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EduChem Hidrokarbon: A Green Chemistry Based Discovery Learning Media on Hydrocarbon Nomenclature

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Abstract: This study aims to develop Educhem Hydrocarbons based on Green Chemistry using the Discovery learning learning model on the nomenclature of hydrocarbon compounds. This study applies the Research and Development (R&D) method with the Brog and Gall approach. The research sample amounted to 44 students of class XI. The instruments used are validation questionnaires, student response questionnaires, pretest posttest questions and student activity observations. The results show that the learning media is declared valid with a validity value of 93.93%, practical with a small scale of 89.76% and 93.53% of a large scale. The effectiveness of the media based on the value of small-scale N-gain 0.71 and large-scale N-gain 0.73. The effectiveness based on student activities on a small scale is 90.71% and a large scale is 92.99%. This shows that the Educhem Hydrocarbons learning media based on Green Chemistry is declared suitable to be used as a learning resource on the subject of nomenclature of hydrocarbon compounds.

Keywords: learning media, discovery learning, green chemistry, hydrocarbon nomenclature.

Abstrak: *Penelitian ini bertujuan untuk mengembangkan media Educhem Hidrokarbon Berbasis Green Chemistry menggunakan model pembelajaran Discovery learning pada materi tata nama senyawa Hidrokarbon. Penelitian ini menerapkan metode Research and Development (R&D) dengan pendekatan Brog and Gall. Sampel penelitian berjumlah 44 siswa kelas XI. Instrumen yang digunakan yaitu angket validasi,angket respon siswa,soal Pretest Posttest dan observasi aktivitas siswa. Hasil menunjukkan bahwa media pembelajaran dinyatakan valid dengan nilai kevalidan 93,93%,Praktis dengan nilai 89,76% skala kecil dan 93,53% skala besar. Efektivitas media berdasarkan nilai N-gain skala kecil 0,71 dan N-gain skala besar 0,73. Efektivitas berdasarkan aktivitas siswa pada skala kecil sebesar 90,71% dan skala besar 92,99%. Hal ini menunjukkan media pembelajaran Educhem Hidrokarbon berbasis Green Chemistry dinyatakan layak digunakan sebagai sumber belajar pada pokok bahasan tata nama senyawa hidrokarbon.*

Kata kunci: *media pembelajaran, pembelajaran discovery, kimia hijau, tatanama hidrokarbon.*

▪ INTRODUCTION

Chemistry learning material is one of the fields of science that learns a lot about the composition, structure, properties and changes experienced by the material either in natural processes or in experimental processes. According to (Munandar, 2017) chemistry is an abstract learning, meaning that there are still many students who think that chemistry is a difficult lesson, difficult to understand because it is abstract so that many students are less interested in learning chemistry. This certainly has an impact on the learning process of students who become less active or passive during class and causes low student interest and motivation in learning chemistry (Sudiana, 2019).

One of the chemistry material that is considered by students to be abstract and difficult to understand is the nomenclature of compounds and isomers of hydrocarbons.

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In this material, students are required to understand the structural form of alkane, alkene and alkyne hydrocarbons. The researchers encountered several difficulties during the pre-study, such as the first students still seemed confused in determining the location of the elements carbon and hydrogen, the second students still did not understand well why there are molecules that are written CH, CH2, CH3 and CH4 on the structural forms of alkanes, alkenes and alkynes. In addition, students in several schools also have limited learning media for nomenclature material for hydrocarbon compounds. So far, the media used is molymod media which is actually effective in describing the molecular shape or structure of alkanes, alkenes and alkynes. As in research (Brom, 2018) the molecular shape of a compound can be described using molymod media, research (Robertson, 2015) introduces atoms and molecules using two-dimensional media and research (O'Brien, 2016) makes molecules with 3-dimensional media from molymod which helps students to know the reactions of organic compounds. Some of these studies are research on effective 3-dimensional learning media to help students learn about the molecular shape and structure of a compound.

