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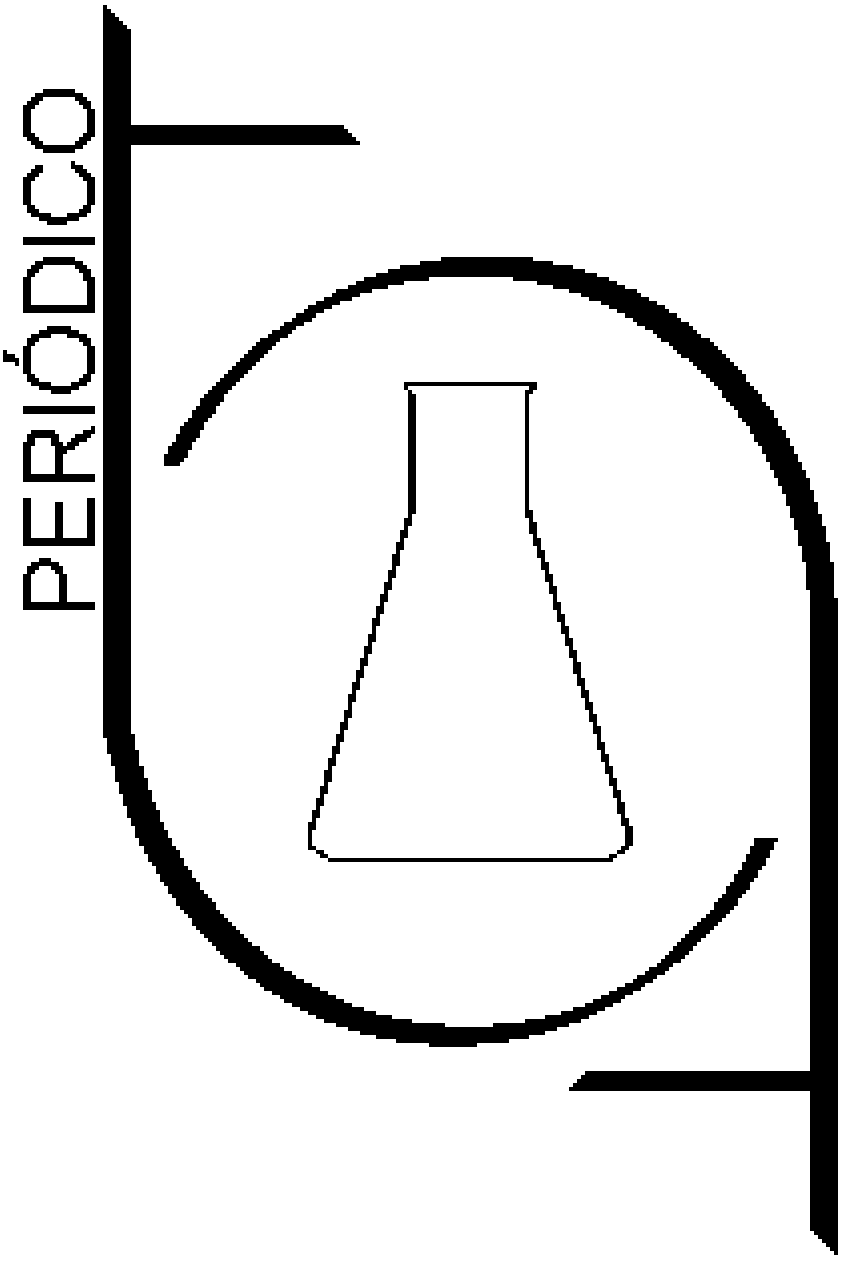

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Tchê Química Journal publishes original research papers, review articles, short communications (scientific publications), book reviews, forum articles, technical reports, articles on chemical education, interviews, announcements or letters. Articles suitable for publication in the Tchê Química Journal are those that cover the traditional fields of **Chemistry, Physics, Mathematics, Biology, Pharmacy, Medicine, Engineering and Agriculture**. We are especially interested in those submissions that are highly relevant to theoretical and applied contributions in the area of chemistry and related disciplines.

