45 and a good learning activity occurs in the students.
Keywords : Model of the Atom, Visualization, Three Dimensions.

1. Introduction

Background**:** Knowledge of physics consists of many of the concepts and principles that are generally abstract. Physics is a subject that requires a relatively high intellect so that most students have difficulty to learn. Many difficulties faced by most of the students are in the interpret various concepts and principles of physics because they are required to be able to interpret the physics knowledge appropriately and not vague or ambiguous. Such situation is further compounded again by the use of learning methods that are not appropriate physics. Students will be able to learn more easily about the concepts that are real and can be observed through teh five senses. Students by using his experience, can gradually develop the ability to understand abstract concepts and symbols, to think logically, and to generalize. This indicates that most students are very dependent on concrete experience, especially on new ideas. Concrete experiences will be very effective in helping the learning process only if itoccurs in the context of the relevant conceptual structure.

Learning Physics in class XII Science in matter Quantum Model of the Atom number is an abstraction matter and difficult to understand students. Usually students learn atomic model sof two-dimensional quantum numbers, only given the picture by filling in the principal quantum number, orbital, magnetic and spin. In this moment I want to provide a learning experience that abstrac into concrete learning experiences through to visualize models of the three-dimensional atomic quantum numbers, at this moment I want to know: "Is Atomic Numbers Visualization Model Three Dimensional Quantum Physics In Class XII Science Learning can improve understanding quantum numbers of the atomic model'

a. Identify the Problem
- many abstract material physics, like where things can be used real.
- Learning in schools is still a lot of lecture so that students are less active.
- Understanding the concept of students less as an event, as much as the facts.

b. Problem Formulation

Does visualization model of the three-dimensional atomic quantum numbers can increase students' understanding of the concept of the quantum model of the atom number in the Class XII Physics Learning Natural Science?

c. Theory Study

The development of atomic theory from Democritus, JJ. Thomson, Rhuterford, and Bohr have weaknesses and strengths of each to approximate the actual atomic model. Further development of the atomic

theory is a model of a modern atom Quantum Numbers, and electron configuration.

Types of Quantum Numbers:

There are four quantum numbers that will we know, the principal quantum number (n), Azimut quantum number (I), the magnetic quantum number (m) and the spin quantum number (s).

1) Quantum Key Numbers.

Principal quantum number n is expressed with the symbol, the energy levels of electrons on the track or to the skin-n. It could be said that the principal quantum number associated with the electron shells in the atom. The principal quantum number limits the number of electrons that can occupy a single track or a skin based on the following equation. The maximum number of electrons in the n-th skin is $2N^2$.

2) Quantum Numbers Azimut / Orbital (I).

Azimuthal quantum number states where electrons are sub-skin and orbital shape, and determine the magnitude of the angular momentum of the electron to the nucleus. The number of the subshell electrons are dependent on the value of the principal quantum number (n). Azimuthal quantum number value from 0 to (n - 1). When n = 1, then there is only one subshell ie l = 0, while n = 2, then there are two sub-shells, namely l = 0 and l.

Sub skins that cost different is given a special name:

l = 0; corresponding sub-skin s (s = sharp)
l = 1; corresponding sub-skin (p = principle)
l = 2; corresponding sub-skin d (d = diffuse)
l = 3; corresponding sub-skin f (f = fundamental)

3) Magnetic quantum number (m)

Electron angular momentum l is a vector. If theangular momentum vector l is projected in the direction of the vertical axis or the z-axis in three dimensions to obtain the components of angular momentum direction of the z-axis is expressed as lz. integers associated with large lz is m. This number is called the magnetic quantum number. Because large lz rely on large angular momentum of electrons l, then the value of m is also related to the value of l.

$$m = -l, ..., 0, ..., +l$$

So the value of the magnetic quantum number associated with the quantum number azimut. Value magnetic quantum numbers between - l to + l.

4) Spin quantum number (s).

