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AN INTEGRATED LEARNING MEDIA IN CHEMISTRY: HOW CAN IT HELP TEACHERS AND STUDENTS TO CREATE A GOOD IMPRESSION?

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Abstract

Most junior high school students considered chemistry as a complicated science subject with abstract symbols and terms that must be memorized. The difficulty of learning chemistry can make students have low positive perceptions of chemistry. The purpose of our multiple case study was to explore how an integrated learning media can help teachers and students understand the difficulty of chemistry and create a good impression in junior high school. The integrated learning media has been developed based on multiple representations in chemistry. The study was conducted in three classes in grade 7. Several techniques were used to collect the data: a classroom observation, a test, the questionnaires, and an interview. We documented that the appearance of integrated learning media could make the students attracted and curious about chemistry. They were interested in various bright colors used in integrated learning media, which captured their attention to focus on learning. The integrated learning media made it easier for the teacher to introduce chemistry through podcast, molymod, and simulation.

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INTRODUCTION

Chemistry is an important subject which studied the matter, energy and the interaction between them. Most students do not really like chemistry although learning chemistry helps them to understand the way the world works (Hofstein et al., 2011). They have problem and difficulties on three main problems area, language-based problem, problem due to conceptual understanding, and problem due to inadequate selection and interpretation of formulae (Taskin & Bernholt, 2014)

The lack of understanding on the significance of chemistry in the future (Kubiatko, 2015) and the complex chemistry concept (Sausan et al., 2018) resulted in the low perception of the chemistry of most junior high school students. Even chemistry is also hard to be learned by senior high school students as it has various concepts at the school level to learn in a short time. The students' attitudes toward chemistry decline from junior grades to senior grades (Cheung, 2009). The senior high school students do not want to learn chemistry and are reluctant to work in the chemistry field because the teacher's explanation of the chemistry topics is not related to the real life and because of the difficulties of chemistry.

Chemistry was first taught to the 7th-grade students of junior high school. It was integrated with biology and physics. Many of junior high school teachers are not junior high school science graduates, but from the fields of chemistry, physics and biology that should be intended to teach at the high school level according to their areas of expertise. From data of the new science teachers during their first 5 years just 35,7 percent of them are teaching only in their trained subject (Nixon et al., 2017). Many of new science teachers practice as out-of-field (OOF) teaching (Donaldson & Johnson, 2010) that has been shown negatively influence instruction and constrain teachers' development. The science teacher educator should prepare prospective teachers to teach multiple science disciplines because disciplinary differences require variations in understanding and instruction (Kloser, 2012). The less-mastered materials by the teachers in the classroom make the students have less meaningful learning experiences. The chemistry materials challenging to deliver without preparation will make the students more aware of chemistry.

The students' interests can be influenced by their perceptions, from their treatment and attitudes towards chemistry. Therefore, chemistry must be appropriately introduced so that the students have a good impression of it. Even though in the 2013 national curriculum there is only a small amount of chemistry material given at the junior high school level, an introduction that is not well prepared will add to the bad impression of chemistry. The stereotype that chemistry is difficult has become a burden for students to begin this subject. Making a good impression is critical in organizational and affective influences on many social judgments (Forgas, 2011; McNulty et al., 2010). A good first impression is when students can influence their interpretation of the chemistry subject in the future and consistently remember that chemistry is a fun and useful topic. The first impression about something begins with visible cue including the physical appearance, nonverbal communication, environments, and behaviour (Smith et al., 2015). Cues that attract attention in the particular context in which they occur are particularly influential.

It is crucial for the teacher to organize the learning environment to create active and meaningful real worlds learning for the students. To deal with the time, cost, and explanation of contents, the media can be the solution. The teacher has to prepare various media in teaching chemistry to improve the students' motivation and impression using fun and more realistic subjects. Instructional media can assist science teachers who are not from the chemistry field and are less capable of understanding chemistry topics to deliver the subject well. Learning media is one of the variable that is particularly suitable for a chemistry reflection to the area of teaching processes (Barke et al., 2012). The goal of using media is the advancement of teaching and learning processes which the choice of media

and their use should be appropriate for the teaching goals, contents, and methods. The classification of general media regarding education at school, there is a differentiation between the kind of sensory experience (visual, audible, audio-visual) and the level of experiences, either primary or secondary experiences (Barke et al., 2012).