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95- Artigo / Article

VOSTRIKOVA, T. V. 1; ZEMLYANUKHINA, O. A.; KALAEV, V. N.

RUSSIA

USO DE CARACTERÍSTICAS BIOQUÍMICAS-FISIOLÓGICAS, CELULARES E SUBCELULARES DE BETULA PENDULA COMO MARCADORES DE GERMINAÇÃO DE SEMENTE E MONITORAMENTO DA POLUIÇÃO DO TERRITÓRIO

USE OF PHYSIOLOGICAL-BIOCHEMICAL, CELLULAR AND SUB-CELLAR CHARACTERISTICS OF BETULA PENDULA AS MARKERS OF SEED GERMINATION AND MONITORING TERRITORY POLLUTION

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Author instructions

As we are updating the journal policy we kindly invite you to visit the journal website to get the most recent pieces of information.

Thank you. Editors.

PERIÓDICO TCHÊ QUÍMICA

WORDS FROM THE EDITORS

Dear readers and authors

On behalf of the editors and editorial board, we would like to inform you that we are going to make some important changes in the journal for the next year in order to improve not only the quality of the Journal but also fill some gaps we are facing regarding evaluation, costs, website, and other subjects.

1. **Make official the 100 manuscripts rule**. It is important to have a standard regarding the number of published papers per issue. Nowadays, we do not have any standard, and sometimes we make mistakes.
2. **Increase the periodicity of the journal from 2 to 3 editions per year**. With the implementation of this concept, we will limit ourselves to a maximum of 300 papers per year. Since this is a small journal, 300 papers would be a lot of material to us. At the same time, it will make us more selective. We have been receiving a few thousand manuscripts per year, and we can't publish them all. **After changing the periodicity from 2 to 3 issues per year, in 2020, we are going to launch the issues in March, July, and November**.
3. **We cannot publish every original manuscript that we receive**. Why? Some manuscripts are not related to the journal's scopes or objectives, so if you are an author, please observe it before making a submission. Other manuscripts have problems that when they are pointed out by the review board of the journal, the manuscripts are too hard to improve.
4. **Implementation of a publication fee**. After all these years, it is important to implement an official publication fee, and it helps to maintain and improve the journal. More information about it will be released soon at the Journal's website. If you can't pay the fee, please talk to us, we are sensitive to your case.
5. **Evaluation time.** After all those years, we can safely say that we normally take from 60 to 120 days to evaluate a manuscript. So we advise the authors to organize their publications schedule, we don't have fast or express publication option. The review process takes time. As an author, you can really help us by executing the requested changes all at once, and properly using the journal's template. Sometimes it is faster, sometimes not.
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8. **Letters of acceptance.** We will no longer provide this type of service in this journal. Why? It takes time to produce it, and it's an instrument take can be falsified and used improperly. Instead, we recommend the authors to present the e-mails that we exchange or present the publication itself in the journal.

PERIÓDICO TCHÊ QUÍMICA
ARTIGO ORIGINAL

REVELANDO AS CONCEPÇÕES DOS PROFESSORES DE QUÍMICA PRÉ-SERVIÇOS SOBRE ORBITAL ATÔMICO DE HIDROGÊNIO USANDO TESTES ABERTOS: UM ESTUDO DE CASO NA INDONÉSIA

REVEALING PRE-SERVICE CHEMISTRY TEACHERS' CONCEPTIONS OF HYDROGEN ATOMIC ORBITALS USING OPEN-ENDED TESTS: A CASE STUDY IN INDONESIA

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RESUMO

O conceito atômico é um conceito abstrato e difícil de descrever. Portanto, uma pesquisa foi conduzida para revelar a concepção dos estudantes no tópico da estrutura atômica, especialmente o conceito de orbitais atômicos de hidrogênio. No total, 44 professores de pré-serviço dos alunos do segundo ano do Departamento de Educação Química da Universidade de Lampung-Indonésia tornaram-se o assunto desta pesquisa. Esta pesquisa utilizou o desenho qualitativo pelo tipo de Grounded Theory. Os resultados mostraram que houve 9 concepções relacionadas aos orbitais atômicos de hidrogênio com o percentual de alunos que apresentam concepções corretas e incorretas (equívocos) de 4,54% e 95,46% respectivamente.