Spin quantum number of electrons produces the intrinsic angular momentum of electrons. Spin angular momentum also has two different orientations, namely spin up and spin down. Each electron spin orientations have different energies thin so it looks as the spectral lines terpisah. Spin quantum number (s): indicates the direction of rotation of the electron on its axis. In one orbital, maximum 2 electrons can circulate and the second electron is spinning through the axis in the opposite direction, and each one is priced spin + 1/2 or - 1/2.

Electron Configuration:

These four quantum numbers *n, l, m* and *s*. Allows us to mark the electrons in atomic orbitals or complete. In this case we can think of the four quantum numbers as the "address" of electrons in atoms.

There are three rules or principles that should be considered in the determination of the electron configuration of an atom, and this principle applies to a variety of elements are:

1) Prohibition of the Pauli principle

No two electrons in an atom can have the same four quantum numbers.

2) The principle of maximum multiplication (Hund's rule)

If there are orbitals with the same energy, electrons singly occupied before he occupied itin pairs. As a result, the atoms tend to have as many unpaired electrons. These properties can be accepted, because all electrons carry the same electrical charge, so they look for an empty orbital before pairing with the same energy electrons have filled orbital shalf filled.

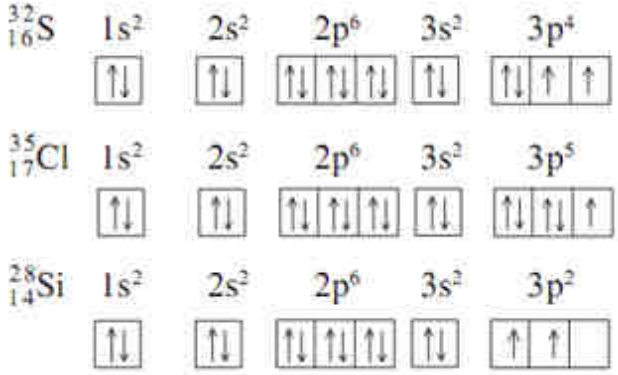

Figure 1. Hund rule electron placement in pairs with higher water wheel.
http://mediabelajaronline.blogspot.com/2010/09/konfigurasi-elektron-dan-diagram.html

3) Aufbau Principle

The minimum energy principle states that electrons in atoms distributed based on the sequence from lowest to highest orbital energy; procedure sequence distribution of electrons in the orbital such as the Aufbau principle means the principle building.

Based on the statement that every orbit Pauli only be occupied by 2 electrons, the skin sub 1s2 there are 2 electrons.

In there are six sub-skin 2p6 electron placement of each is 2 electrons in the px orbital, two electrons in orbit py and 2 pz electrons in orbit. usually some teachers illustrate that there are six sub-skin 2p6 electrons in one orbit.

Table 1. Relationship of Quantum Key Numbers, Azimut, Magnetic and Spin Quantum Numbers.

Skin	Quantum Number Main (n)	Quantum Number Azimut (l)	Sign Orbital	Quantum Number Magnetik (m)	Quantum Number Spin (s)	Amount Orbital	Max electron in sub skin	Mak electron in skin
K	1	0	1s	0	$\pm\frac{1}{2}$	1	2	2
L	2	0	2s	0	$\pm\frac{1}{2}$	1	2	8
		1	2p	-1, 0, +1	$\pm\frac{1}{2}$	3	6	
M	3	0	2s	0	$\pm\frac{1}{2}$	1	2	18
		1	3p	-1, 0, +1	$\pm\frac{1}{2}$	3	6	
		2	d	-2, -1, 0, +1, +2	$\pm\frac{1}{2}$	5	10	
N	4	0	2s	0	$\pm\frac{1}{2}$	1	2	32
		1	3p	-1, 0, +1	$\pm\frac{1}{2}$	3	6	
		2	d	-2, -1, 0, +1, +2	$\pm\frac{1}{2}$	5	10	
		3	f	-3, -2, -1, 0, +1, +2, +3	$\pm\frac{1}{2}$	7	14	