Media such as podcasts (Drew, 2017; Abdous et al., 2012) is the example of audio media and molymod (Priyambodo & Wulaningrum, 2017) is the example of secondary experience media, which can improve students' learning experiences. Audio-visual media is also proved can improve students' activity (Saputra et al., 2018). Along with times, technology has an important role in the development of learning media like multimedia, which led to infinite application of computer technologies. Multimedia is one of the best educational techniques because it addresses more than one sense simultaneously (Aloraini, 2012). The efficiency of the multimedia achieved in the educational domain can help students remember and transfer their knowledge (Aloraini, 2012), can improve the learning achievement of junior high school students (Khoiriah et al., 2016), students 'generic skills (Mulyani et al., 2016), and students' outcome in chemistry (Sugiharti, 2018; Cahyana et al., 2017). The advantages of using learning media are currently obtained from the use of media separately. In fact, each media has weaknesses so that there needs to be innovation in the use of media, which can maximize media efficiency such as the integration of learning media. However, the use of the various types of media in integration has not been done. Integrated learning media needs to be developed and applied in learning that can provide more benefits instead of separate use.

The integrated learning media can facilitate the three levels of representation of chemistry in learning. Integration means the use of several types of media to support one another so that they can cover each other's shortcomings. There are three levels of chemical knowledge, i.e. the macroscopic, the sub-microscopic and symbols, which are inter-related and support each other (Gilbert & Treagust, 2009). The students will be able to understand the meaning of the terms by integrating the three levels of chemistry learning. Also, they can understand the explanation between the symbol and sub-microscopic levels with their existing concept. The interaction among the three levels is the critical characteristic as well as the source of difficulties for the students. But the fact is the main source of learning used by the teacher is still the printed book that only presents two representative levels, the macroscopic and symbolic (Tania & Fadiawati, 2015). The absence of a sub-microscopic level makes the students unable to understand what happens in chemical processes. They often directly connect the macroscopic, things they see with symbols without understanding the sub-microscopic level (Farida, 2009). It is difficult for them to visualize the interactive and dynamic nature of chemical processes by looking at symbols and equations and for making three-dimensional (3D) images by visualizing two-dimensional (2D) structure (Gilbert & Treagust, 2009).

Based on the learning subject, the 7^{th}-grade students of junior high school, the choice of media types used must be more attractive in terms of both appearance and ease of use. A podcast is one type of audio media rarely used in learning in the form of sound recordings that can be accessed online. It supports students with an audio learning style more excitingly. Students like to listen to their teachers' voices, and podcasts are their multitude of ways to get the information (Carvalho & Aguiar, 2009). Based on the three levels of chemistry, sub-microscopic is the level that often becomes the source of student difficulties. Molymod can be used to represent the sub-microscopic level regarding the 3D shapes of atoms and molecules in the introduction of chemistry to junior high school students. Real objects that can be sensed by the students can help build concepts that are difficult to accept. The description of phenomena such as molecular movements can be presented through animation and simulation using digital-based media such as Macromedia Flash. Animation and simulation can easily display interactions and the sub-microscopic of chemical changes

and observations of macroscopic levels that cannot be done in the classroom. Integrated learning media considers the students' convenience in building mental models through images, animations, simulations, and real objects because of the visuospatial abilities as an important role in chemistry learning (Stieff et al., 2012). The various media which use in integrated learning media can improve chemistry learning and support students' understanding of the three relationships of multiple chemical representations.

Integrated learning media is essential to be developed because it sees from various kinds of different students' learning styles so that it can facilitate their learning. Teachers should adjust and facilitate their teaching styles to meet their students' learning styles and create fun and more effective learning (Awla, 2014). Instead of choosing and favoring a teaching style, the teacher should strive for balance teaching stale to accommodate multiple learning styles. The presence of media that combine some characteristics, i.e. visual, auditory, and kinesthetic will make learning more effective (Risnawati et al., 2018). Integrated learning media is developed as a solution for introducing chemistry more enjoyable by considering multiple representations in chemistry and student learning styles. From the result of the successful learning with numerous interpretations, the students choose the vital information for the subject, organize and connect its parts to be new knowledge. New knowledge gained with a good impression will be remembered in the future, especially in senior high school. Thus, students will be more interested in learning more deeply