Palavras-chave: Concepções; Conceito atômico; Orbitais Atômicos de Hidrogênio

ABSTRACT

Atomic concept is one concept that is abstract and difficult to describe. Therefore, a research has been conducted to reveal students' conception in the atomic structure topic, especially the concept of hydrogen atomic orbitals. Totally, 44 pre-service teachers from the second-year students of the Chemical Education Department University of Lampung-Indonesia became the subject of this research. This research used the qualitative design by the type of Grounded Theory. The results showed that there were 9 conceptions related to hydrogen atomic orbitals with the percentage of students who have correct and incorrect conceptions (misconceptions) of 4.54% and 95.46% respectively.

Keywords: Conceptions; Atomic concept; Hydrogen Atomic Orbitals

1. INTRODUCTION

Chemistry is an of the branch of natural science. Chemistry develops based on phenomena that occur in nature. Characteristics of chemistry itself are related to studies of substances- both those that can be touched and can not be touched- including compositions (structures and compositions) of substances, properties, changes that can be experienced, and phenomena accompanying the changes (Author Team, 2003; Author Team, 2006; Firman, 2007; Fauzi, 2015).

The properties of a substance are determined by the nature of the constituent particles. Atom as the constituent particle of a substance has the same properties as other similar atoms. In addition, atom also has different properties with other different atoms. It depends on its atomic structure. By understanding the structure of atoms, the nature of the elements: the tendency of atom of an element to interact with other atom (either similar or not similar type of atoms) to form compound; type of chemical bonding formed; structure and composition of the compound formed; properties of compound formed; and so on could be explained and understood (Matta & Boyd, 2007). Therefore, it can be said that the atomic concept is a fundamental/prerequisite concept to understand other chemical concepts.

The atomic concept is a concept that is abstract and difficult to describe. Abstract concepts often make the students confuse in understanding chemistry lessons (Johnstone, 1991; Nakhleh, 1992; Fadiawati & Liliasari, 2008). From various studies that have been carried out, it was revealed that there were many students having difficulty in understanding chemical concepts (Nakhleh, 1992; Ayas & Demirbas, 1997; Taber, 2003; Yezierski and Birk, 2006; Özkaya et al., 2006; Barke et al., 2008), even it was founded that some misconception happen in most of students in understanding atomic concept (Fadiawati & Liliasari, 2008; Fadiawati & Liliasari, 2009). Based on that description, the term misunderstanding or misconception is still sightseen among researchers.

Strategies such as testing students or asking students to explain reasons were used generally. Open-ended tests provided the researchers not only both qualitative and quantitative data, but also much and wide information about misconceptions (Abraham, Williamson, & Westbrook, 1994; Bowen & Bunce; 1997; Tanahoung, Chitaree, & Soankwan, 2010).

Many reseachers use open-ended test to prob students' conception. Nakiboglu (2003) investigate Turkish pre-service chemistry teachers' conception of atomic orbital related to hybridization. Fadiawati & Liliasari (2008) investigates high school students' alternative conceptions releated to atomic structure. Fadiawati & Liliasari (2009) also investigates high school teachers' conception of atomic structure. Additionally, no study investigated the understanding of hydogen atomic orbitals with open-ended test among Indonesian pre-service chemistry teachers.

Regarding the description above, it would be very apprehensive if pre-service chemistry teachers have some misconceptions. Considering that most of the students in Indonesia still rely on teachers as the source of learning. Cause it is feared that this will be the source of misconceptions when they become teachers. Therefore, this study will reveal pre-service chemistry students' conceptions in atomic structure topic, especially the concept of hydrogen atomic orbitals.

2. MATERIALS AND METHODS

This research used qualitative design by the type of Grounded Theory. This research consisted of three matters, there are: (1) Concept, a baseline study formed from data conceptualization; (2) Category, a set of higher and more abstract of representative concept; and (3) Proposition, showing the relationship between one category and other accompanying concepts (Moleong, 2008).

