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RESEARCH ARTICLE

Development of Online Crossword Puzzles as A Media of Learning on Hydrocarbon Material 11th Grade Senior High School

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ABSTRACT

Hydrocarbons are a fairly dense material, it is necessary to strengthen the concept of this material in the form of exercises. As a result of the distribution of the questionnaire, 98% of students participated in training in the form of a game. One game that can be used as practice is a crossword puzzle. This study aims to produce an online crossword game and determine its validity and level of practicality. The research method used is research of development with a plomp model. The research time was carried out from January 2021 to October 2022. The place where this research was carried out was the FMIPA UNP campus and schools. The results of the study found that the crossword game media obtained an Aiken V index value at construct validation of 0.87 and content validation of 0.91. Furthermore, the results of the small group practicality test showed that the resulting media received a percentage score of 83% teacher response and 86% student response. This study concludes that the online crossword game media developed is already valid and very practical.

KEYWORDS

Crosswords Online, Games, Hydrocarbons, Research of Development

ABSTRAK

Hidrokarbon merupakan materi yang cukup padat, diperlukan pemantapan konsep pada materi ini dalam bentuk latihan. Hasil penyebaran angket didapatkan, 98% peserta didik menyukai latihan dalam bentuk permainan. Salah satu permainan yang dapat digunakan sebagai latihan yaitu teka-teki silang. Penelitian ini bertujuan untuk menghasilkan permainan teka-teki silang online dan menentukan kevalidan dan tingkat kepraktisannya. Metode penelitian yang digunakan adalah research of development dengan model plomp. Waktu peneltian dilakukan pada Januari 2021 sampai dengan Oktober 2022. Tempat dilakukan penelitian ini yaitu kampus FMIPA UNP dan sekolah. Hasil penelitian didapatkan bahwa media permainan teka-teki silang memperoleh nilai indeks aiken V pada validasi konstruk 0,87 dan validasi konten 0,91. Selanjutnya, hasil uji praktikalitas small group menunjukkan bahwa media yang dihasilkan mendapatkan nilai presentase respon guru 83% dan respon peserta didik 86%. Kesimpulan dari penelitian ini media permainan teka-teki silang online yang dikembangkan sudah valid dan sangat praktis.

KATA KUNCI

Hidrokarbon, Permainan, Teka-Teki Silang Online, *Research of Development*

1. INTRODUCTION

Hydrocarbons are a chemical material that is studied in class XI senior high school. The characteristics of this material study the characteristics of carbon atoms, molecular structures of hydrocarbons (alkanes, alkenes, alkynes), isomers, nomenclature, physical properties, chemical reactions in hydrocarbons namely alkanes, alkenes, and alkynes, and the uses of alkanes, alkenes, and alkynes. Hydrocarbon material has quite dense and has many sub-materials, so it takes practice to understand this learning material[1]. Opinion from Kartini (2022), said students thought that hydrocarbons had a high level of difficulty, so it was difficult for students to understand because of a lack of conceptual understanding of hydrocarbon material[2].

Exercise can help students understand the subject matter they have learned. One form of practice questions that students like is in the form of games. This can be seen from the distribution of questionnaires given to students at senior high school. Media games that are fun, motivating, and give the impression of addiction make this activity popular with many people, following the opinion of Muhtarom (2016) games have an entertainment side that can motivate students in learning[3]. The advantage of the game is that it is an effective tool in learning because it creates motivation and personal satisfaction, accommodates a wide variety of learning styles and skills, provides deep interactive context to solve problems, and put forward real action rather than just an explanation[19].

The crossword game is a game of filling in empty columns in the form of a box with letters horizontally and downwards to produce a word.[4]. Crossword puzzle games can have the effect of refreshing memory so that the brain's work function returns to its optimum because the brain is used to learning in a relaxed way. A state of mind that is clear, relaxed, and calm makes the brain's memory strong and memory increases[5].

Based on the distribution of questionnaires conducted at three senior high schools it can be concluded that students are less enthusiastic about doing the exercises given by the teacher, students are stalling for time in doing the exercises so that the time given is up and there is no training in the crossword puzzle game.

Crossword puzzle games can be developed and modified as learning media in the form of exercises on hydrocarbons by answering questions briefly and precisely using a mobile phone. This is to the demands of the 2013 curriculum which states that educators and students are expected to be skilled at using media and technology in learning[6].

The use of crossword puzzle media in learning can motivate students to answer questions because there is an element of the game, that increases cooperation between students, stimulate students to think critically and spur students to work carefully on questions[7]. This crossword puzzle is included in the reviewing strategy (repetition strategy), this crossword puzzle strategy relates to ways to recall what has been learned and test the knowledge that students have acquired [18]. Learning with crossword media makes students more interested because they feel challenged within looking for answers to questions that exist and adapting to the answer column already available. Indirectly, It requires students' thinking power more active and purposeful discuss and be more thorough in finding the right answer [20].

