Profile of Students' Learning Outcomes on Chemical Bonding and an Appropiate Learning Media to Improve Students' Learning Outcomes in Vocational High School

Profil Hasil Belajar Peserta Didik pada Materi Ikatan Kimia dan Media Pembelajaran yang Tepat untuk Meningkatkan Ketuntasan Hasil Belajar Peserta Didik di SMK

Rivaldi Dwi Kurniawan, Rusly Hidayah*
Jurusan Kimia, Universitas Negeri Surabaya, Jl. Ketintang, Kota Surabaya, Indonesia

*The corresponding author: ruslyhidayah@unesa.ac.id

Abstract. This study aims to determine the profile of students' learning outcomes in Chemical Bonding material and an appropriate learning media to be applied in improving the completeness of students' learning outcomes in Vocational High School. This type of research was conducted using a preliminary research with data collection techniques in the form of a written test filled out by students, student questionnaires, and teacher interview questionnaires. The data obtained were analyzed descriptively. The study was conducted on 35 students of class XI APL 2 of Vocational High School 1 Driyorejo, Gresik. Based on the results of the written test, it was found that only 1 student succeeded in achieving the minimum completeness criteria and the classical completeness that was obtained is 2.857%. It means that the students' learning outcomes are not yet completed. Based on the student questionnaire, it was found that 82.86% of students enjoy learning while playing and 94.29% of students most often played Android-based games, but 82.86% of students never used games as a learning media. Therefore, an Android-based games is needed as a learning media to improve students' learning outcomes.

Keywords: Learning Outcomes, Games, Chemical Bonding

Abstrak. Penelitian ini bertujuan untuk mengetahui profil ketuntasan hasil belajar peserta didik pada materi Ikatan Kimia dan media pembelajaran yang tepat untuk diterapkan dalam meningkatkan ketuntasan hasil belajar peserta didik di SMK. Jenis penelitian yang dilakukan menggunakan penelitian pendahuluan dengan teknik pengumpulan data berupa tes tertulis yang diisi oleh peserta didik, angket peserta didik, dan angket wawancara guru. Data yang diperoleh dianalisis secara deskriptif. Penelitian dilakukan pada 35 peserta didik kelas XI APL 2 SMK Negeri 1 Driyorejo, Gresik. Berdasarkan hasil tes tertulis diperoleh hanya 1 peserta didik yang berhasil mencapai kriteria ketuntasan minimal dan ketuntasan klasikal yang diperoleh sebesar 2,857%. Hal ini menunjukkan bahwa hasil belajar peserta didik belum tuntas. Berdasarkan angket peserta didik diperoleh 82,86% peserta didik gemar belajar sambil bermain dan 94,29% peserta didik paling sering memainkan permainan berbantus Android, namun 82,86% peserta didik tidak pernah menggunakan permainan sebagai media pembelajaran. Oleh karena itu, diperlukan permainan berbantus Android sebagai media pembelajaran untuk meningkatkan ketuntasan hasil belajar peserta didik.

Kata kunci: Hasil Belajar, Permainan, Ikatan Kimia

1. Introduction

One of the main foundations of 21st-century learning is mastering the development of information technology. This has a good impact in life, one of which is in education because the 21st-century education paradigm emphasizes the ability of students to think critically, be able to develop knowledge in the real world, be able to master information technology and be able to communicate and collaborate. Education is a learning process so the students can develop their

potential [1]. One of the ways to develop the students' potential is through effective learning with effective media. Effective learning is learning that involves the activities of students to be able to achieve the learning goals optimally. The essence of the learning process is the communication process between the message source (teacher) and the message recipient (students). To facilitate the process of conveying messages, a learning media is needed and it must match the characteristics of the material to be conveyed. Especially during the Covid-19 pandemic, the use of learning media is important in providing educational facilities for distance learning or face-to-face learning. The use of appropriate learning media in the learning process can generate new desires and interests, generate challenges, and motivation of students to take an active role and stimulate learning activities that can have a psychological influence on students [2].

