Effect of using chemsketch on teaching molecular shape of hydrocarbon to increase student’s achievement

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Abstract. This research aim to know the effectiveness of using chemsketch on the teaching molecular shape of hydrocarbon to increase student achievement. Hydrocarbon is very interesting to be discussed. Technology utilized need to solve this problem which is by using chemsketch. Chemsketch implemented by powerpoint. Research conducted in SMAN 5 Medan sample that used consists of two classes, that consist of experiment class and control class. The average pretest score in control is 33.33 and posttest score is 73.03. Percentage of passed students post-test is 69.70% from 33 students only 23 students. While experiment class average pretest score is 32.12 and posttest score is 81.21. Percentage of passed students post-test is 85.71%, from 35 students only 30 students. The gain percentage between the post-test score in the experiment and the control class is 16.01%. The result showed that chemsketch with PowerPoint effective to increase student’s achievement in hydrocarbon and suitable following industrial revolution 4.0 to prepare student face globalization era education.

1. Introduction

Chemistry as one of the science branches that really important, but students regarded it as a difficult subject. So the teacher as a facilitator must solve this problem by communicating the material to the student using strategy, where to provide multiple communication between teacher and student not only meet each other but they also can use animation, sound effect, and other media to explain the data also can be used graphic and chart. Multimedia can help teaching become efficient, teacher must be integrated by technology to make the learning process more fun[1].

To improve the quality of teaching, the teacher required to be creative as we knew the world today’s has been developed in Technology of industrial revolution 4.0 using Information communication and Technology (ICT). In education ICT can be used as a learning media to deliver the topic to the student, this is one of the way of teaching to make the learning process more enjoyable and not bored and make the student motivated to learn Animation as a media used in the learning process able to increase motivation of student, because media able to help the student to memorize visualization[2].

Hydrocarbons characterized as an abstract concept, for example, the reaction that occurs in alkanes, alkenes. The reaction could not be observed directly. Hydrocarbon demand the students able to draw the molecular shape, many students have difficulty in relating molecular formula with molecular shape. Actually to showing molecular shape used molymod. But needs more time to arrange the ball to form the molecular shape. Students difficult to understand the concept[3]. Student were difficult to understand the microscopic representation of molecules symbol and equation of chemical formula. Technology was developed and computer animation is a better concept to use in the teaching of an abstract subject. Learning process in the classroom always conducted by the conventional
method so it makes student bored and difficult to understand. Media is really important in the development of education for the learning process, especially in chemistry because some of the topics molecular shape of hydrocarbon must be explained by media to make student easy to understand and learning process more enjoyable if we used as a learning media in education [3]. This research conducted by using learning media to deliver the topic. The effectiveness of the implementation of media in teaching and learning process. Blended between media and learning method are more effective and efficient because teacher make the condition of class different. It need to be done to make sure student have many experience. If possible teacher suggest student to bring their own computer or laptop while learning activity [4].

Implementation of technology in education is a good choice in industrial revolution 4.0 to develop education service. Technology in era 4.0 can change the circumstance from teacher centre learning become student centre learning. With information system student able to explore the information in the world, they will learn independently and figure of teacher only as a facilitator[5]. Chemskech used for drawing structures of molecular shape in hydrocarbon, chemskech can draw chemical bonding in the form of 2D and 3D. The molecule that showed can move and able to observe the movement of every atom in the molecule. Student experience in learning by using technologi to implement the courses in chemistry was chemskech, where for increasing the understanding computation project of molecular shape via visualization tools[6][7]. By using chemskech media, students will be able to draw the hydrocarbon molecules, the 3D of molecules and name the molecule. Actually, learning will be more interesting if students can see the animation, in this case, the 3D of hydrocarbon molecules. The visualization that produced affords student to make the abstract concept that manipulating by chemical structure becomes visible.

Chemical structure drawing software is specialized in the chemical structure information with regard for processing, rendering, and editing. With the advance of bioinformatics for drawing chemical structure[8]. Not only using chemskech but also using powerpoint to present Students achievement that used Chemskech as a learning media higher than students achievement that thought by the conventional method, so by using media on hydrocarbon able to improve student achievement[9][10]. Founded molecular models, simulations, and animation integrated by visualizing in teaching to promote student more understand in science about unobservable phenomena in chemistry topic. The significance of technology for teaching chemistry in schools is inevitable to ignore because the application of technology plays a contributory role in the teaching of science by accelerating and improving work of supporting technology in learning process able to increase student motivation in learning chemistry. The student will explore more information about the experiment in chemistry and they can see all the process for making a molecular shape in chemskech clearly. So students can see the shape in three-dimension rotation, it can make them easy to understand molecular shape.

The use chemskech on hydrocarbon topic make student more deep to understand the subject, automatically will be able to increase student achievement[12]. By using interactive media, the cognitive test result student learning completeness from 51.35% becomes 76%. All the treatment was done by using media to conduct learning process on teaching hydrocarbon aim to increase the activity and learning achievement of the student[13][12]. Teacher required being creative and innovative to support and help student motivation to learn the topic in chemistry. Globally every people must face industrial revolution 4.0 by supporting ICT and following the trends in education to find resource and information [3][14]. Because all people need information, using technology really useful and important in education nowadays [15][16].