Relevant research related to the development of crossword puzzles has been carried out by Paula, Yohanes, and Sukarman (2021) who said that the crossword media developed was stated to be very valid and very feasible to be implemented in biology learning specifically for movement system material[8]. Then research from Eni and Andriyanto (2021) says the integrated science crossword learning media produced is very valid in terms of language, material, presentation, and graphics. This media can also be used in the learning process with very practical criteria[9]. Furthermore, research by Annisah, Depriwana, and Suci (2022) said that the mathematical crossword game media developed was very feasible to use and made it easier for students to learn mathematics, especially on integer operations material[10].

These studies were applied to mathematics, biology, and natural sciences. There were no chemistry subjects, especially hydrocarbons, that were applied to this crossword puzzle game. Researchers are trying to develop a crossword game on hydrocarbon material that can be accessed using a mobile phone.

2. METHOD

The method of research used is a research of development. was conducted on the FMIPA UNP and senior high school campuses with the research subjects being three chemistry lecturers at UNP, two chemistry teachers, and twelve students in class XII MIPA. The development model used in this research is the plump development model developed by Tjeerd Plomp which consists of stages, namely the preliminary research, the prototype stage, and the assessment phase.

1. Preliminary research

It is carried out with the following activities: (1) Needs analysis, namely collecting information through questionnaires distributed to students and teachers at senior high schools to see problems in hydrocarbon learning; (2) Context analysis, namely analyzing basic competence which can then be formulated into a competency achievement index; (3) Literature study, aims to understand the sources related to the development activities carried out and relevant to the problems in the research; (4) Development of a conceptual framework, carried out to link the problems that occur with the theoretical basis and research strategy to be carried out.

2. Prototyping stage

The initial design of the crossword puzzle game is carried out and determines the important components contained in this game. Furthermore, to complete the important components contained in the crossword game, a self-evaluation was carried out on prototype I with a checklist system.

Then made improvements, resulting in a complete crossword game.

The resulting crossword game was then carried out by prototype II, namely an expert review evaluation by five validators using a validity sheet and individual evaluation (one-to-one evaluation) using an interview sheet to obtain a valid development product. If there are revisions, improvements are made, resulting in a valid crossword game.

The valid crossword game is then carried out by prototype III, namely a small group trial by students and teachers using a practicality questionnaire to produce a practical crossword game. This research is limited to the prototype III stages, namely the practicality test in small groups (small groups).

Data obtained from validity were processed using Aiken's V formula. To obtain a validity value, a calculation was performed by dividing the sigma value of s by the number of validators multiplied by the highest validity rating number (in this case $c = 5$) minus one. The s value (the score set by the validator minus the lowest score in the category used) is obtained from the number obtained by the assessor minus the lowest validity rating score (in this case $lo = 1$).

Data on practical results were obtained through a questionnaire filled in by teachers and students. The practicality percentage value is obtained from the score obtained divided by the maximum score multiplied by 100%.

3. RESULT AND DISCUSSION

The results of the research can be described as follows:

3.1. Preliminary Research (Preliminary Stage)

3.1.1. Needs Analysis

Based on the needs analysis of the questionnaires distributed, it was concluded that: (1) the hydrocarbon material is quite dense and a lot, so training is needed to strengthen students' concepts; (2) Students are less enthusiastic about doing the exercises given by the teacher, so a variation of the exercise is needed in the form of a game to attract the attention of students; (3) crossword puzzle games can create a clear, relaxed, and calm state of mind so that the brain's memory is strong and memory improves[5].

3.1.2. Context Analysis

Syllabus analysis was carried out with basic competencies, namely: 3.1 analyzing the structure and properties of hydrocarbon compounds based on the characteristics of carbon atoms and the classification of compounds. These basic competencies are lowered to a competency achievement index, namely: (1) Explaining the uniqueness of a carbon atom; (2) Determining primary C, secondary C, tertiary C, and quaternary C of a hydrocarbon compound; (3) Explaining the meaning of hydrocarbon compounds; (4) Distinguishing alkanes, alkenes, alkynes; (5) Determine the name of the hydrocarbon compound (alkane, alkene, and alkyne) based on the given structure; (6) Analyze the physical properties of alkanes, alkenes, alkynes; (7) Predict the reactions of hydrocarbon compounds (alkanes, alkenes, and alkynes); (8) Explain the meaning of isomers; (9) Distinguish between structural isomers (framework, position, and functional groups) and geometric isomers (cis and trans); (10) Make structures of isomers from alkanes, alkenes, alkynes; (11) Explain the use of alkanes, alkenes, and alkynes.