The role of a learning media in the teaching and learning process of chemistry can foster student learning motivation and can improve student understanding. This is in line with research (Fourches & Feducia, 2018) which states that by using 3D Print media to make molecules, students really enjoy the activity of making molecules with 3D prints. (Khairunnisa, 2018) states that Hydrocarbon Scrabble media is an effective medium for student learning outcomes at SMK Muhammadiyah 3 Samarinda.

Green Chemistry-Based Hydrocarbon EduChem Learning Media Using the discovery learning Model is a learning media that is the result of innovations carried out by researchers so that students who do not have molymod media can use media developed by researchers. This media can certainly be a reference or media choice for a teacher so that students become active in class on the nomenclature of hydrocarbon compounds. This medium can also describe or arrange the nomenclature structure of alkanes, alkenes and alkynes. In addition, the media that the researcher developed is a media based on Green Chemistry which according to the researcher has the advantage that it is made of environmentally friendly and easily available materials such as wood. The concept of making learning media using environmentally friendly wood raw materials refers to the principle of Green Chemistry, namely the design of chemical products that are not dangerous or safe and prevent hazardous chemical waste. Green Chemistry is a concept that encourages the design of a product or process that reduces or minimizes the use and production of hazardous chemicals (Karpudewan, Roth & Ismail, 2013).

Teachers also need to use appropriate learning models for the material presented so that students are more motivated to learn and can improve learning outcomes and student activities. One of the steps to make students active and motivated in learning the nomenclature of compounds and isomers of hydrocarbons is to use a discovery-based learning model. (Großmann & Wilde, 2019) stated that the discovery learning model of students who previously had low knowledge, by applying the discovery learning model led to an increase in students' conceptual and procedural understanding. (Andrews, 2016) states regarding the comparison between the discovery learning model and the Application Exposition, that the discovery learning Model generates inductive conclusions, students are more independent and more productive. Research (Evans, 2015) regarding the influence of the discovery learning model has a good impact on achievement motivation and students' mental abilities.

Students who were given the discovery learning model were significantly better than students who were given the conventional approach. (Künsting, Wirth, & Paas, 2011) states that with the discovery learning model, students experience good changes in cognitive terms, the discovery learning model also emphasizes student activities such as group discussions to solve a problem. (Künsting, Kempf, & Wirth, 2013) states that using the discovery learning model can increase students' motivation and cognitive abilities compared to conventional learning.

Based on the description above, regarding the importance of making students more active in class and increasing students' knowledge of the concept of nomenclature of compounds and hydrocarbon isomers for the better, the researchers are interested in conducting research on the development of educhem hydrocarbons learning media based on green chemistry by using the discovery learning model on principal discussion of nomenclature of hydrocarbon compounds and isomers.

▪ METHOD

This study uses research and development (R&D) methods to produce certain products and test the effectiveness of these products (Sugiyono, 2014). The research and development model used in this study is the Brog and Gall model which consists of 10 steps and then reduced to 9 steps by the researcher. In this study, the researcher carried out several stages including reviewing potential and problems, data collection, product design, design and product validation, design revision, product testing (small & large scale trials), data analysis and reporting.

This research was conducted in August 2021 at the MA Sabilarrsyad Samarinda with a sample of 44 students of class XI. This study uses questionnaire data collection techniques, observation tests and assessments, the instruments used include media and material validation sheets, pre-test and post-test questions, student response questionnaires, and student activity observation assessment sheets. The data analysis technique used is the analysis of validity, effectiveness and practicality. Media validity was obtained based on the assessment of media expert validators, material experts and learning practitioners. The criteria for validation of learning media are based on percentage figures according to (Riduwan, 2007) that learning media have very valid criteria if they are in the percentage range of 81% to 100%, valid criteria are in the range of 61% to 80%, criteria are quite valid in the range of 41% to 60 %. While the percentage range of 0% to 21% includes invalid criteria.