In can be concluded that the literature about the effect of multimedia on the students' impression especially in the introduction of chemistry is limited. This problem is an essential concern for teachers in the use of appropriate learning media for the introduction of chemistry for beginners. This study aimed to explore the usefulness of integrated learning media in assisting students in understanding chemistry and building a good first. This study was to see the response and success of integrated learning media. Based on the characteristics of different students viewed from various aspects such as origin, attraction, and learning style, a multiple case study is needed to analyze the use of media in high, medium and low groups.

METHODS

A descriptive analysis was used in this study in the form of multiple case study conducted in Pekalongan regency, Central Java. The participants were selected using stratified random sampling. They came from three different schools with different final examination scores, high, moderate, and low. The 7th-grade students from heterogeneous populations came from private schools. The data collection techniques were classroom observation, test, questionnaires, an interview. Classroom observation was the collection of documents and processes, significant incidences, and evidence about students' responses toward the integrated learning media. The questionnaire was referred to the basic elements of perception toward media with ten questions consisted of four Likert scales. The classification of matter test was given (multiple choices test) to find out the students' levels of understanding. To explore how integrated learning media can assist the students in understanding and creating a good impression toward chemistry, their thought and interest in this field in the future, a semi-structured interview was conducted.

RESULTS AND DISCUSSION

The Use of Integrated Instructional Media in Learning

The followings are the principles of designing multimedia tools that assist the students in understanding chemistry: (1) giving multiple representations and descriptions, (2) creating visible linked referential connections, (3) providing the dynamic and interactive nature of chemistry, (4) promoting the transformation between 2D and 3D, and (5) reducing cognitive load by creating explicit information and integrating the information for students (Gilbert & Treagust, 2009). Integrated

learning media is developed based on these fundamental principles by integrating podcasts, molymod, and Macromedia Flash to introduce chemistry to junior high school students.

Private schools as the subject of the study have class divisions that are relatively different from schools in general. The students are given the opportunity to choose classes with different characteristics and number of lesson hours. There are three types of classes, namely classes with a boarding school system where the students have a dormitory close to a school, classes with additional Islamic subjects, so they study in school from morning to evening, and regular classes where they study until noon without other Islamic content subjects. This difference in class types causes the students to have different learning burdens. Seeing the facts in the field regarding students' learning burdens, integrated learning media was made with clear explanations accompanied by much visualization. The adopted strategies were important without being overloaded with excessive and unnecessary information that would help students be held independently in working memory in order to remember (Cowan, 2014).

The three types of media were used to introduce chemistry to 7th-grade students to produce various responses. High group students who had previously been introduced to several media, both digital and real objects, in other subjects were not too surprised by the media used in this study, while the medium and low group students seemed very excited about the existence of integrated learning media. The results of the interview stated that the medium and small groups rarely learned using media.

Podcasts were the first type of media displayed in learning. The students seemed to concentrate on what they heard because they were previously instructed that there would be an exercise sheet to be done related to the content of the podcast. The three groups needed at least 2-3 repetitions in listening to podcasts. This is because they need time to adapt and digest information. Because it is in the form of sound recordings, podcasts can be easily repeated or used by the students to review the results of previous learning. Podcasts are useful and practical because they allow students to slow down. Podcasts are quite centralized and straightforward, which helps the students to listen, reflect and understand what is discussed. The length of the podcast is around 1-2 minutes which contains macroscopic phenomena that are easily imagined by junior high school students. The survey results show that podcast listeners prefer different podcast durations depending on the content (Matava et al., 2013). For case discussion and presentations, the preferred type of podcast is the short-survey podcast.