3.1.3. Literature Study

Hydrocarbon material is a material that is quite a lot and dense, so it needs a good understanding of this material[1]. According to Smaldino (2011), students' understanding of the concepts, principles, and procedures that have been learned can be increased by providing training. To attract the attention of students in doing the exercises, a variation was made to the students' exercises in the form of a game. According to Sadiman (2012), the game is something fun and entertaining to do and the game is not rigid (flexible) and can be used for various educational purposes. One of the games that can be used as a consolidation of the concept is a crossword puzzle. Research from Srirahayu (2019) said the training media in the form of crossword puzzles was very valid and the responses of teachers and students were very interested in this crossword puzzle on compound nomenclature material[11]. Then research from Nenggani (2020), said the use of crossword puzzles was effective in mastering German vocabulary in SMA 8 Makassar students[12].

3.1.4. Conceptual Framework Development

Problems are obtained based on needs analysis, context, and literature studies, namely that the hydrocarbon material is quite dense and a lot, so training is needed to strengthen the concept and students are less enthusiastic about doing the exercises given by the teacher, so a variation of the exercise is needed in the form of a game. This problem is solved by developing an online crossword game on hydrocarbon material. Crossword puzzle games can have a refreshing effect on memory, so that brain function returns to its optimal level and memory improves. Then this product was developed using the plomp development model and analyzed using a validity test to determine the validity of the product being developed and a practicality test to determine the practicality of the product.

3.2. Prototyping Stage

3.2.1. Preliminary Design

At the prototyping stage, the initial design of a crossword puzzle game made in Microsoft word consists of (1) cover; (2) KD and IPK; (3) game rules; (4) material summary; (5) crossword boxes; (6) horizontal and descending questions. Making crossword boxes is assisted by using the crossword application. Then the crossword game is converted into a web link using liveworksheet.com. The questions presented in the online crossword game are per KD and IPK of hydrocarbons.

3.2.2. Prototype I

The online crossword game that has been made is self-evaluated through a checklist system for the components in the crossword game. The results of this evaluation were made to improve the appearance of the crossword game to make it more interesting, add game rules so that students can understand how to play this game, and improve the competency achievement index so that basic competence is achieved in the material. hydrocarbons. To produce a complete online crossword puzzle game.

3.2.3. Prototype II

The resulting online crossword game was then carried out by prototype II, namely an expert review evaluation by five validators, namely three UNP chemistry lecturers and two chemistry teachers at senior high school to get a valid development product. This test was carried out using the content and construct validation sheet instrument. The results of the content validation test show that the value of V is 0.91 with the validity category being valid, this is following Aiken's opinion that a product can be said to be valid if the value of large V is equal to 0.8[13]. The results of this content validity indicate that the competency achievement index presented is by the basic competency 3.1 hydrocarbons and the questions presented are under the competency achievement index in hydrocarbon material. This is according to Haviz (2016) said, content validation shows that the product developed is based on the relevant curriculum[14].

The overall construct validation value has a V value of 0.87 with the validity category being valid. The results of construct validation for each component can be seen in Figure 1.

Construct Validation Results

Assessed Aspects	Average of V Value
Presentation	0,87
Linguistic	0,86
Graphic	0,84
Programming	0,93

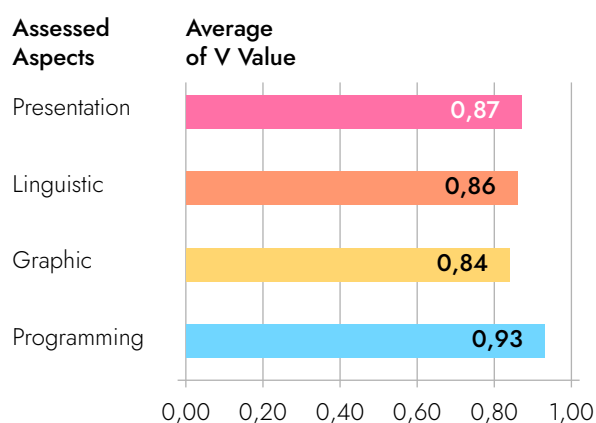(x-axis: 0,00 0,20 0,40 0,60 0,80 1,00)

Figure 1. Construct validation results.

For each component of the construct validation of the presentation component, linguistic component, graphic component, and programming and utilization aspects, the validity value is valid which can be described as follows:

3.2.3.1. Presentation components

Data analysis on each construct validation component shows that in terms of the presentation component, the online crossword puzzle game on hydrocarbon material is valid. The assessment given by the validator is a V value of 0.87. This is following Aiken's opinion that a product can be said to be valid if the large V value is equal to 0.8[13]. This shows that online crossword games have been systematically arranged.