The subject of this research was pre-service teachers from the second-year students of the Chemical Education Departments University of Lampung who were taking Inorganic Chemistry lecture, which was consisted of 44 students. The subject of the research was chosen by theoretical sampling technique (Creswell, 1997). The subject of this research was also chosen by some considerations: (1) Those students have learned about both Bohr and Quantum atomic theory when they were in high school; (2) Those students have taken General Chemistry lecture in which materials containing atomic structure topic both Bohr and Quantum atomic theory; and (3) those students were taking Inorganic Chemistry lecture in which materials containing both Bohr and Quantum atomic theory.

Instrument of open-ended test and interview were used to prob pre-service teachers' conceptions of hydrogen atomic orbitals. Data in this qualitative research was analyzed by uniting and categorizing technique. Data trustworthiness was investigated by using: (1) credibility replace internal validity; (2) tranferability replace external validity; (3) dependability replace reliability; and (4) confirmability replace objectivity (Moleong, 2008).

3. RESULTS AND DISCUSSION:

The results of this research are in the form of students' responses obtained from the test. The responses are students' conceptions related to the question of "Explain your idea about the statement of: hydrogen atoms only have one orbital, namely 1s orbital?"

The responses make 2 units of conception, there are "agree" and "disagree" to that statement as shown in Table 1. Based on a further interview to confirm the answers, it is founded that there are 9 conceptions as presented in Table 2.

Table 1. *The number of students' conceptions related to the statement of "Hydrogen atoms only has one orbital namely, 1s orbital."*

Number of Students	Number of Conceptions	Number of units
44	9	2

Students' percentage who have correct conceptions related to hydrogen atomic orbitals is presented in Figure 1.

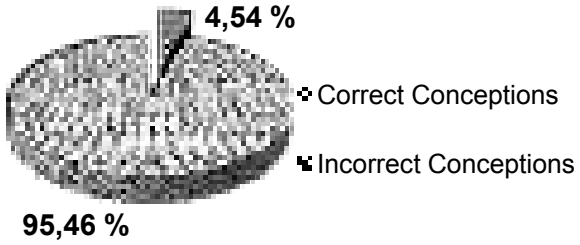

Figure 1. *Percentages of students' conceptions*

3.1. Possible factors causing the emergence of various students' conceptions

The atomic concept, including orbitals, is one of an abstract concept and difficult to describe. This concept is different from other usual chemical concepts which the phenomena could be observed by using human sense. Based on the further interview, some conceptions on hydrogen atomic orbitals emerge because of the following possible factors:

Table 2. *Students' conceptions related to hydrogen atomic orbitals*

Conceptions	Total
Hydrogen atom only has 1 orbital, namely 1s orbital	
1. Hydrogen atom has the atomic number of 1 with electronic configuration of 1s1, based on its electronic configurations, hydrogen atom only have 1 orbital, namely 1s orbital (ICC)	9
2. Hydrogen atom has 1 electron which only occupies the first energy level of orbitals, where the first energy level is on 1s orbital (ICC)	7
3. Hydrogen atom is the simplest atom with an atomic number of 1, which means that it only has 1 proton and 1 electron (ICC)	13
4. Hydrogen atom is the simplest atom with valence electron of 1 which occupies the lowest energy level of orbitals, namely 1s orbital (ICC)	4
Hydrogen atom does not have 1 orbital only, namely 1s orbital	
1. The phenomena of hydrogen atomic spectra showing 4 lines indicate electronic transitions, this confirms that orbitals in hydrogen atom are not only 1s orbital (CC)	2
2. Hydrogen atom does not have 1s orbital only, but also 2s, 2p, 3s, 3p, 3d and so on (ICC)	5
3. There are other orbitals in hydrogen atom, but generally only 1 orbital filled which can be indicated from these isotopes: $^{1}_{1}\mathrm{H}$, $^{2}_{1}\mathrm{H}$ and $^{3}_{1}\mathrm{H}$ (ICC)	2
4. Hydrogen atom has other orbitals besides 1s orbital, but there is an empty orbital which is unoccupied for the distance near at zero (ICC)	1
5. Hydrogen atom has other orbitals besides 1s orbital, because it has more than 1 mass number in nature, namely 1, 2, even 3 (ICC)	1
Total	**44**