After the students had been introduced to the phenomena and activities around them which were the macroscopic level of chemistry, the next step was that the teacher entered the sub-microscopic level using molymod media. Molymod is a three-dimensional (3D) model defining the molecular structure. In general, male students were more expressive in expressing their interest in molymod media. They were curious about the shape and color of molymod which have varied shapes and colors. Compared to female students in the middle and low groups, female students in the high group were more courageous in asking questions related to molymod. The high group class environment was slightly different compared to the other two classes. In the upper group class, gender differences are not visible, and the students are accustomed to being active in learning. The middle and low classes were more dominated by male students who actively asked questions and answered questions from both the teacher and other students. The female students were a little bit shy, so they were silent and listened to the communication between the male students and the teacher. To overcome this, the teacher formed small groups so that each student both male and female got the opportunity to study chemistry at the sub-microscopic level. Students should be given a chance to construct 3D molecular models using a physical model such as molymod, which can be used in conjunction with two-dimensional images (Harris et al., 2009) through experience they got after the discussion with their peer friends or teacher. Learning molecular structures using models becomes easier to

understand by the students and can enrich their learning experiences (Sarita, 2015).

Media is needed to facilitate students' understanding in transmitting from 3D molecular representations to their 2D analogs. Macromedia Flash is the solution used by the teacher in giving instructions to students to describe their 3D observations into two-dimensions so that they do not lead to a different understanding. The implementation of learning using Macromedia Flash influences the students being more focused on the material being taught. The classroom situation is more conducive because the students' attention is focused on the images, animations, and simulations shown by the media. Bright and varied colors are the main reason the students focus their attention on learning. Colours can be very effective in learning with influencing students' attention (Dzulkifli & Mustafar, 2013). This is because the emotional reaction of the students to bright colours becomes increasingly positive (Kurt & Osueke, 2014; Pope, Butler, & Qualter, 2012) which the right colours selection may contribute to a longer span of concentration in learning, improve performance and influence emotions and positive perceptions (Jalil et al., 2012).

The results of the questionnaire analysis in Figure 1 showed that the three groups chose the scale of "delighted" more than 50% after using integrated learning media in terms of usability, appearance, ease of use and making chemistry look not as difficult as previously imagined. The type of Likert scale used is the level of satisfaction which uses four options namely not at all satisfied, slightly satisfied, moderately satisfied, and very satisfied. Based on these results, the students from all three groups were very satisfied with the introduction of chemistry using integrated learning media.

In general, from the three classes, the appearance of integrated learning media is an essential factor that causes the students to have a good impression of chemistry. Through bright colors, unique molecular shapes according to them, and animation, the simulations they see make them happy to learn the classification of matter. The side effects of this good impression cause the students not to get bored during classroom learning, to raise them to actively ask questions, and to find out more about the use of chemistry in solving problems in their lives.

The students need active and interactive experiences to motivate and actively engage them in learning. An interactive electronic media can make it easier for students to get high learning outcome (Suyatna et al, 2018). This is why integrated learning media is essential to use. The use of integrated learning media is not only fun because it contains many things such as collaboration and exploration, but also able to motivate, provide feedback and enable the students to repeat the topics they want.

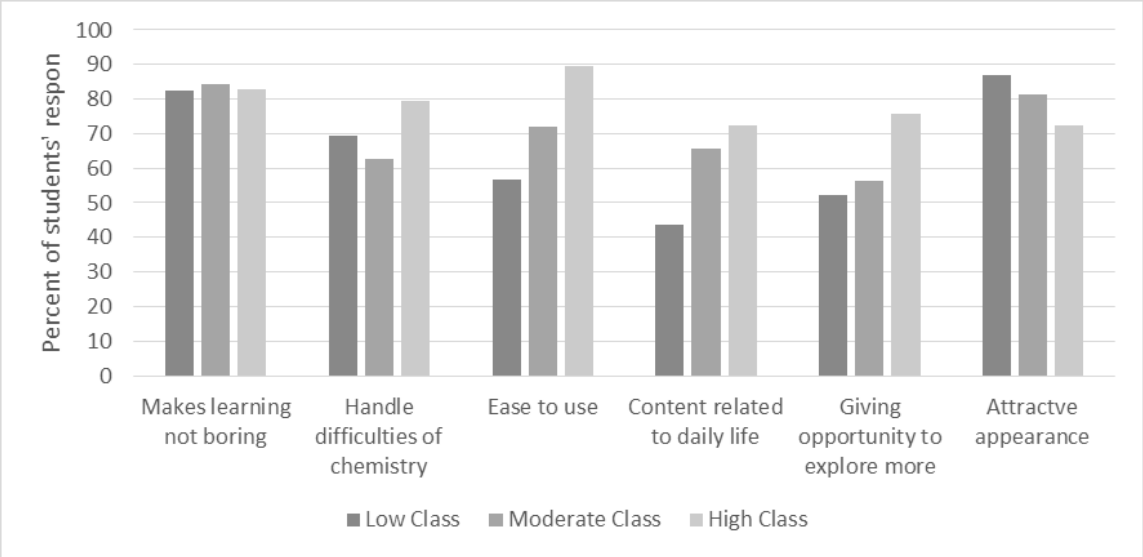

Figure 1. The students' responses (very satisfied) in using integrated learning media