3.2.3.2. Language component

In the linguistic component, online crossword puzzle games on hydrocarbon material are valid. The assessment given by the validator is a V value of 0.86. This shows that the information provided in the online crossword game is clear, the shape and size of the letters in the game are legible, the language contained in the online crossword game is following Indonesian language rules, is clear, and does not cause confusion and can be understood. This is by the Ministry of National Education (2008) which states that the sentences in the media used are simple so that the information conveyed is clear[15].

3.2.3.3. Graphical components

The graphical component of the online crossword puzzle game on hydrocarbon material is valid. The assessment given by the validator is a V value of 0.84. This shows that the images presented in the online crossword game can be observed clearly, the designs and colors in the online crossword game as a whole are attractive and the media layout of the online crossword game is attractive and neat. Following the opinion of Sudjana and Rivai (2011) who said colorful media designs make students interested and foster interest in learning.

3.2.3.4. Programming and utilization aspects

In terms of programming and utilization of online crossword puzzle games on hydrocarbon material, it is valid. The assessment given by the validator is a V value of 0.93. This shows that the ease of filling out online crossword puzzles is good, filling out identity and sending answer icons is easy to fill in and use, and the availability of images helps students understand the material.

Then an individual evaluation (one-to-one evaluation) was carried out by filling in the interview sheet by three class XII MIPA students at senior high school with different academic abilities. Students think that the cover display is attractive, the rules of the game are easy to understand, the puzzle boxes are easy to fill in but it's a little difficult to find the number of the box because it's too small, the questions in the game are easy to understand. The color design and appearance of the game attract the attention of students to play it, and the language and writing used are easy to understand and clear. This game can also help students in strengthening the concept of material.

Advice from expert reviews and one-to-one evaluation is used as a basis for revising. The fix resulted in a valid online crossword game.

3.2.4. Prototype III

Furthermore, the valid online crossword game was carried out by prototype III, namely a small group trying to find out the practicality of this game. This test was carried out by two chemistry teachers at senior high school and twelve students of class XII MIPA.

3.2.4.1. Teacher practicality
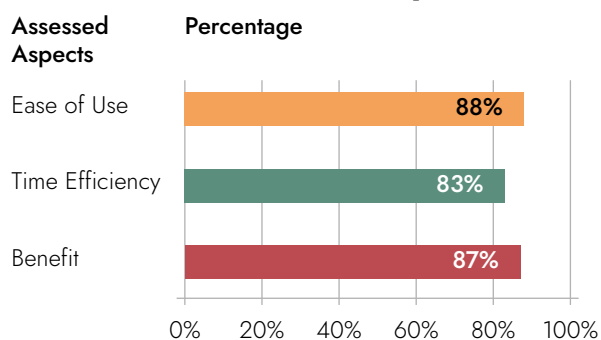
Result of Teacher Practicality

Figure 2. Results of teacher practicality.

The results of practicality by the teacher as a whole get a percentage value of 83%, the practicality category is very practical. With a percentage value of the ease of use aspect of 88% (very practical), it can be said that the ease of use of online crossword games is very good, according to what Arsyad (2013) said good learning media is defined as media that has ease of use[16]. The efficiency aspect of learning time is 83% (very practical), which shows that the use of this crossword puzzle game is efficient. And the benefit aspect is 87% (very practical). The determination of this practicality category is following the provisions set by Anshari (2019), namely if the percentage value is in the range of 81% -100%, it means it is very practical[17].

3.2.4.2. Practicality of Learners

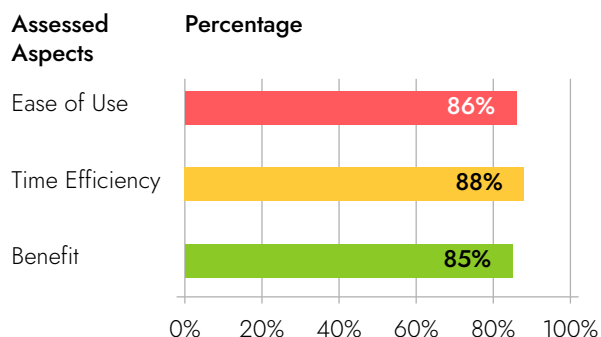**Result of Students Practicality**

Figure 3. Construct validation results.

Practical results obtained from 12 students get a percentage value of 86% (very practical). With the ease of use aspect of 86% (very practical), this shows that the media can be understood and used by

students properly. The value of the efficiency aspect of learning time is 88% (very practical) and the value of the benefit aspect is 85% (very practical). This shows that the developed media helps students in consolidating concepts in hydrocarbon material

This online crossword game is expected to be used as an alternative for students to practice the concept of hydrocarbon material in class and outside the classroom.

4. CONCLUSION

This research produced an online crossword game media on hydrocarbon material for class XI senior high school. The validity test shows that the resulting media is valid with a value of V content is 0.91 and V construct is 0.87 and the small group practicality test shows that the media is very practical with the scores from the teacher and student questionnaires being 83% and 86%, respectively.

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