Information:
CC : Correct Conceptions
ICC : Incorrect Conceptions

3.1.1 Students' studying process

Every student always tries to understand the orbital concept on hydrogen atom by interpreting and keeping it by their own way on every learning process. Every student also tries to connect the knowledge and experiences related to atomic orbital concepts that they obtained from, namely from high school and General Chemistry lecture, and also from new knowledge and experiences they got when taking Inorganic Chemistry lecture. According to information-processing theory, knowledge and experiences that they just obtained are saved in short-term memory (STM), and previous knowledge and experiences are saved in long-term memory (LTM) (Solso et al., 2005; Reisberg, 2006). Therefore, it is possible that the comprehension of every student is not fixed and not similar to other students from time to time.

3.1.2 Learning process

The learning process is a more complex process than the studying process. This because there is a curriculum about atomic structure in which there are discussions about atomic orbitals and also educators, in this case are teachers (when they learned chemistry at high school) and lecturers (when they took related lectures in university). In teaching the atomic concept, educators have a personal understanding about atomic orbitals which will be delivered to their students. According to Fadiawati (2011), it is impossible for educators to communicate all of their personal understanding to their students. Hence, students' personal understanding (if obtained from their teachers) generally tends to be less than their teachers' personal understanding.

3.1.3 Students' personal understanding

In studying chemistry, one concept with other concepts are interconnected. Hence, students are expected to be able to connect one concept with another concept constructively and comprehensively. During the studying and learning process, the more efforts made during the active processing in STM, the better chance of new information transferred to LTM permanently and vice versa. Thus, it is possible for students to lose the information they just obtained. This depends on the efforts during active processing phase in STM (Solso et al., 2005; Reisberg, 2006). Consequently, when the knowledge about hydrogen atomic orbitals kept in the memory is called through test and interview, there are some conceptions emerge which describe giving a meaning (idiosyncratic) by every student on the knowledge of hydrogen atomic orbitals.

The three factors are possible to be the cause of the emergence of some students' conceptions about hydrogen atomic orbitals. This agrees with Fadiawati (2011) that the emergence of various conceptions is possible from (1) events that occur in the study process of the students; (2) events that occur in the learning process, and (3) Students' personal understanding.

3.2. The influence of textbooks and educators' conceptions during the studying process and learning process towards students' conceptions

Atomic structure phenomena including atomic orbitals concept can't be understood by human senses directly. According to Nakiboglu and Tekin (2006), such conception is a more abstract phenomenon produced by some learning experiences. In the learning process, textbooks and educators are possibly the most dominant factors.

3.2.1 The effect of textbooks

Based on interview results, it is obtained that the most widely used textbooks in high school are Purba (2006) and Purba with Sarwiyati (2013). Both the textbooks contain the same materials generally, the difference is only at curriculum integration used at that time. The writers gave the information about electromagnetic radiation in the form of continuous spectrum illustrated by rainbow and absorption spectrum illustrated by emission spectrum of hydrogen atom. In discussing emission spectrum of hydrogen atom, the writers informed that there are some packets of energy illustrated by raindrops. Further, the writers presented Bohr's atomic model associated with the emission spectrum of hydrogen atom. The depiction of the Bohr atomic model was also associated with the electronic transition of electrons accompanied by its energy packages. In both textbooks, the writers also discussed quantum mechanics' atomic structure preceded by de Broglie's hypothesis and a little discussion about Schrödinger's wave function and Heisenberg uncertainty principle. However, the writers jumped the discussion to quantum numbers (principle, azimuthal, magnetic, and spin). Then, the writers depicted the atom (in the

form of a circle) which consisted of a nucleus (in center position) and some shells. The first shell was illustrated by one orbit with one box labeled as s subshell. The second shell was illustrated by two orbits, the first orbit consisted of a box and labeled as s subshell while the second orbit consisted of three boxes labeled as p subshells. The third shell was illustrated by three orbits, the first orbit consisted of a box labelled as s subshell, the second orbit consisted of three boxes labelled as p subshell, and the third orbit consisted of five boxes labeled as d subshell. Furthermore, the emission spectrum of hydrogen atom presented was not connected with electronic transitions which were related to the orbitals of hydrogen atom. Atomic structure topic was ended by the construction of energy level diagram for many electrons atom.