Chemistry is a branch of natural science that studies everything about matter including composition, structure, properties, and changes in matter and energy, which requires skill and reasoning because chemistry is an abstract concept that requires a media that appropriate to help students understand chemistry well [3]. It is an abstract science and includes a lot of memorization and calculation, so it makes students feel difficult to learn it. A subject in chemistry that is difficult for students to learn is Chemical Bonding. This subject requires a serious understanding of fun and effective media. One of the fun media is a game. The game can be used as a learning media when they can develop cognitive and operational abilities such as problem-solving. Cognitive abilities are related to the competence to distinguish objects, events, or stimuli, and apply the rules and solve the problems [4].

Educational games are a part of mobile learning. Mobile learning is learning that refers to the use of information and communication technology as a learning media so the students can access materials, directions, and applications related to learning anywhere and anytime. The advantages of mobile devices are the portability, can be connected to the network anytime and anywhere, more flexible in accessing learning resources, the proximity of information, and students can be actively involved [5]. By using mobile learning, teachers can help students to more easily understand the material being studied. It is because the students can link the concepts of subject matter according to their thinking so it can stimulate students to more easily understand the material [6].

The effectiveness of the game is the eligibility criteria for the game seen from the classical completeness of students. The game is said to be feasible and effective if the students' learning outcomes in learning activities reach completeness after using the game. The minimum completeness criteria are the criteria for learning completeness determined by the education unit which refers to the graduation competency standards, taking into the characteristics of students, the characteristics of subjects, and the conditions of the education unit. A class is said to have completed learning classically if it reaches ≥80% [7,8]. Based on the data in the previous year, many students had incomplete learning outcomes due to the lack of fun learning variations, which caused students to be less than optimal in mastering the material. Therefore, an effective learning media that can provide interesting and fun things is needed, so the messages or information can be conveyed, students are more active in the learning process, can learn independently, not feel bored, and can improve students' learning outcomes. It can be overcome by providing a mobile learning media that using games that can meet the needs of students and teachers, especially in a Chemical Bonding material to improve students' learning media. Based on the description above, the main objective of this study is to determine the profile of students' learning outcomes in Chemical Bonding material and to find out an appropriate learning media to be applied in improving the completeness of students' learning outcomes in Vocational High School.

2. Method

The research used descriptive research design and not to test a hypothesis. The results of the research are to determine the profile of students' learning outcomes in Chemical Bonding material and to find out an appropriate learning media to be applied in improving the completeness of

students' learning outcomes. This research was conducted in August 2020 with 35 students of class XI APL 2 of Vocational High School 1 Driyorejo, Gresik. Data collection in this research was carried out by the interview method, the test method, and the questionnaire method given to students. To get the instrument data used (1) student questionnaire sheets, (2) teacher's interview sheet which contains the teacher's profile in teaching in a class, (3) test questions sheet which aims to determine the completeness of students' learning outcomes, especially in Chemical Bonding material.

The data that has been obtained were analyzed descriptively. The purpose of this analysis is to explain the completeness of students' learning outcomes in the school through the results of the learning outcome data obtained during learning. The completeness of learning outcomes contains individual learning completeness and classical completeness. Individual learning completeness was determined with a score of ≥75 according to the minimum completeness criteria in Vocational High School 1 Driyorejo, Gresik. Classical completeness was determined with a score of ≥80% [7,8]. To determine individual completeness, the following formula is used.

$$\text{Individual completeness} = \frac{\text{the number of obtained scores}}{\text{the number of maximum scores}} \times 100\%$$

For classical completeness, it can be determined using the following formula.

$$\text{Classical completeness} = \frac{\text{the number of students who completed}}{\text{the total number of students}} \times 100\%$$

3. Results and Discussion

The results of this study aim to determine the profile of students' learning outcomes in Chemical Bonding material and to find out an appropriate learning media to be applied in improving the completeness of students' learning outcomes. Students were given a questionnaire consisting of questions about students' experiences and the learning media that used while studying Chemistry at school. The teacher also interviewed to know the teacher's profile in teaching in class, including a method and learning media that used to teach. Besides, a test was conducted by providing a test question sheet containing several questions related to Chemical Bonding material with Taxonomy Bloom level C1 until C6 to determine the completeness of students' learning outcomes.

