RESEARCH ARTICLE | APRIL 28 2023

Understanding the essential materials of lesson: Reflection on the professional competency of chemistry teachers in Lombok

Agus Abhi Purwoko ✉; Saprizal Hadisaputra; Lalu Muhamad Ali Zakaria

AIP Conference Proceedings 2619, 080005 (2023)
https://doi.org/10.1063/5.0124422

Understanding the Essential Materials of Lesson: Reflection on The Professional Competency of Chemistry Teachers in Lombok

Agus Abhi Purwoko[1,a)], Saprizal Hadisaputra[1], and Lalu Muhamad Ali Zakaria[1]

[1] *Department of Chemistry Education, FKIP, University of Mataram, Mataram, Indonesia*

[a)] Corresponding author: agus_ap@unram.ac.id

Abstract. Understanding the concept of subject matter in depth is one of the most important competencies for teachers to have. However, empirically, there are still many teachers in schools who have not mastered this professional competence properly. For chemistry lessons in high school, for example, almost all concepts on the subject have not been mastered in depth and broadly. This article aims to describe the results of a study on the professional competence of chemistry teachers in Lombok, West Nusa Tenggara. The data source is in the form of teaching materials compiled by chemistry teachers and from the discussions with teachers through meetings in the forum of chemistry teacher (MGMP). The documents studied include syllabus, lesson plans (RPP), student worksheets (LKPD), and practical / demonstration instructions and it was found that there are many problems faced by teachers. The findings were analyzed and presented descriptively and qualitatively. The results of this study suggest strong relationship between mastery of subject matter in depth and success in the implementation of teaching learning process in the classroom. Thus, the need to master subject matter in depth is the pivotal key to improve professional competence of teacher.

INTRODUCTION

The quality of education is largely determined by the extent to which the quality of existing educators / teachers. It is arguably that other factors also come into play, but it is the teacher that determines the final achievement as teachers have a strategic position in the context of the quality of education. For example, the curriculum is also an important component in the quality of education, but no matter how good a curriculum is, it is useless if not supported by qualified teachers. On the other hand, qualified teachers would be able to sustain the effectiveness of a simple curriculum.

According to Law 14/2005 teachers are professional educators. The question is when a teacher is called a professional. Among the indicators of teacher professionalism, one of which is meeting academic qualifications, namely a bachelor's degree or D-4 degree in the field of study being taught. Moreover, PP 19/2005 states that professional teachers must also have competencies, which include: professional, pedagogical, personal, and social competence.

As a professional teacher, the professional competency component plays an important role for a teacher and determines the success of carrying out its duties, especially in the classroom. Professional competence is the ability to master learning material broadly and deeply, as stated in the National Education Standards article 28 paragraph 10-point c. Hence, mastery of teaching material is an absolute requirement for teachers to be successful in carrying out teaching learning process. This is because teaching is the process of communicating knowledge to students. Of course, the ability to communicate is very dependent on the mastery of the knowledge to be communicated. It is said that the better the mastery of teaching material by the teacher the easier the communication process to students.

Mastery of teaching materials by the teacher may be inferred from the lesson plans that have been compiled. In the teaching plan document, a teacher needs to articulate the curriculum into a real plan for classroom activities. The curriculum of subject matter contains formulations of basic competencies which, among others, serve as criteria for

The 1st International Conference on Science Education and Sciences
AIP Conf. Proc. 2619, 080005-1–080005-4; https://doi.org/10.1063/5.0124422
Published by AIP Publishing. 978-0-7354-4446-1/$30.00

any teaching material that needs to be delivered. In this case a teacher needs to analyze the essential materials contained in a basic competency, and it is needless to say that the ability to analyze basic competencies is strongly related to teacher's mastery of teaching materials.

The activity of analyzing the basic competencies above produces essential materials that will be delivered in class. The success of identifying the essential material in question will further support the success in the implementation of classroom learning. Why do teachers need to identify the essential material contained in each of basic competencies? among the many reasons for this question, there is a limit to the time allocation in the syllabus provided for each basic competency. Therefore, the essential materials serve as to avoid a lengthy learning process in the classroom, namely delivering material that is too broad without paying attention to time allocation. Long-winded learning may occur if the teacher delivers subject matter based on the overall content of each chapter in the textbook used.

This study describes problems faced by chemistry teachers in high schools across Lombok in delivering the subject matter in the classroom, and simultaneously comes out with recommendation. Among many problems are low grade achievement by students and their low interest in the chemistry class due to the low quality of teaching learning processes. This low quality should be analysed to benefit both the teachers and students in the long terms.

METHOD

This study described qualitatively the professional competence of chemistry teachers in high schools throughout the island of Lombok. The research data was collected through observations at the Subject Matter Teacher Forum (MGMP) meeting, which included Chemistry MGMP in the districts of Eastern Lombok, Central Lombok, Northern Lombok, Western Lombok and City of Mataram.