Visualization of Three Dimensional Model of the Atom

Visualization according to Indonesian dictionary is disclosure of an idea or feeling by using a form of drawing, writing (words and numbers), maps, charts, and so on, the process of changing into a depiction for the presented concept. Furthermore Visualization is in the manufacture of engineering drawings, diagrams, or animations to

appearance information. In general, visualization in the form of images both abstract and real has been known since the beginning of human civilization. At this time visualization has been developed and used for the purposes of science, engineering, product design visualization, education, interactive multimedia, medicine, and others. Visualization of three-dimensional atomic model is intended as a real depiction of the atomic model in three dimensions that can be made into learning model of the atom.

Research Objectives:

1) Make a model visualization of three-dimensional atomic quantum numbers.
2) Increase understanding of physics concepts and principles of quantum numbers of atomic models in physics class XII Science High School.
3) Gives readings as resources that may help teachers of physics in adding insight and knowledge to design and develop a competency-based physics learning scenarios.

Benefits:

1) Increase the creativity and motivation of students in student-centered learning.
2) Students have a learning experience quantum numbers of atomic physics models with learning to make their own media.
3) Improving students' mastery of concepts and principles to the atomic model of quantum numbers.

2. Step - Step Execution

Learning physics in the second half of class XII on the atomic theory of matter is an abstract matter, where students can only imagine the arrangement of atoms in its orbit. Students will have difficulty in understanding the material, if only the lecture method of teaching and learning without the appropriate media. To further provide a real picture to students, the authors conducted Visualization Model Three Dimensional Atom Quantum Numbers.

Making Visualization Model Three Dimensional Atom Quantum Numbers

In table 1 there is a relationship between the principal quantum number, Azimuth, magnetic and spin. Students still confusionlay where the electronis located. Quantum numbers still seem abstract for students, to help students clarify and understand well the concept of quantum numbers, then made visualization model of the three-dimensional atomic quantum numbers.

Competency Standards.

Analyzing various physical quantities in quantum phenomenon and the limits of the enactment of Einstein's relativity in modern physics paradigm.

Basic Competence.

Describethe development of the atomic theory.

Achievement Indicators of Competence.

1) Distinguishthe principal quantum number, orbital, magnetic, andspin.
2) Connect theelectronconfigurationwithquantum numbers.

The purpose of the practicum.

1) Distinguish the principal quantum number, orbital, magnetic, and spin.
2) Explain the selection rules.
3) State the Pauliban.
4) Distinguishing skin and subshell.
5) Explain the electron configuration.
6) Write the electron configuration shorth and notation.
7) Linking with konvigurasi electron quantum numbers in three dimensions.

The tools use dare:

1) Playdough four color 3) Isolation
2) Wire 4) Tang

Learning steps:

1) Students were divided into eight groups with one group of four.
2) Students choose what will be made of atoms.
3) Students determine the number of atoms, the number of protons and neutrons in the atomic number they have chosen.
4) Students determine how many atomic shells and subshell sare going to make. Leather or leather submay on ly be occupied by 2 electrons.

Figure 2. Students create protons, electrons and neutrons.

5) Students make atomic nucleus consists of protons and neutrons.

Figure 3. Students make an atomic nucleus.

6) Students make shells, subshells then putting the atomin shells and subshells. Students create electrons, protons and atomic Examples skin; For the K shell1s 2 means there is no one orbital electron and filled by 2, and the sub-skin leather L there is no 2 electrons 2s2, and 2p6 sub skin then there are 2 electrons in orbit px, there are 2 electrons in orbit py, dan 2 electron s in pz.

Figure 4. Students are actively preparing their atomic models.

Figure 5. Students make models of atomic quantum numbers and modeling that has been created

7) Presenting the results of the atoms are made of students and discussion group.