3.1 Student Questionnaire Results

A total of 35 students of class XI APL 2 at Vocational High School 1 Driyorejo were asked to fill out a questionnaire. This questionnaire aims to find out the students' experiences and the learning media that used while studying Chemistry at school, a total of 12 questions were asked in the questionnaire whose results were presented in Table 1.

Table 1. Students Questionnaire Results

Number	Question	Total Students	Percentage
1	Is chemistry lesson difficult and boring to learn? a. Yes b. No	a. Yes = 27 Students b. No = 8 Students	a. Yes = 77,14% b. No = 22,86%
2	What chemistry subjects are difficult to study? (the answer may be more than one) a. Chemical Bonding b. Hydrocarbons c. Atomic Structure d. Electron Configuration e. Others	a. Chemical Bonding = 32 students b. Hydrocarbons = 5 students c. Atomic Structure = 7 students d. Electron Configuration = 8 students e. Others = 1 student	a. Chemical Bonding = 91,43% b. Hydrocarbons = 14,28% c. Atomic Structure = 20% d. Electron Configuration = 22,86% e. Others = 2,86%

Number	Question	Total Students	Percentage
3	What makes the subject in question 2 difficult to study? (the answers may be more than one) a. Difficult to understand b. The learning is not interesting c. Not motivated to learn chemistry d. Others	a. Difficult to understand = 33 students b. The learning is not interesting= 29 students c. Not motivated to learn chemistry = 3 students d. Others = 0 student	a. Difficult to understand = 94,28% b. The learning is not interesting = 82,86% c. Not motivated to learn chemistry = 8,57% d. Others = 0%
4	What is your learning style? a. Audio b. Visual c. Kinesthetic	a. Audio = 6 students b. Visual = 12 students c. Kinesthetic = 17 students	a. Audio = 17,14% b. Visual = 34,29% c. Kinesthetic = 48,57%
5	Do you like to play games? a. Yes b. No	a. Yes = 29 students b. No = 6 students	a. Yes = 82,86% b. No = 17,14%
6	Right now, what game do you often play? a. Traditional games b. Android games c. PC games	a. Traditional games = 2 students b. Android games = 33 students c. PC games = 0 student	a. Traditional games = 5,71% b. Android games = 94,29% c. PC games = 0%
7	What learning methods do your chemistry teacher use often? a. Lecture b. Discussion c. Assignment (working on Student Worksheet)	a. Lecture = 4 students b. Discussion = 5 students c. Assignment (working on Student Worksheet) = 26 students	a. Lecture = 11,43% b. Discussion = 14,28% c. Assignment (working on Student Worksheet) = 74,29%
8	What learning media are used in learning chemistry in the classroom? (the answers may be more than one) a. Power point b. Student books c. Whiteboard d. Student Worksheet e. Others	a. Power point = 8 students b. Student books = 26 students c. Whiteboard = 28 students d. Student Worksheet = 18 students e. Others = 1 student	a. Power point = 21,86% b. Student books = 74,28% c. Whiteboard = 80% d. Student Worksheet = 51,43% e. Others = 2,86%
9	Have you ever used games as a learning media for chemistry? a. Yes b. No	a. Yes = 6 students b. No = 29 Students	a. Yes = 17,14% b. No = 82,86%
10	Do you enjoy learning while playing?	a. Yes = 33 students b. No = 2 students	a. Yes = 94,29% b. No = 5,71%

Number	Question	Total Students	Percentage
	a. Yes b. No		
11	Do you like adventure games? a. Yes b. No	a. Yes = 31 students b. No = 4 students	a. Yes = 88,57% b. No = 11,43%
12	Do you agree if the chemistry learning process is carried out using adventure-themed game media? a. Yes b. No	a. Yes = 32 students b. No = 3 students	a. Yes = 91,43% b. No = 8,57%

Based on the data in table 1, it was found that 77.14% of students stated that chemistry lessons were difficult and boring to learn with 91.43% of students stated that the difficult material is Chemical Bonding because students are difficult to understand it with the methods and learning media which commonly used by the teacher. This is supported by 74.29% of students stated that the learning method used by the teacher was an assignment on student worksheets, 74.28% of students stated that the learning media used were the blackboard, and 82.86% of students stated that they never used games as a learning media. Meanwhile, based on the results of the questionnaire, it was known that 82.86% of students enjoyed learning while playing and 94.29% of students most often played Android-based games, especially in adventure games with a percentage of 88.57%. As many as 91.43% of students also expect that chemistry learning to used adventure-themed games. So, it is known that Android-based games are needed to meet the needs of students who enjoyed learning while playing.