During observation a questionnaire were distributed to selected students to assess their opinions to the teaching of chemistry subject and to “measure” their satisfaction in undertaking the chemistry class. Data from questionnaire was used as a baseline to conduct group discussion with chemistry teachers during MGMP meetings. In these meetings the participants discussed various things including strategies for implementing the Curriculum 2013 through the development of teaching materials. In this context, the documents that have been developed are analyzed to see the accuracy of the concepts discussed, the learning methods to be applied, and the appropriateness of the available time allocation with the teaching material to be delivered.

The results of the data analysis are written in the form of a narrative containing findings related to the ability of teachers in the aspect of professional competence, namely understanding the basic concepts of knowledge that are deep and broad. First, whether the concept of the material to be presented is valid / accurate followed by question is whether the time allocation is reasonable to deliver the listed material.

RESULTS AND DISCUSSION

Results

The analysis of teaching materials is mainly focused on basic competencies (KD) and indicators of basic competency achievement (IPKD), descriptions of learning activities, and the contents of student worksheets (LKPD). Here are some findings that illustrate the weakness of teachers to identify essential material in basic competency:

1. In delivering KD which related to the atomic structure of the periodic table of elements. Learning activity needs a lengthy time because it includes an explanation of the process of discovering the particles that make up atoms (electrons, protons and neutrons), explanations of the development of atomic models (Dalton, Thomson, and Rutherford), development of the periodic table of elements. Further finding illustrates that many of the teachers do not appropriately understand the meaning of atomic orbitals as they are suspected of not understanding deeply the dualistic nature of electrons.
2. In delivering KD which related to chemical bonds and molecular shape. Description of learning activities illustrate that the teacher is ambiguity in distinguishing stable electron configurations and stable particles / substances. As a result of this ambiguines, there is a misunderstanding in discussing the topic of chemical bonds, especially in the process of ionic bonds formation.
3. Presentation of basic competency in thermochemistry topics. The inspection of the LKPD made by the teachers show that there are often misconceptions in giving examples of chemical reactions that require / release heat; still uncertain in distinguishing the physical changes and chemical changes.

Problems on the topic of hydrocarbon compounds. Granulated sugar is very often used as an example when explaining that the main constituent of hydrocarbons is carbon.

Discussion

Topics about atomic structure and the periodic table are the early topics presented in class X. These topics are covered in at least three KD. If during 1 semester there are ten KDs, then the topic above approximately requires 30% of the time allocated in the classroom. Given the limited time allocation in the classroom, it is necessary to select the essential material to be discussed in class. For the topic of atomic structure, the meant materials are the Bohr atomic model and the wave mechanics model as these two models are the ones to be used to explain various chemical processes. Meanwhile, the relating and supporting materials are designed for out of classroom learning, which may be in the form of assignments, simple projects and so on. By doing so, teachers may have plenty of time to discuss subject matter in class.

Regarding the topic of the atomic wave mechanics, all / almost all teachers have not properly understood the nature of atomic orbitals. The teachers' view of atomic orbitals still rests on the particle properties of electrons so that the orbital is portrayed to have physical meaning. With this view, the question as to why there are 2 electrons occupying 1 orbital will be difficult to explain because naturally the 2 electrons will repel each other.

As a result of a lack of understanding of the quantum concept of electrons, problems often occur in explaining the topic of electron configuration in relation to the location of the elements in the periodic table and the periodic properties of the elements. The explanation of the periodic properties of elements such as ionization energy, atomic radius, electron affinity, is done separately and is not related to the electron configuration. This gives the impression that the periodic properties of the elements must be memorized verbally, not understood as a result of electron configuration patterns.

The above problems continue when discussing the topic of chemical bonds. Discussion always starts with delivering a stable electron configuration, that is, an octet configuration. It was explained that each element tends to have an octet configuration, such as the rare gas configuration. For example, a sodium atom will release 1 outer electron to become a cation in order to achieve stability, whereas, on the other hand, a chlorine atom tends to accept 1 electron to become an anion. Actually, such an explanation is not wrong, but it is still predominantly verbal because it is not connected with the periodic properties of the elements previously discussed. This phenomenon eliminates the functional relationship among topics that should be emphasized so that all topics in chemistry appear as a completely inter-connected.

The critical question related to the above phenomenon is whether sodium ion and chlorine ion which have an octet configuration are stable species. Seemingly there has been confusion when understanding the term stability associated with electron configuration. Undoubtedly, the two ions will become stable species when combined, through the formation of ionic bonds, to form sodium chloride, each of which has an octet configuration.

