Implementing Non-Experimental Hands-On Activities Using SAVI Approach in Learning Chemistry to Improve Students' Interest and Multiple Intelligences

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ABSTRACT

Students' interest in learning chemistry is low, and experimental activities in learning chemistry are rare, whereas laboratory activities can actually be activities that attract students. Responding to these problems and conditions, a study focusing on the implementation of non-experimental hands-on activities using Somatic, Auditory, Visual, and Intellectual (SAVI) approach to improve students' interest, mastery of Hydrocarbon concept, and students' multiple intelligences become an alternative of student centred learning activities. It was a Classroom Action Research (CAR). The subjects were 33 eleventh grade students of SMAN 4 Banjarmasin, Indonesia. The data were collected using achievement test, questionnaire of students' interest, multiple intelligence test, and observation sheet. The data were then analyzed using descriptive and percentage techniques. The results showed that by applying student activities based on SAVI approach in 3 learning cycles, the problem of students' low interest on chemistry can be overcome. Students' interest in learning chemistry using non-experimental hands-on activities using SAVI approach was high. It was as much as 81.80% to 96.97% of the students responded positively to the implementation of the learning approach. The students' concept understanding on Hydrocarbon material increased as much as 12.70% from cycle 1 to cycle 3. The implementation of the non-experimental hands-on activities using SAVI approach in these 3 cycles was able to increase all types of multiple intelligences ranging from .13% to 14.72%. The highest multiple intelligences improvement were interpersonal and visual spatial which increased 14.72% and 4.73% respectively.

Keywords
Hands-on activities; SAVI; Interest; Students' achievement; Multiple intelligences

Introduction

Studies on the use of experimental method have successfully proved their effectiveness in learning chemistry (Badeleh, 2011; Omiko, 2015; Omwirhiren and Ibrahim, 2016). Experimental learning in laboratories is also able to increase the students' interest in learning chemistry. Unfortunately, experimental activities require the readiness of high-priced laboratory equipment, while not all schools in Indonesia are equipped with laboratories. Not to mention, laboratory preparation requires additional time and teacher's schedule is hectic. A preliminary observation of this study showed that chemistry learning at schools rarely involves experiments optimally to help the acquisition or proof of chemistry concepts. The applied method by the teacher returns to the old-fashioned method that is lecturing.

This condition affects students' interest in learning chemistry as there is a relationship between interest and learning achievement (MeenuDev, 2016; Peipei and Guirong, 2009). This problem also occurs in SMA Negeri 4 Banjarmasin, Indonesia. In this school, teachers rarely use laboratory for learning chemistry. The most commonly used methods are Direct Instruction and group discussions. Students seem to show less enthusiastic in learning. The chemistry learning completeness at school is also relatively low, ie an average of 56%. In the material of Hydrocarbon mastery, the achievement is even below 50%. To overcome this problem, it is necessary to have an alternative learning chemistry which is not only interesting, but also easy to do, does not require big costs, and should be able to help students find the concept of chemistry that is being studied as a substitute for practical activities.

This study aims to implement non-laboratory experimental hands-on activities to increase students' interest in learning chemistry. It is intended as an alternative whenever the laboratory practicum is not possible to do. It involves hands-on activities that are applied using the SAVI approach (Somatic, Auditory, Visual, and Intellectual). This approach is chosen because it involves students activity such as moving, speaking, observing, and solving problems (Meier, 2000). In SAVI, students not only sit still but also actively move, not only hear but also speak, not only pay attention but also observe and describe the results of the observation, and not only answer questions but also solve problems. Some studies showed SAVI is proven to effectively improve critical thinking, students' achievement and interest in learning (Alexander, et. al., 2016; Sahara, et al., 2017). Moreover, SAVI's approach is able to make the Direct Instruction learning model which is more teacher-centered to become more student-centered (Sahara, et. al., 2017).

In this study, in addition to interest and understanding of the concept, students' multiple intelligences will also be identified. The multiple intelligences are expected to develop through the SAVI-based learning as it involves physical movement (somatic), oral communication (auditory), visual observation (visual), and critical thinking (intellectual). Indeed, it is very relevant to the intelligences of kinaesthetic, linguistic, visual spatial, and mathematical logic in multiple intelligences. Therefore, it is expected that by adopting the SAVI approach, the multiple intelligences are also developed. According to Kornhaber and Gardner (1991), the development of multiple intelligences is salient; it is a potential, the presence of which allows an individual access to forms of thinking appropriate to specific kinds of content. As a result, one's ability to understand concepts is also influenced by his/her multiple intelligences (Kandeel, 2016; Ahvan and Pour, 2016; Abdi et al., 2013).