How is the Learning Process?

The topic which is the subject of the case study research is the classification of matter given at the beginning of the odd semester in the 7th grade. In this topic, the teacher introduced the
composition of substances, the elements in the periodic system table and the terms regarding the nature of the solution and the physical and chemical changes of a substance.

The level most readily accepted by the students is a phenomenon or macroscopic. This is evident when the students easily distinguished between mixtures and pure substances but required a longer time to understand the differences in elements and compounds. The teacher used the molymod molecular model assisted by Macromedia Flash animation to visualize elements and compounds. The difference between elements and compounds cannot be easily made from macroscopic activities without resorting to explanations using molecular model representing elements and compounds (Gabel, 2009). Starting from an understanding of what are the various types of elements in the periodic table, the students began to understand why elements and compounds are different.

The teacher introduced a periodic table of elements with Macromedia Flash that can show names, symbols, and images of elements. These images make it easier for the students to remember visually from the significant number of elements. In classroom observations, the students had difficulty understanding the meaning of metalloids compared to metal and non-metal. This is because the term metalloid is a new term for them, so they don't have any idea about what metalloids look like. The scientific language literacy is one of the factors that significantly influence the students' success in studying chemistry (Woldeamanuel et al., 2014) so the role of the teacher is needed in building the right concept of new terms. Needed by the teacher with a very good understanding of the context because the most important model in teaching chemistry is the chemistry teacher himself/herself (Cardellini, 2012).

The students' understanding of changes in the phase of water was limited to seeing from the microscopic level without knowing what happened at the sub-microscopic level. One source that causes low student perceptions of chemistry is the difficulty of understanding at the sub-microscopic level, which connects between macroscopic and symbolic levels. Integrated learning media helps teachers by providing representational relationships from all three levels so that science teachers, especially those not from chemistry graduates, can give the explanations more precise and clear paths. This is intended to minimize conceptual errors early on by the students because one of the problems in learning is that the teacher presented incomplete concepts (Redhana et al., 2017). Sub-microscopic representations such as atoms and molecules that describe matter at the particle level are considered as a beginner's teaching method that makes sense because it allows them to understand what happens to the microscopic level from the perspective of particles (Gilbert & Treagust, 2009).

Based on the level of students' understanding of the three levels of representation, there are three categories of students, namely no conceptual understanding, partial understanding, and sound conceptual understanding. The analysis of the results of the exercise indicates that the students who no conceptual understanding have difficulty at the basic level such as not being able to transform 3D molecular model images into 2D on their answer sheets. They looked confused in describing the molecular shapes and placement of distances between molecules when they are solid, liquid or gas. Even though the teacher has used integrated learning media, this type of students still had difficulty distinguishing between elements, compounds, and mixtures. Students who no conceptual understanding of the three classes have different numbers with an average of four students per class. The interview results stated that they assumed that water in all three phases had different molecular forms. In this case, the change in student preconceptions is still difficult because they choose to believe what they consider reasonable. The students need proper

guidance so that their preconception will not be restructured and developed into alternative ideas as misconceptions (Kambouri, 2016). Students' initial knowledge is developed through everyday activities that enable learning even before entering formal education (Allen, 2014).

The students who partial understanding have understood the basics of sub-microscopic representation, but they had difficulty in interpreting the terms and symbols introduced by the teacher. They were confused when they had to use the terms atoms, elements, molecules, compounds, and mixtures. New terms and symbols that they think have similar meanings make them difficult to understand.