Figure 6. Discussion students presented the results of an atomic model of quantum numbers that they have made.

8) Teacher and students draw conclusions about what is already doing.

9) Displaying student work in the physics labor in the classroom each student.

Data Collection Techniques.

Data collected through student questionnaire responses.

1. Mechanical Analysis of Data.

Data were analyzed descriptively, the student activity data and student responses.

a. Student Activity Assessment.

Student activity observed in the observation sheet student in detail can be found in appendix. Every aspect of the assessment criteria observed in the observation sheet with the notation shown in the following table:

Table 2. Criteria Assessment for observation sheet

No	Assessment Criteria	Notation	Score Value
1	Less	K	1
2	Self	C	2
3	Both	B	3

(Sudjana, 1995:77)

Kisaran nilai untuk setiap kriteria penilaian= $\frac{Skor\ tertinggi - Skor\ terendah}{Jumlah\ kriteria\ penilaian\ observasi}$

Table 3. Scores range Assessment for Student Observation Sheet.

No	Assessment Criteria	Score Range
1	Less	7 - 11
2	Self	12 - 16
3	Both	17 - 21

b. Student Response Assessment

Table 4. Score seach Item Question Answer Questionnaire.

Answers	Score
Strongly Agree(SS)	4
Agree(S)	3
Disagree(TS)	2
Strongly Disagree(STS)	1

Source: (Arikunto, 2002)

Analysis of student questionnaire responses is done by calculating the average score of the students' responses to the following formula:

$$Respon\ positif\ siswa = \frac{Jumlah\ Skor}{Jumlah\ siswa\ X\ \ Jumlah\ Butir\ Soal\ X\ \ Skror\ Tertinggi}\ X\ 100\%$$

The results of the students' responses are then analyzed using the assessment criteria in accordance with the assessment criteria sheet student questionnaire responses as follows:

Table 5. Criteria Assessment Questionnaire Response Sheet Students.

No	Assessment Criteria	Persentase
1	VeryPositive(SP)	75,6% ≤ X ≤ 100%
2	Positive(P)	50,6% ≤ X ≤ 75,5%
3	Negative(N)	25,6% ≤ X ≤ 50,5%
4	VeryNegative(SN}	0% ≤ X ≤ 25,5%

X = Student Response

Source: Modification of the 2006 study in paradise (2009:61)

Measures Success Criteria

a. Involvement of the student in the learning process and are on the rise on both criteria in the range of 17-21.
b. Percentage of students who have positive response ≥ 75%.
c. The classical 85% of students scored ≥ 65.

3. Results And Discussion

Usually students still imagine that the arrangement of electrons in an atom according to the Bohr atomic model like figure 7. Following:

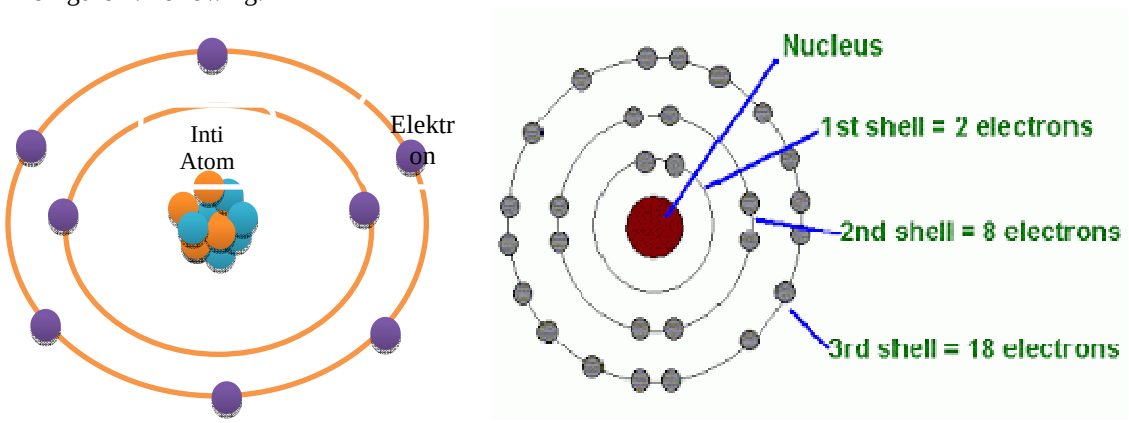

Figure 7. Composition ofelectronsinanatom(image taken from http://datacybernetwork.Blogspot.com/2013/01/perkembangan-theory-atom.html)

If you like the above picture the arrangement of electrons Pauli ban stating that no two electrons in an atom can

have the same four quantum numbers at once difficult to prove, because it becomes a weakness Bohr model of the atom. Students still imagine the configuration of electrons in an atom is like the Bohr atomic model theory, despite being studied atomic quantum numbers because usually the teacher gives an explanation of the numbers just as theory just to make the configuration in front of the class (on the board). Teachers not give vivid account of how the electrons are arranged in orbits of electrons according to the rules of quantum numbers and three Aufbau rule, Hund and Pauli ban simultaneously.

From the research conducted, students can understand the concept of atomic quantum numbers as a whole. Laying the electron configuration of the orbits of the electrons with the quantum number of rules and laws apply Aufbond, Hund and Pauli ban on atomic models of quantum numbers. Then according to the model of modern atomic arrangement of electrons in atoms as in Figure 8. Following:

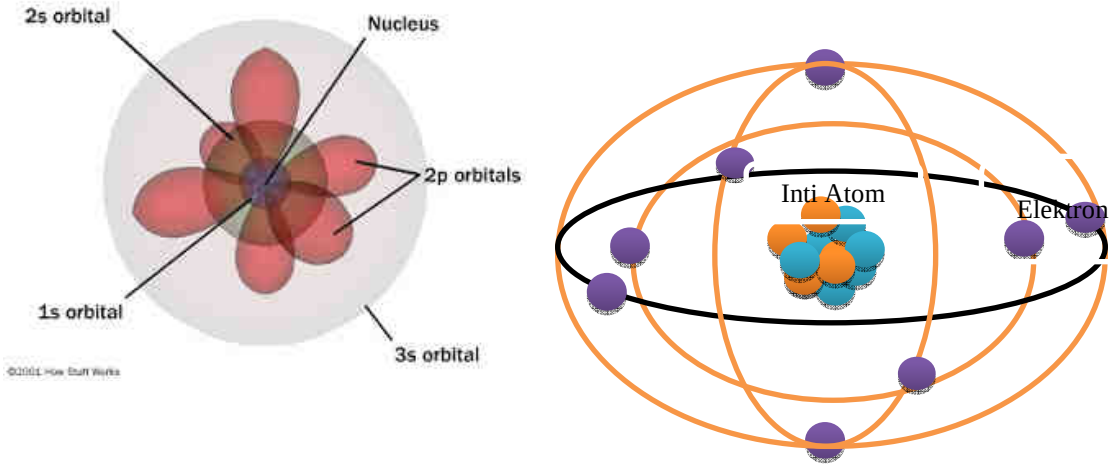

Figure 8. Composition of electrons in an atom according to modern atomic theory. (http://datacyber network.blogspot.com/2013/01/peerkembangan-teori-atom.html)

In this arrangement the atoms as quantum numbers and Hund's rule, Aufbau principle and Pauli prohibition can be applied. In certain electron orbits are events where the electrons according to Heisenberg's theory. Students can assume and translate presence electron in an atom orbits the abstract becomes more apparent.

By creating a model of visualization of three-dimensional atomic quantum numbers as the picture 9.