During General Chemistry lecture, the students used Chang's book (2005) which was translated by Chemistry Department of Bandung Institute of Technology and also Oxtoby et. al. (2008). In Chang's (2005), the writers discussed the displacement of classical mechanics to quantum mechanics, including electromagnetic radiation and light's dualism phenomena. Further, the book discussed Bohr's atomic structure started by hydrogen atomic spectrum and its interpretation related to spectral series of hydrogen atom. While the discussion of quantum theory was preceded by de Broglie's hypothesis, then the introduction of Schrödinger's wave function and Heisenberg Uncertainty Principle. However, the next discussion jumped to quantum numbers (principle, azimuthal, magnetic, and spin) including atomic orbitals concept. Atomic structure topic is ended by the construction of energy level diagram for many electrons atom.

Other references, Oxtoby et al. (2008), which also used in General Chemistry lecture had similar content like Chang (2005). However, it was written that the definition of the shell is a set of orbitals having the same principle quantum numbers, reflecting the fact that average position of electrons on every shell are close with each other, but far apart with other electrons from orbitals with different n-value.

When the students were taking Inorganic Chemistry lecture, the students were asked to use the textbooks of Fauzi and Fadiawati (2018), Housecroft and Sharpe (2012), Sugiyarto (2004), Priyana and Narsito (1990). Generally, the writers presented the atomic structure topic started by electromagnetic radiation and emission spectrum phenomena of hydrogen atom. Then the writers informed about Bohr's atomic theory and the description of electronic transition equation to explain the phenomena. The writers also discussed the weaknesses of Bohr's theory and its consequences so that quantum's theory emerged. In discussing quantum's theory, the writers were representing light's dualism phenomena, de Broglie's hypothesis and Heisenberg's uncertainty principle. Furthermore, the books were also presenting Schrödinger's wave function and its relationship with orbitals and quantum numbers. The discussion of atomic structure was ended by the construction and explanation related to energy level diagram of hydrogen atom and of many electrons atom.

According to the explanation above, discussions and sentences in textbooks will be very affecting the conceptions either students or educators (teachers and lecturers). From various textbooks used, there are some textbooks containing irrelevant conceptions related to atomic structure, especially about hydrogen atomic orbitals.

3.2.2 Educators

Based on the observation in the learning process in General Chemistry lecture and Inorganic Chemistry lecture, it was not indicated that there were any irrelevant conceptions delivered by lecturers as educators.

It seems that students still bring their old conceptions they got from high school. Based on interview results, it was gained information that they got irrelevant conceptions from their chemistry teachers related to atomic structure. This indicates that their conceptions are still similar to their teachers'. This also agrees with Fadiawati and Liliasari (2009) who said that chemistry teachers are very resistant to atomic structure concepts. Furthermore, it is revealed that most high school students have the same conceptions with their teachers, even university students still have the same concepts as their teachers. Related to this, Nakiboglu and Tekin (2006) revealed that teachers were possible to be the source of misconceptions because some teachers failed to give accurate information to their students. Atomic structure learning both in General Chemistry and Inorganic Chemistry lectures were conducted during two meetings (one meeting lasts for 150 minutes) seemed to be less able to improve students' conception significantly.

4. CONCLUSIONS:

Based on results and discussions there were 9 conceptions related to hydrogen atomic orbitals with the percentage of students with the correct conception of 4.54% and misconceptions of 95.46%. Most of the students had the same conceptions like their chemistry teachers' conceptions in high school. Factors affecting the formation of students' conceptions were studying process, learning process in high school and students' personal understanding.

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