Literature Review

SAVI Approach

SAVI approach combines physical movement and intellectual activity by engaging all sense devices (Meier, 2000). The elements of SAVI approach consist of (1) Somatic learning by moving and doing, (2) Auditory learning by speaking and listening, (3) Visual learning by observing and describing, and (4) Intellectual learning by solving problems. This approach accommodates different learning styles of Visual, Auditory, and Kinaesthetic owned by students (Santrock, 2010).

Combination of moving activity, listening and speaking, observing and describing, and solving problems makes SAVI approach to be a potential approach to optimizing a child's learning experience. According to Rakhmad (2010), learning with movement is substantial as an integration of habituation and sensory input enables students to play, connect and create new understanding. Each movement becomes a vital connection with learning and processing of the mind. In addition to moving, listening and speaking are also important activities in learning. The internal auditory ability even makes a child strong in metacognition (Jensen, 2007).

Interest

Interest is a state that leads to a particular situation or object that is pleasant and gives a satisfaction to someone. Interest can lead to an attitude that is a readiness to do something when there is stimulation in accordance with the circumstances (Semiawan, 1988). Previous studies have proven that the involvement of interest in learning activities makes someone to become active and motivated in learning. Therefore, interest has a great influence, not only on improving the quality of learning outcomes, but also the on the development of one's personality (Krapp et al., 1992; Gendjova, 2016). Interest itself according to Santrock (2010) can be born from within (intrinsic) and can also because of outside influence (extrinsic). Students are motivated to learn when they are given a choice, challenge, and rewards in the form of praise. Interest in learning a subject can also arise from within if the students are happy on the subject. That is why learning activities need to be designed so that students are happy on that subject.

Multiple Intelligences (MI)

Multiple Intelligences (MI) Theory *was* developed in 1983 by Gardner. This theory shows that traditional notions of intelligence based on IQ tests are too limited. Based on MI theory, Gardner (1993) proposes eight different intelligences to explain human potential more broadly, namely (1) linguistics, (2) mathematical logic, (3) visual-spatial, (4) kinaesthetic, (5) musical, (6) interpersonal, (7) intrapersonal, and (8) naturalist intelligences. The key to MI theory is that all human beings have eight independent intelligences with each other at different levels.

According to Armstrong (2004), there are at least three important roles of education in developing intelligence. First, to recognize the intelligence of each student early; second, to provide an educational service model appropriate to that intelligence; third, to hone and develop the intelligence of all students optimally. The application of MI theory in learning requires that each student is given the learning service in accordance with the type of intelligence so that the potential of each of them can be more developed.

Methods

This study employed a Class Action Research (CAR) model. The research procedure consists of (1) plan, (2) action, observation and evaluation, and (4) reflection stages. In the planning stage, a learning tool set consisting of the lesson plan, students' worksheet, and assessment test. At the action stage, learning was done by using the tool that has been prepared. The observation and evaluation stages were done by observation of the learning activity to get activity, interest, and development of students multiple intelligence data. Further, the evaluation stage was done at the end of each cycle. On the reflection stage, the observation and evaluation data were analyzed to determine the effectiveness of the action that has been done.

The subjects of this study were 33 students of SMA Negeri 4 Banjarmasin, Indonesia. The selected material was Hydrocarbon Chemistry due to its level of difficulty which is high (> 50%). As a result, its completeness remains low. The conceptual characteristics of hydrocarbon which is microscopic (hydrocarbon compound structure), symbolic (naming of hydrocarbon compound), and macroscopic (hydrocarbon reactions compound) make SAVI model suitable for this material.

This study was conducted in 3 cycles because after the 3 cycles, some problems arose, namely low interest of students in learning chemistry, development of multiple intelligences, and students' ability in carrying out the stages SAVI can be overcome and have been running well. The data collection was done through questionnaire and observation technique. The multiple intelligence development data were obtained using Multiple Intelligence Development and the observational instruments developed by Armstrong (2004) and Santrock (2010). The obtained content validity of the multiple intelligences development was 84.52% and the reliability using the test re-test was 0.70 (McCLellan and Conty, 2008; Winarti, 2016).