The industrial revolution now has a very important role. Globally industrial revolution 4.0 also used social, economic, industry, government research, and all scope[15][17]. The use of media has a big impact on a human activity every day to find more information that relates to their activity, of course, using technology like the internet, social media and others. In the world of education, teachers and students are required to utilize technology in carrying out the learning process. this is very important for the teacher when doing learning in the classroom which is using Technology as a media in the learning process[18].
2. Research Method

2.1 Type of Research
This research used quasi-experiment by grouping the sample.

2.2 Research Variable
There are two variables that used in this research, which is:

2.1.1 Independent Variable
The independent variable in this research is use chemsketch and powerpoint in experiment class
control class using conventional method (Direct Instruction).

2.1.2 Dependent Variable
The dependent variable in this research is student achievement on hydrocarbon topic.

This research conduct in senior high school in grade X (ten). The sample consist of two classes,
first class as an experimental treated by using chemsketch with powerpoint for display and the second
as control treated by using conventional method that is direct instruction. The research design showed
below.

Table 1. Research Method

| Class    | Initial Evaluation | Teaching process | Final Evaluation |
|----------|--------------------|------------------|------------------|
| Experiment | I1                 | A                | F1               |
| Control   | I2                 | B                | F2               |

Description:
A : Teaching by using project base learning and chemsketch
B : Teaching by using project base learning without chemsketch
I1 : Score of Initial Evaluation in experiment class
I2 : Score of Initial Evaluation in control class
F1: Score of Final Evaluation in experiment class
F2: Score of Final Evaluation in control class

There are several steps that will be done to obtain the data in this research which consist of
choosing population and sample, doing pretest, doing treatment, evaluation in figure 1 below.
2.2 Research Procedure

Research procedure conducted in this research following the

![Research Procedure Diagram](image)

**Figure 1. Research Procedure**

2.2.1 Population and Sample. The populations of the study are all first grade of high school students. The samples are chosen purposively due to the limitation of the researcher. The sample is selected from randomly two classes each in SMAN 5 Medan. The first class is experiment class and the second class is control class.

2.2.2 Initial evaluation. An initial evaluation in this experiment is giving pretest to the student both in control and experiment class to know how far student understand about hydrocarbon before teaching treatment done in both of the class.

2.2.3 Implementation. Implementation of teaching process done in both of the class in control and experiment.

2.2.4 The learning process in the control. Control class used the conventional method (project base learning). Control class conducted in one meeting, the activity is consists of initial, core and final activity. In the initial activity, the teacher evaluates initial knowledge of students by giving a pretest for 15 minutes. Student’s achievement in the control class gets from the result of the test in the posttest. In core activity, student taught by using the conventional method, which is explained about hydrocarbon especially about alkane. Teacher giving question to the students to know the ability of the student understand about hydrocarbon. The last activity is the teacher and student makes a conclusion together. Then they are given the posttest to measure how far the student understands about the topic that was explained before.

2.2.5 The learning process experiment class. The learning process is the same with control class, this process aims to know the initial knowledge of the student in both of the class before doing the treatment. To make comparison between experiment and control. In core activity, the researcher gave a mind map about the hydrocarbon generally using project base learning. Then explained about hydrocarbon especially about alkane using PowerPoint. Besides that, in the subject matter about molecular structure. After finish makes the molecular structure, the researcher showed students the molecular shape in 3D. Making student interested in the learning process. Although it is not too
effective because students couldn’t try it by themselves because of limited computer, but it made them more interesting to see the 3D shape of molecular structure. For learning process, students were active in answering every question that is given. The last step is evaluation. That is obtained from students’ achievement; students’ achievement is obtained based on their score in the evaluation test of posttest who answer rightly. There are 10 questions in each test that cover the hydrocarbon topics.

3. Result and Discussion
This research conducted in SMAN 5 Medan by using two classes in Grade X, the first class as a control class and the second as experiment class. In control class at there are 33 students, the average pretest score is 33.33 and posttest score is 73.03. Percentage of passed students post-test is 69.70% (23 students). In the experiment class, there are 35 students. The average pretest score is 32.12 and posttest score is 81.21. Percentage of passed students post-test is 85.71% (30 students). The gain percentage between the post-test score in the experiment and the control class is 16.01%. It shows that there are differences in student achievement between.

| Table 2. Result of Student Achievement |
|----------------------------------------|
| Control | Experiment |
|         | Pre test | Post test | Pre test | Post test |
| Mean    | 33.33    | 73.03     | 32.12    | 81.21     |
| Median  | 30       | 80        | 30       | 80        |
| Maximum | 50       | 90        | 50       | 100       |
| Minimum | 20       | 50        | 20       | 60        |
| Deviation Standard | 9.57 | 10.15 | 8.57 | 11.39 |

Based on the explanation above, if we compare the mean of post test in class control and class experiment, there are significant differences score where the score in experiment class is higher than in the class control. It is shown in the figure below 2 below. From the table above student score in experiment higher than student score in control.