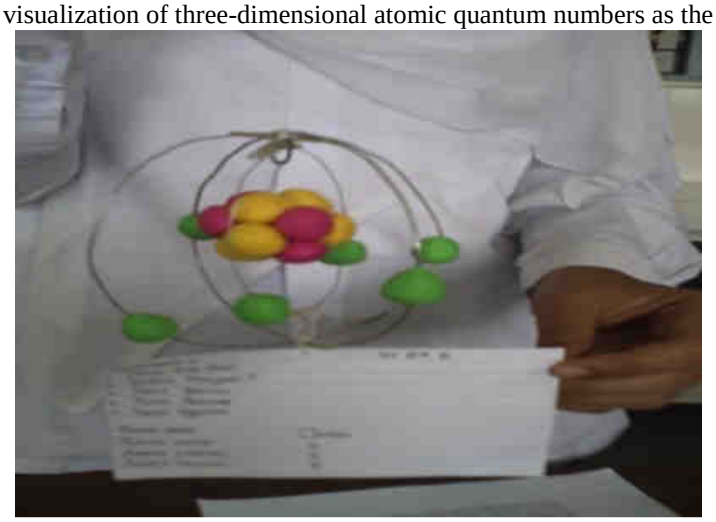

Figure 9. Visualization Model Three Dimensional Atomic Quantum Numbers Made students.

- Students can understand the concept of an atomic model of the atom with a good quantum number.
- Students can put the corresponding electron configuration atomic model quantum numbers.
- By creating a model of the three-dimensional atomic quantum numbers motivated students and in crease creativity.
- From the questionnaire given observation of students showed an understanding of both the concept and value of 92.45% occurred a good activity for students.

This provides a learning experience for the students to do their own make models of three-dimensional atomic quantum numbers. Teachers as mentors and facilitators of student learning was evident. Teachers guide

students to create and Student facilities. Work sheet to guide students in performing activities. When learning activities take place teachers guide students in performing activities in the laboratory. Knowledge of physics consists of many concepts and principles in generalis abstract thas become apparent with the learning process of students do and have experience in learning. Students can easily learn more about the concepts that are real and can be observed through the five senses. By using the experiences students can gradually develop the ability to understand abstract concepts into real and manipulate symbols, to think logically, and to generalize. This indicates that most students are very dependent on concrete experiences, especially about new ideas. Concrete experiences will be very effective in as sisting the process of learning in the context of the relevant conceptual structure.

Most of the problems faced by the majority of teachers of physics is still relatively low ability to develop competency-based learning scenarios physics, learning without good planning scenarios or poor creativity, insight, knowledge, and not progressive. Can be answered that the teacher by utilizing available resources able to develop a learning process in order to achieve competency through appropriate learning experiences of students. The learning experience is a physical or mental activity that is done inter acting with the students in the learning resources in order to achieve there quired learning competence. Scenario as operational technical guide for teachers in developing learning both inside and out side the classroom. Objectives to be achieved through this study is to provide readings as resources that may help teachers of physics in adding insight and knowledge to design and develop a competency-based learning scenarios physics.

The benefits that can be drawn from this study is the increased ability of physics teachers in developing competency-based learning scenarios physics. In addition, the learning process used optimally to improve the quality of learning in the classroom and the teacher of physics. All that will ultimately lead to the learning process at school physics becomes meaningful. As a result, difficult physics subjects transformed into a fun, easy to understand and most students favored, occurs because teachers use instructional approaches or strategies and appropriate learning media.

4. Conclusion

Based on the results and discussion of the research, have been performed can be concluded:

a. Learning physics in abstract concepts necessary props or media that is designed for students to understand the concepts of physics very well to do your own learning.
b. By visualizing the atomic models of three-dimensional quantum numbers of active students and are happy to do physics learning in class XII Science.
c. By visualizing the atomic models of three-dimensional quantum numbers can increase students' understanding of concepts and results from a questionnaire completed student and the average value reached 92.45.

5. Recomendation

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