Data of the student's interest in learning chemistry were obtained from the questionnaire and observation, while the students activity data were obtained through observation technique. The instruments of students' interest and activities used the instruments developed by the researchers themselves. Validity and reliability of interest and activity instruments were tested using expert judgment with 93.33% for interest questionnaire and 87.24% for activity observation sheet.

Data Analysis

As the class action research, the data analysis of this study applied a descriptive analysis and percentage without conducting an inferential statistic. The success of the treatment in each cycle was analyzed by comparing the data with the treatment success indicators. The actions are considered successful if they meet the following criteria: students achieve minimum 75% of concept understanding, and students respond positively to the strategy being implemented. The category of multiple intelligences, interests, and students' activity after learning used the criteria developed by the researchers.

Results

Students' Interest in the Non-Experimental Hands-On Activities Using SAVI

The learning activities were varied such as demonstrations using props, problem solving, playing card games, using parts of the body to simulate concepts, and presentations. Data on students interest after learning are presented in Table 1.

Table 1. Students Interest in Learning Chemistry by Non-Experimental Hands-On Activities Using SAVI Approach

No.	Statement	Positive Response (%)	Doubt (%)	Negative Response (%)
1	Learning chemistry is more interesting by using	90.91	9.09	0

	non-experiential hands-on activities based on SAVI.			
2	Learning by using this method fosters learning motivation in groups.	93.94	6.06	0
3	Learning by using this method makes it easy for me to understand the concept of hydrocarbons.	90.01	9.09	0
4	Learning by using this method makes me directly involved in the learning process.	90.91	9.09	0
5	Learning by using this method improves my ability in answering questions.	90.91	9.09	0
6	The tasks assigned by the teacher made it is easier for me to understand the concept of hydrocarbons.	96.97	3.03	0
7	Learning by using this method is suitable to apply to hydrocarbon material.	90.91	9.09	0
8	Learning by using this method gives me the freedom to give opinions.	81.80	18.20	0
9	I enjoy every activity that has been done.	96.97	3.03	0
10	I feel more actively involved in learning.	90.91	9.09	0
	Average	91.42	8.49	0

Table 1 shows that the percentage of students who responded positively to the chemistry learning using the non-experimental hands-on activities using SAVI approach after the 3rd cycle was high. It was ranged from 81.80% to 96.97%. None of the students gave a negative response to the learning. The best response is given by students to the statement that the task is given by the teacher facilitates students' understanding, and the students like the SAVI based learning activities. One statement that received many hesitant responses is related to the ability of SAVI-based learning in giving freedom to give opinion.

The Students' Concept Understanding of the Non-Experimental Hands-On Activities Using SAVI Approach

Student's understanding of hydrocarbon material in cycle 1, cycle 2, and cycle 3 in the non-experimental hands-on activities in learning using SAVI is presented in Table 2.

Table 2. Students' Concept Understanding of Hydrocarbon Material

Indicator	Cycle 1	Cycle 2	Cycle 3
Explaining the relationship between boiling point of hydrocarbon compounds together with The mass of the formula and its structure	80.45	83.24	93.94
Determining structural isomers and geometric isomers.	68.18	70.06	72.73
Analyzing simple reaction of HK compounds	69.70	78.14	87.88
Average	72.77	77.15	84.85

As shown in Table 2, on learning cycle 1 to cycle 3, the students' concept understanding was increasing. In general, the learning cycle 2 has actually achieved the success indicator, except indicator number 2 which is still below 75%. The highest understanding is achieved by the students in explaining the relationship between the boiling point of the hydrocarbon compound with the mass of the formula and its structure. In order for all indicators to complete, the learning activities continued until cycle 3. The ability of teachers in managing the learning using the non-experimental hands-on activities using SAVI approach in cycle 1 to cycle 3 also increased, ie 78.33% in cycle 1, 81.48% in cycle 2, and 96.67% in cycle 3. The students also can follow the learning well, proven by the students' activity results increased from 71% (cycle 1) to 87% (cycle 2), and 90.67% (cycle 3).

Students Intelligence after Learning by Using the Non-Experimental Hands-On Activities Using SAVI Approach

From the learning outcomes in cycles 1, 2 and 3, the obtained data on the development of multiple intelligences are seen in Figure 1.