3.2 Results of Interviews with Teachers

This interview aims to know the teacher's profile in teaching in class, including a method and learning media that used to teach. The teacher who was interviewed was one of the Chemistry teachers at Vocational High School 1 Driyorejo, Gresik. The teacher said that she experienced a little difficulty in the chemistry learning process, especially during the Covid-19 pandemic due to the limited available learning media. During learning, the teacher only used available learning media as much as possible and never used other learning media such as games. Therefore, the students' learning outcomes are less than expected. So, the teacher expects an effective learning media that can be used anywhere and anytime which makes it is more practical and the students do not mind always carry it, especially if the learning media is fun so it can attract students' interest and the learning is not boring anymore. To overcome this problem, mobile learning using Android-based game media is a learning media that is following the media that is needed by the teacher, because students can access it anywhere and anytime. Students should also have no objection to bring it anywhere because it is already on their smartphone. It is following the current phenomenon because right now the students are never leaving their smartphones, and with the existence of games as a learning media, students can learn as well as play.

3.3 Completeness of Students' Learning Outcomes Test Results

This test aims to determine the completeness of students' learning outcomes. Based on the data obtained, the value of the completeness of students' learning outcomes is calculated based on students' answers. Students are given 10 questions related to Chemical Bonding with a score of 10 points for each question, so the students must answer 8 questions correctly to get 80 points to achieve the minimum completeness because the minimum completeness criteria for each individual is 75. The completeness of students' learning outcomes test results was presented in Table 2.

Table 2. Completeness of Students' Learning Outcomes Test Results

Number	Name	Score	Category
1	EZF	40	Not Complete
2	FRF	50	Not Complete
3	DS	40	Not Complete
4	DNA	20	Not Complete
5	EDBF	30	Not Complete
6	IH	10	Not Complete
7	MAA	60	Not Complete
8	MNL	70	Not Complete
9	DM	40	Not Complete
10	IBNP	60	Not Complete
11	LQ	60	Not Complete
12	LZN	50	Not Complete
13	GDH	20	Not Complete
14	MJC	80	Complete
15	MA	70	Not Complete
16	GFP	70	Not Complete
17	IHK	60	Not Complete
18	DY	70	Not Complete
19	DD	60	Not Complete
20	EK	70	Not Complete
21	EBP	40	Not Complete
22	DPL	30	Not Complete
23	JIP	50	Not Complete
24	DAL	20	Not Complete
25	KP	30	Not Complete
26	LRA	40	Not Complete
27	DK	50	Not Complete
28	FM	30	Not Complete
29	FT	30	Not Complete
30	HF	60	Not Complete
31	FI	40	Not Complete
32	IBA	30	Not Complete
33	LFA	20	Not Complete
34	LPJ	20	Not Complete
35	MFL	20	Not Complete

The classical completeness obtained is as follows.

$$\text{Classical completeness} = \frac{\text{the number of students who completed}}{\text{the total number of students}} \times 100\% = \frac{1}{35} \times 100\% = 2.857\%$$

According to data from Table 2, only 1 out of 35 students can achieve the minimum completeness criteria and the classical completeness is less than 80%. So, it is known that the students' learning outcomes in XI APL 2 Vocational High School 1 Driyorejo, Gresik are still incomplete.