The effectiveness test aims to find out how learning media can improve learning outcomes and increase student activity. The effectiveness test based on student learning outcomes was measured from the pre-test and post-test scores which were then analyzed using the N-gain formula as follows:

$$Gain\ index = \frac{Postest - Pretest}{Max - Pretest}$$

The results of the N-gain analysis according to (Hake, 1998) that the N-gain criterion is declared High if it is in the range of N-gain values > 0.70, the N-gain criterion is in the range of 0.30≤ N-gain 0.70 , and the low N-gain criteria are in the range of N-gain <0.30. Meanwhile, the distribution of N-gain acquisition categories in the form of % can refer to the percentage range >76% effective category, 56%-75% quite effective, 40%-55% less effective and <40% ineffective.

The effectiveness test is based on the results of the student activity observation assessment which is then analyzed using the following formula:

$$Students'activities = \frac{score}{overall\ score} \times 100\%$$

The results of the analysis of student activity based on percentage figures according to (Yonni, 2010) that the percentage of student activity has very good criteria if it is in the percentage range of 80% to 100%, good criteria in the range of 70% to 79%, criteria is quite good in the range of 60% to 100%. 69%. Meanwhile, the percentage range from 0% to 59% is not a good criterion.

The test of the practicality of the media is seen based on the results of the student response questionnaire. (Rockyane and Sukartiningsih, 2018) states that the media is said to be practical seen from the results of the implementation and learning achievements that are observed or assessed by observers and the results of the opinions of media users, both teachers and students. The results of the student response questionnaire analysis based on percentage figures according to (Irsalina and Dwiningsih, 2018) that the percentage of media practicality has very practical criteria if it is in the 80% to 100% percentage range, practical criteria in the 60% to 80% range, less practical criteria in the range 40% to 60%. Meanwhile, the percentage range from 0% to 40% includes impractical criteria.

▪ RESULT AND DISCUSSION

In this study, the researcher carried out several stages including assessing potential and problems, data collection, product design, design and product validation, design revision, product testing (small & large scale trials), data analysis and reporting. The potential and problem stages aim to determine the problems faced in learning chemistry in SMA/MA. This stage is based on the results of interviews of researchers with class XI teachers at MA Sabilarrasyad Samarinda. The researcher found that during the teaching and learning process the teacher only used conventional methods without the help of learning media, this of course would make students feel bored and not enthusiastic in learning the material for nomenclature of compounds and hydrocarbon isomers. The data collection stage aims to find information from various literatures from books or journals regarding previous studies related to the development of learning media that will be made for nomenclature material for compounds and hydrocarbon isomers. At the product design stage, the product design to be made is carried out, the product design consists of the design of the media form, the media storage area and determining the media material itself. The following is an image of the design for EduChem Hydrocarbons based on Green Chemistry.

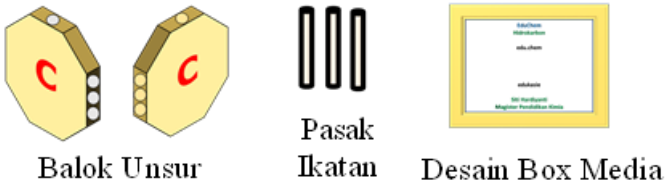

Figure 1. EduChem Hydrocarbon Media Based on Green Chemistry

The initial part of the product is a box, where this box is in the form of a box and is named according to the media that the researchers developed, namely Educhem Hydrocarbons based on Green Chemistry. The second part is a hexagon-shaped block, this block is inscribed with the elements Hydrogen and carbon. On the top and bottom there is one hole and on the left and right there are 3 holes each. The third part is the peg, this peg is useful as a connector between the beams. The type of material used in

EduChem Hydrocarbon media based on Green Chemistry is wood, in accordance with the wishes of the researchers, this media is based on Green Chemistry. Researchers chose this material because wood is an environmentally friendly material, easy to obtain, does not cause hazardous waste and is durable and not easily damaged. The validation of the EduChem Hydrocarbon learning media based on Green Chemistry is based on the assessment of the media validator, namely two expert lecturers from the MIPA and FKIP study programs, the material validators, namely two expert lecturers from the MIPA and FKIP study programs as well as the assessment from learning practitioners, namely two chemistry teachers who have experience teaching directly at school. From the results of the assessment of expert lecturers and learning practitioners, then analyzed and obtained the results of the analysis as follows:

Table 5. Recapitulation of the validation results of the expert team and learning practitioners

Validator	Percentage	Criteria
Ahli Media	97.77%	Excellent
Ahli Materi	91.8%	Excellent
Praktisi Pembelajaran	92.23%	Excellent
Rata-rata	93.93%	Excellent

Based on the results of the assessment of learning media from the expert team, it can be seen that the EduChem Hydrocarbons based on Green Chemistry developed are included in the category of very valid learning media with an average percentage of 93.93%. This is also in line with previous research, namely research (Ijay, 2021) that valid learning media has an average percentage of 93.07% with a very valid category. Judging from the results of the analysis from a team of experts, the EduChem Hydrocarbon based on Green Chemistry media is feasible to be tested on small-scale and large-scale trials at Sabilarrsyad MA Samarinda. Based on the validation results from a team of media, material and learning practitioners. Before being revised, this media only contained elements of hydrogen and carbon, CH2, CH3, and the ethyl group in the design of the media box only on the top. Therefore, suggestions from the expert team to add other elements or molecules such as CH2, CH3, as well as ethyl groups and box designs are made more attractive. The following are the results of the revision of the developed learning media:

Figure 2. Before and after the product of learning media

This small-scale and large-scale trial is a test in a class using EduChem Hydrocarbons based on Green Chemistry. The small-scale trial group here consists of 10 samples and the large-scale trial group of 44 students of class XI MA Sabilarrasyad Samarinda. Data collection techniques include taking pre-test and post-test scores, assessing student activity observations and assessments based on student response

questionnaires. The following are the results of the recapitulation of pre-test and post-test scores on small-scale trials and large-scale trials, the results of student response questionnaires, n-gain, and student activities

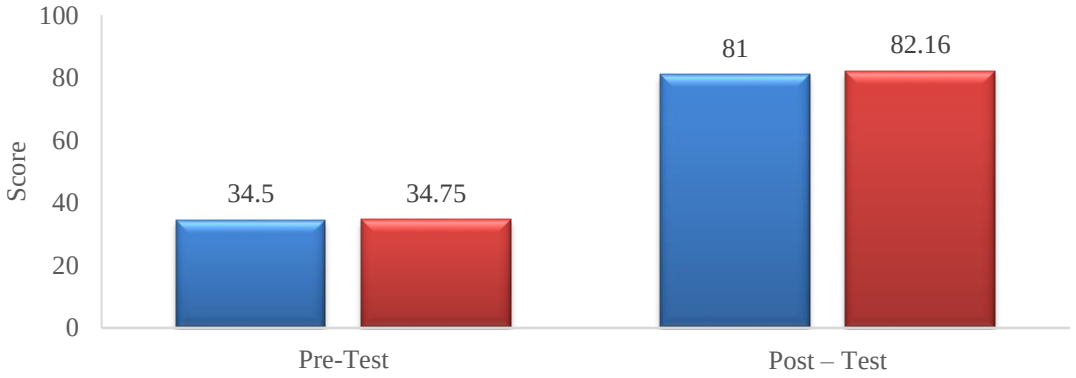

Figure 3. Pretest and posttest score in small (blue) and large group trial (red)