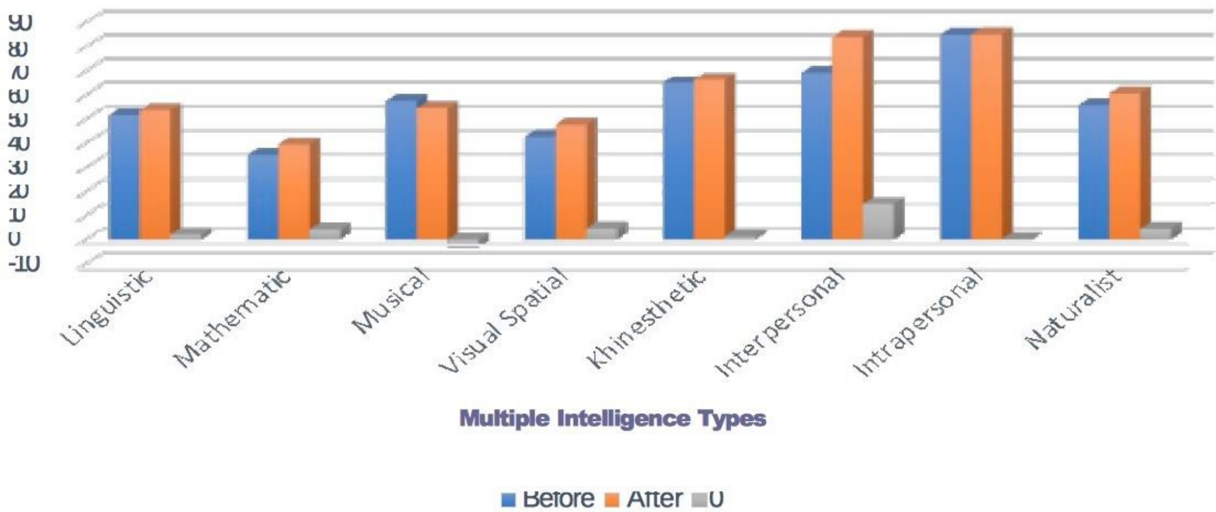

Figure 1. Development of the Students' Multiple Intelligences Scores at the Beginning and End Cycle

Figure 1 shows a change in the score of multiple intelligences before and after the learning. As shown in Figure 1, the average types of multiple intelligences have increased. The multiple intelligences that have the highest score increase were visual spatial and interpersonal intelligences. The other intelligences were slightly increasing, but not as high as the visual spatial and interpersonal intelligences.

Data Analysis

The results show that non-experimental hands-on activities using Somatic, Auditory, Visual, and Intellectual (SAVI) approach which was applied in this research get good responses from the students. The average percentage of students who gave a positive response of 91.42% indicated that the majority of students enjoy the SAVI based learning activities. The data of concept understanding shows that learning cycle 1 has not met the success indicator. However, in the 2nd and 3rd cycles, there has been an increased of the concept understanding which meet the treatment success indicators. The success of non-experimental hands-on activities using SAVI approach is also indicated by the increasing percentage of students' understanding on the 3rd cycle. Viewed from the conceptual understanding of each indicator, the understanding of the relationship between boiling point of HC compound with formula mass and its structure is the highest compared to the other two indicators, ie determining the isomer of structures and geometric isomers and analyzing the simple reaction of hydrocarbon compounds. In contrast, among these three indicators, determining the isomer of structures and geometric isomers of hydrocarbon compounds was the lowest achievement indicator. Students seem difficult to understand the 3 dimensional form of an abstract hydrocarbon compound. Although the ability to analyze the simple hydrocarbon reactions such as addition and substitution remains low in cycle 1, but it improves at the end of cycle 3. In terms of multiple intelligences, all intelligences except musical intelligence develop well, but visual spatial and interpersonal intelligence increased the most compared to other types of intelligences.

Discussions

Table 1 shows the high interest of students in chemistry learning of the non-experimental hands-on activities using SAVI approach. As it is seen in Table 1, the non-experimental hands-on activities using SAVI applied in this study is able to increase the students' interest in learning the material of hydrocarbon chemistry. The high interest of students in learning after the implementation of SAVI approach is similar to that of Iskandar, et al., (2016) and Sahara, et al.

(2017). According to Iskandar, et al., (2016), the high interest of students in learning using SAVI approach is caused by the variety of activities conducted to attract students' attention.