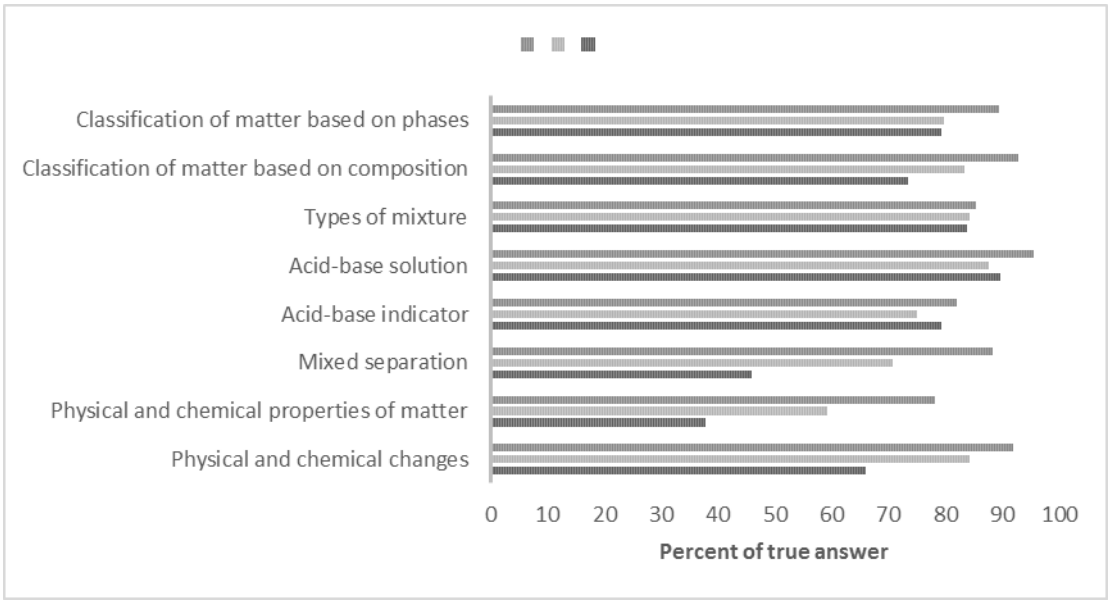

Figure 2. Percentage of students who choose correct answers on the test of classification of matter

They only rely on memorization without digesting the meaning of the terms and symbols. The symbolic level is a chemical language that attempts to describe and explain at both macroscopic and sub-microscopic levels through symbols, formulas, and chemical equations (Allen, 2014).

The number of students who sound conceptual understanding is the higher of all the other two types. The students who sound conceptual understanding have the right concepts and can connect the three levels in explaining a problem. They accept all concepts that can accept logic then connect them with the facts in real life. The significance of the understanding of chemistry learning is that the student can solve problems in real life (Wu & Foos, 2010).

The results of the final test given to the three classes are shown as shown in Figure 2. There are eight subtopics in the classification of substances and their changes. The topic with the correct answers in all three classes is the classification of substances based on their phases. This is because this topic has been taught since elementary school and includes easy-level questions. In the low group, the topic the physical and chemical properties of substances is the most challenging topic with below 50% of students who answered correctly. Although it is not as low as the low group, the medium and high groups also obtain the same results for the topic of physical and chemical properties of substances. In this subtopic, the students were still having difficulty distinguishing and interpreting the physical and chemical properties of a substance. Many new terms introduced in this subtopic discuss the chemical properties of substances such as ionization, substance reactivity, and corrosion. High group students have the highest percentage of correct answers to eight

subtopics. The characteristics of students and a supportive learning environment provide results that are satisfactory for the high group. On the other hand, the medium and low groups obtain slightly different results in which the average of 50% of students can answer correctly. This result indicates that the use of integrated learning media is one solution for teachers who find it challenging to introduce chemistry to beginners such as junior high school students.

CONCLUSION

The method to introduce the right chemistry can give a good impression which can then lead to curiosity to learn more. Integrated learning media can introduce chemistry through the perspective of the three levels of chemical representation so that the students can understand it clearly and easily. The main factor that makes the students very interested in learning using integrated learning media is its attractive appearance such as bright colors, molecular forms, and visualization of Macromedia Flash. Integrated learning media helps teachers to explain chemistry in a way that is not boring and readily accepted by logic through daily activities that are used as examples of problems.

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