![Figure 2. The difference between pretest and posttest score in control and experimental class](image)
Based on calculation, \( t_{\text{calculation}} = 11.39 \), meanwhile \( t_{\text{table}} = 1.997 \). It means that \( t_{\text{calculation}} \) is bigger than \( t_{\text{table}} \). From hypothesis can conclude that \( H_a \) is accepted and \( H_0 \) is ignored. So there is significant difference between teaching uses the chemsketch using powerpoint with conventional teaching method, where teaching uses the chemsketch, is effective to be conducted in SMAN 5 Medan.

4. Conclusion

Chemsketch as one of the program is used to display two or three dimension structure of chemical bonding. The advantage of using chemsketch is a student can see the rotation of the molecule and show the colour to improve visualization. In the learning process, students become interested to learn hydrocarbon. Implementation of chemsketch in learning process able to increase student’s achievement, besides that student easier to memorize the color of atom information of hydrocarbon.

Based on research in control class, the average pretest score is 33.33 and the post-test score is 73.03. Percentage of passed students post-test is 69.70% it means that from 33 students only 23 students able to pass the test. While in the experiment class average of pretest score is 32.12 and the post-test score are 81.21. Percentage of passed students post-test is 85.71%, from 35 students only 30 students passed the exam. The gain percentage between the post-test score in the experiment and the control class is 16.01%.

References

[1] Baek Y, Jung J and Kim B 2008 What makes teachers use technology in the classroom? Exploring the factors affecting facilitation of technology with a Korean sample Comput. Educ. 50 224–34

[2] Ilhan G and Oruç S 2016 Effect of the use of multimedia on students’ performance: A case study of social studies class Educ. Res. Rev. 11 877–82

[3] Saripudin E, Sari I J and Mukhtar M 2018 Using Macro Flash Animation Media on Motion Material to Improve Learning Achievement for Learning Science in Junior High School J. Penelit. dan Pembelajaran IPA 4 68

[4] Yanda, Safitri and Yulia S N 2018 The effect of using e-learning material on hydrocarbon chapter to improve students’ achievement motivation in learning chemistry 843–7

[5] Munir 2018 Kontribusi Teknologi Informasi dan Komunikasi (TIK) dalam Pendidikan di Era Globalisasi Pendidikan Indonesia J. Teknol. Inf. dan Komun. 2 1427–34

[6] Nurvitasari E and Riyawan Susanto Khumaerah D N E M 2018 The Utilization of edmodo in Blending Learning Adv. Soc. Sci. Educ. Humanit. Res. 226 1427–34

[7] Nurvitasari E 2015 Utilization of Information and Communication Technology By Extension 2 2092–6

[8] Mayer R 2008 Getting Started with Blended Learning 5 331–46

[9] Z Li H Wan Y Shi p Ouyyang 2018 Effect of the Use of Multimedia on Students’ Performance in Secondary School Mathematics Glob. Media J. 16 1–8

[10] Li Z, Wan H, Shi Y and Ouyyong P 2004 Personal Experience with Four Kinds of Chemical Structure drawingSoftware: Review on Chemdraw, Chemwindow, Isidisdraw and Chemsketch J. C. Inf. Comput. Sci. 44 1886–90

[11] H.P.S.Voviana, M.Mohammad H 2018 Pengaruh Pemanfaatan Media Chemsketch dalam Pembelajaran yang Menggunakan Metode Resitasi Terhadap Motivasi dan Hasil Belajar Kimia di SMK Kelas XI J. Ilm. Integr. 7

[12] Jaenudin A and Baedhowi T M 2017 The Effectiveness of the E-Module of Economics Learning on Problem-Based Learning used to Improve Students’ Learning Outcomes Ahmad Jaenudin 1, Baedhowi 1, Tri Murwaningsih 1 1 158 30–6

[13] D Silva F, Belém K, D Santos L, C Lobato C, Costa J, Lopes G and Santos C B 2015 Computational Chemistry Programs as a Facilitating Tool in the Teaching and Learning Process vol 8

[14] Pasaribu Y P, Fitrianti H and Suryani D R 2018 Rainfall Forecast of Merauke Using
Autoregressive Integrated Moving Average Model *E3S Web Conf.* **73** 12010

[15] Betaubun H F and Betaubun P 2018 Evaluation of the Performance of Traffic Signs for Vehicle Speed Limits in Merauke District *Int. J. Civ. Eng. Technol.* (IJCIET) **9** 568–73

[16] Betaubun P 2018 Concrete characteristics of local sand materials of suru-suru, merauke-papua *Int. J. Civ. Eng. Technol.* **9** 610–8

[17] Pasaribu Y P, Buyang Y and Monika N S 2019 Potential of mollusks from the coastal of Merauke as protein source for local community *IOP Conf. Ser. Earth Environ. Sci.* **235**

[18] Bahri S, Waremra R S, Reski A, Silubun H C A and Rettob A L 2019 Early Conditions of Physics Learning Reviewed From Teacher Pedagogic Competencies in Smp Negeri 11 Merauke (Ri-Png Border Area) *Int. J. Mech. Eng. Technol.* **10** 1391–6