King (2009) explains that learning using SAVI combines 4 ways learning styles that are somatic, auditory, visual, and intellectual. Employing this approach, the students can move, talk, listen, observe, and think directly about what they are learning so that learning becomes more meaningful. Learning chemistry with the non-experimental hands-on activities using SAVI approach involves all five senses and the activity of students directly in the discovery of concepts. That is why on the statements 1, 2, 4, 9, and 10, the students perceived they were interested, motivated, directly involved, enjoyed learning, and felt active in learning. This is supported by the opinion of Cronbach (1975) that the best learning is learning by experiencing something using the five senses. Thus, the use of all sense-devices and directly being involved in the process of concept discovery is a factor that leads to high students' interest in learning. In addition, to attract and motivate students, the use of this method also makes it easier for students to understand the concepts (statements 3, 5, 6, and 7). This is supported by the opinion of Jensen (2007) and Willis (2010) which states that learning involving more sense devices reinforces students' understanding optimally. This is because the more variety of ways to learn something and the more senses involved in receiving important information, the more memory paths are formed and the higher the concept of understanding obtained.

The students' interest increasing in learning chemistry using non-experimental hands-on activities based on SAVI is also followed by their increased understanding of the concept with the average mastery of the concept of 12.08% from cycle 1 to cycle 3. The increased understanding of the concept and the high interest of students towards chemistry uncovered in this study are the forms of two things which are related to each other. According to previous research findings, Peipei and Guirong (2009) and MeenuDev (2016), one of the learning achievement influences is the interest to the subjects. Interest can lead to an attitude namely readiness to do something whenever there is stimulation in accordance with the circumstances (Semiawan, 1998). The interest in the lessons affects students to learn better on those subjects. The comprehension of the concept reached 84.85% in cycle 3 which was influenced by the high interest of the students toward the learning activity.

In addition to being influenced by the increased interest, the increased of students' understanding of concepts is also due to the variety of SAVI activities that involve many sense devices. Creating molymood media from simple tools and materials, watching videos, playing cards, simulating compound structures using limbs, discussions, and presentations are non-experimental activities that require high involvement of sensory devices such as the eyes, ears, hands, and mouth. According to Gav (2012) and Jensen (2007), learning that involves more senses improves students' understanding optimally.

The increase of the students multiple intelligences in this study can be understood because in addition to the theory of constructivism, the SAVI approach is also based on the theory of Multiple Intelligences (Iskandar, et al., 2016). The involvement of somatic, auditory, visual and intellectual activities is relevant to Gardner's multiple intelligence activities which include kinaesthetic, linguistic, visual, and mathematical logic (Meier, 2000; Gardner, 2004). Visual spatial and interpersonal intelligences are the highest level of development due to many SAVI-based attitudes that teachers do relate to these two types of intelligence. For example, the implementation of cooperative strategy in all activities, both the fun activity such as games and more serious activities such as problem solving. In addition, there is also the use of power point media, making moly mod from colourful plastic as a demonstration material, colour card games, and demonstration of the compound structure as a creative way to answer test questions.

Conclusion

From the research results, it can be concluded that: (1) the application of the non-experimental hands-on activities using SAVI approach on hydrocarbon chemistry increased students' interest in learning chemistry with positive response of 81.80% up to 96.97%; (2) the students' concept understanding on hydrocarbon material increased from 72.77 % in cycle 1 to 77.15 % in cycle 2, and 84.85% in cycle 3; (3) the implementation of the non-experimental hands-on activities using SAVI approach in 3 cycles was able to increase all types of multiple intelligences by 0.13% to 14.72%. The visual spatial and interpersonal intelligences have the highest score increase than the other types of multiple intelligences.

Limitations and Future Studies

The relatively small increase of the multiple intelligences (0.13% - 14.72%) is in part due to the relatively short duration of actions (3 weeks). In order to produce a more significant development, relatively longer action time is required. This study can be continued with the implementation of longer-term actions to obtain more significant compound intelligence data development. In the future, the results of this study can be implemented by applying SAVI to other science materials, perhaps even outside of natural science. The use of learning resources such as the internet strongly support the implementation of SAVI-based learning as it provides material to carry out the SAVI stages including visual observation (visual), and critical thinking (intellectual). Laboratory activities can be replaced with other hands-on activities equipped with discovery-based worksheet and group discussion. As long as the learning activity is designed by applying SAVI steps, it will give relatively similar results.

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