3.4 Discussion

From the results of the student questionnaire, teacher interview, and completeness of students' learning outcomes test. It can be seen that the students are expecting that chemistry learning to used adventure-themed games, while the teacher never used learning media such as games, and there are still many students who cannot achieve the minimum completeness

criteria. It is because of the learning media that was carried out on the Chemical Bonding material did not effective and not attract the attention of students to understand the concepts, so the concepts that learned by students were not included in the students' long term memory and they were easily forgotten by students which are following the information processing theory. Information processing theory is a cognitive theory of learning that explains the processing, storage, and recall of knowledge from the brain showed as in Figure 1 [9].
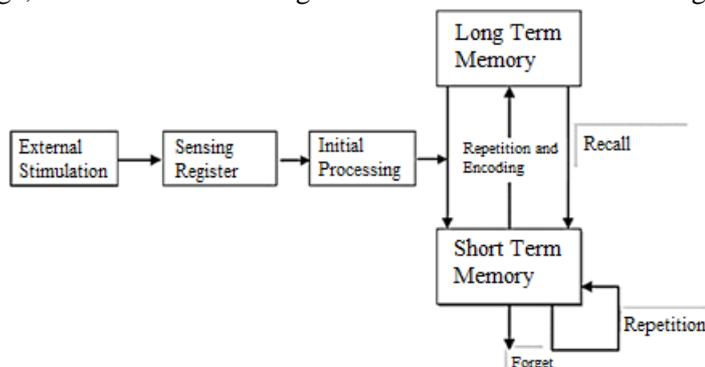

Figure 1 Order of Information Processing

There are two forms of information stored in long-term memory, namely visual and verbal. Visually or verbally coded information is better remembered than information encoded in only one of the two ways. For example, someone can remember names well if they can connect them with faces [9].

To help students more easily understand the concept of Chemical Bonding, a fun learning media is needed so the students can code the information visually or verbally, namely a mobile learning using a game media. Games that are used in learning are usually called educational games, in which the activities are very fun and using educational methods or tools. It is specifically designed to teach players a particular lesson, namely for understanding and developing concepts, training students' abilities, and motivating students [10,11]. Besides, it can require students to apply their ideas and knowledge directly in-game activities related to the subject matter. The theory which is used as the basic concept and important in the games refers to constructivism theory. Constructivism theory is a theory which states that students must personally formulate and apply complex information, check new information then compared it to old information, and improve the information if they are no longer appropriate [12].

Mobile learning using game media can improve the students' learning outcome and it is according to the needs of students and teachers as a learning media to help students review and study chemistry in a fun way in achieving learning goals [13,14,15]. This is because game software is a type of application that can not only be used for entertainment, but also for serious purposes that can be applied to different domains such as education, business, and health. When students play Android-based games, it is easier for students to absorb what is contained in the game and students are more enthusiastic about learning. The interactions carried out by students with visual material and providing opportunities for students to learn while having fun in games contribute to effective learning. There are significant differences in improving student learning outcomes using ICT (Information and Communications Technology) media rather than using conventional learning [16,17,18,19]. Like the research conducted by Putra, Wijayanti, and Mahatmanti (2017) which state that the students can achieve the completeness of students' learning outcomes with a 100% classical completeness percentage after using games as a learning media. This is under Nurhalimah, Suhartono, and Cahyana's research (2017) which states that Android-based games are feasible and effective to be applied as a chemistry learning media where students get 100% classical completeness.

Other researchers also conducted a study to improve students' learning outcomes and stated that using the game as a learning media obtained the positive influence on the learning process with classical completeness of the experimental class was greater than the control class. The increase in the completeness of students' learning outcomes indicates that the learning media that used are effective learning media [13,20,21,22,23,24,25]. So, It can be concluded that the mobile learning using an Android-based game is a learning media that can improve students' learning outcomes.

4. Conclusion

Based on the results and discussion, it was found that the students' learning outcome in XI APL 2 Vocational High School 1 Driyorejo, Gresik has not been achieved. This is based on student test results and questionnaires that have been answered by students as well as the results of interviews with chemistry teachers which showed that the learning media that were used have not been able to help students achieve completeness of students' learning outcomes.

Student completeness is still not achieved, it was found that the individual completeness of class XI APL 2 is lower than 75 and classical completeness is 2.857%. So, a learning media that can improve students' learning outcomes including individual completeness and classical completeness is needed. It can be accomplished using an Android-based game as a learning media.

For suggestions in research that is research can be carried out in other classes to determine the completeness of students' learning outcomes and the appropriate learning media to be applied in improving the completeness of students' learning outcomes. This research can also be done in other materials to determine the completeness of students' learning outcomes, not only Chemical Bonding material.

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