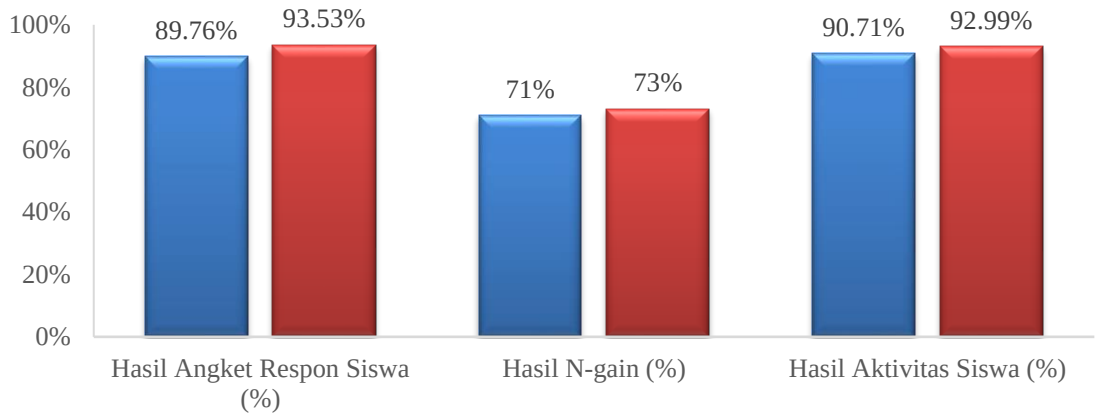

Figure 4. Graph of student response questionnaire results, n-gain results, and student activities in small (blue) and large group trial (red).

Learning media is said to be practical if students are easy and are greatly helped by the presence of the media during the learning process Nomenclature of compounds and isomers of hydrocarbons. Graph 4 shows that the level of practicality of the media on a small scale is 89.76% and on a large scale it is 93.53%, meaning that the EduChem Hydrocarbon media based on Green Chemistry using the Discovery Learning learning model is a practical medium used by students on compound nomenclature material. hydrocarbons. This is in line with the research by Rockyane and Sukartiningsih (2018) that the media is said to be practical seen from the results of implementation and learning achievements that are observed or assessed by observers and the results of opinions from media users, both teachers and students.

Based on the N-gain value obtained in large-scale and small-scale trials, the EduChem Hydrocarbon based Green Chemistry media was declared quite effective with a percentage of 71% on a small scale and 73% on a large scale, because students experienced an increase in mastery of the material after the learning activities were carried out. using EduChem Hydrocarbon media based on Green Chemistry. This improvement in learning outcomes is based on EduChem Hydrocarbons based on Green Chemistry

using the Discovery Learning learning model which requires students to be actively involved during the learning process, students not only write examples of compounds given by the teacher but students directly make compounds that are listed on the LKPD and make or assemble it using EduChem Hydrocarbons based on Green Chemistry.

The effectiveness of learning media is also seen based on the level of student activity during the learning process using EduChem Hydrocarbons based on Green Chemistry with the Discovery Learning learning model. Graph 4 shows that the level of student activity on a small scale is 90.71% and a large scale is 92.99%. Assessment of student learning activities is viewed from several things such as students' attention to learning materials, students working on LKPD, using Hydrocarbon Educhem media, discussion with groups, presentation of discussion results to making conclusions about learning materials. The results of the percentage of student activities using EduChem Hydrocarbons based on Green Chemistry with the Discovery Learning learning model can be seen in the graph below: Based on the results of the questionnaire, the media developed is a very practical learning medium. Some students also responded that EduChem Hydrocarbons based on Green Chemistry made it easier for them to make compounds based on nomenclature and isomers, they also became more active in learning in class. With interesting media, students will be motivated to learn chemistry so that later it will have a good effect on student learning outcomes.

▪ CONCLUSION

Based on the results of data analysis and discussion in this study, it can be concluded that the Educhem Hydrocarbons learning media based on Green Chemistry using the Discovery Learning learning model is a suitable learning media to be used as a learning medium on the subject of Hydrocarbon Compound Nomenclature based on the validity results with a validity value of 93, 93% with very valid criteria, Practical with a value of 89.76% small scale and 93.53% large scale with very practical criteria. The effectiveness of the media based on the small-scale N-gain value of 0.71 and the large-scale N-gain of 0.73 with very effective criteria. Effectiveness based on student activities on a small scale of 90.71% and 92.99% on a large scale with very effective criteria.

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