How to discuss the topic of chemical bonding that can minimize verbal recognition? as an alternative, the discussion should begin by discussing the tendency of the ionization energies of the elements in each group; for example, by comparing the mentioned property between the elements in group 1 and the elements in group 17. Then, it is continued that ionic bonds will take place if cations and anions attract each other to form stable compounds, and the constituent components of the compound have an octet configuration. It should be understood that a stable species is something that can exist under normal conditions, such as the rare gas elements. Sodium and chlorine atoms, as well as in the form of ions thereof, cannot be found under normal conditions unless they combine to form a new species of sodium chloride.

Surprisingly, misconceptions often occur when discussing the topic of thermochemistry; especially when giving examples of chemical reactions that release / absorb heat. Processes of dissolving a substance in water, for example dissolving sugar or urea, are used as examples of chemical reactions involving heat change. There seems to be a misconception in understanding chemical change, by not distinguishing it from physical change. Therefore, presenting the process of changing the state of a substance from solid to a solution is considered a representation of a chemical reaction, as the process is accompanied by a change in heat.

After demonstrating the heat change in a chemical process/reaction it is often presented an experiment to determine the enthalpy change of a reaction by measuring the temperature change during the reaction. However, it often happens that there is no mention of the relationship between the change in enthalpy and the change in temperature being measured. The discussion of enthalpy stops at a point where the results of calculations using the data of the initial reaction temperature and the final temperature and specific heat produce changes in the reaction enthalpy. The logical

question is why we end up with the enthalpy of the reaction from data in the form of temperature. If you do not understand correctly about enthalpy, the question will continue to be largely unanswered.

The topic of hydrocarbon compounds is interesting to discuss. In the learning process, it is often presented the burning of sugar on a spoon which produces a black solid as an illustration that the main constituent of hydrocarbons is carbon. In this case there is a misconception, namely sugar is not an example of a hydrocarbon. If someone wants to demonstrate carbon as a constituent of hydrocarbons, kerosene is a better choice, which in its combustion may produce carbon solids.

Furthermore, when discussing the characteristics of the carbon atom, it is said that the carbon atom has 4 valences which are able to form covalent bonds with other atoms. While this is not entirely wrong, it does carry some hints of inaccuracy. The notion of a characteristic is meant something that is not shared by other species / atoms. Be remembered that the silicon atom is also able to form 4 covalent bonds with other atoms, then where is the unique characteristic of the carbon atom.

In fact, the exact characteristic of a carbon atom is its ability to undergo a catenation reaction, which is to form covalent bonds with other carbon atoms, resulting in an almost infinite and varied chain of carbon atoms. Are there atoms other than carbon capable of forming long and varied atomic chains? The suggested answer is no, it because of the carbon may form straight chains, branch chains, and cyclic chains. For example, with only 4 carbon atoms, straight chain, branched, and cyclic chains (4 C atoms and 3 C atoms) are possible.

If the catenation ability is used as a characteristic of carbon atoms, discussion of the classification of hydrocarbons will flow naturally. The ability of catenation can be used as a starting point for discussing the topic of isomers and homologous series of hydrocarbon compounds. This strategy also allows students to be actively involved by practicing developing the structure of hydrocarbons from a certain number of C atoms. The topic of nomenclature and characteristics is also directly discussed with the exercise so that the discussion is time-efficient and there is a link between one topic and another. Further, in discussing the topics of hydrocarbons it seems that they are separated or not inter-related.

CONCLUSION

Mastery of the material broadly and deeply is an important provision for teachers to succeed in classroom learning. Adequate mastery of material will lead the teacher to be able to identify the essential material of each subject to be conveyed in classroom learning. Thus, the learning strategy becomes dynamic, adjusted to real learning conditions in the classroom. Unfortunately, based on the results of assessment on the teaching materials made by chemistry teachers throughout Lombok, it can be concluded that the professional competence of chemistry teachers still needs to be improved. A simple and easy way to improve the professional competence of chemistry teachers is through MGMP meetings. This forum has been established but the organization of the meetings needs to be revitalized so that regular meetings occur at a certain time period. For this purpose, support from schools and other related parties is sincerely needed.

REFERENCES

1. _____, Undang-Undang Nomor 4 Tahun 2005 tentang Guru dan Dosen
2. _____, Peraturan Pemerintah Nomor 19 Tahun 2005 tentang Standar Nasional Pendidikan.
3. A. Dudung, J. Kesejah. Kel. dan Pend. **05**(01), 9 (2018).
4. W. B. Sulfemi, "Kompetensi Profesionalisme Guru Indonesia Dalam Menghadapi MEA", Prosd. Sem. Nas. STKIP Muhammadiyah Bogor, ISSN: 977-2443-247-02 (2019).
5. B. Kartowagiran, Cakra. Pend. **30(**3), 463 (2011).
6. M. Hasan, J. Eco. **5**(2), 70 (2017).
7. M. I. Ismail, Lentera Pend. **13(**1), 44 (2010).
8. C. Fitriani, A.R. Murniati, and N. Usman, J. Mag. Admin. Pend. Pascasarjana Univ. Syiah Kuala **5(**2), 88 (2017).