The Development of Learning Devices Using Advance Organizer Model to Improve the Concept Understanding of the Students in Ion and Covalent Bond Materials

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Abstract- This research aimed to produce learning media based advance organizer model which is valid, practical and effective to improve understanding students' concept in material of ion bond and covalent bond. This research was conducted at Senior High school of Sport East Java in class X in odd semester. This development research used development model of Dick and Carey with the trial using One-Group Pretest-Postest Design.

This research was done in three stages, (1) preparation phase which was to develop learning media based advance organizer model, (2) validation phase of learning media and (3) implementation phase of learning media in class. Instruments used in this research were learning media validation sheet, observational sheet of learning process implementation, observational sheet of students' activity, observational sheet of readability of textbooks and LKS, test sheet of students' concept understanding, and questioner sheet of students' responses.

The findings of the research as follow: 1) learning device based advance organizer model that had been developed was revealed valid and proper to use in learning activity; 2) learning device was reviewed from RPP implementation showed in good category; 3) students' activity during learning device implementation had been described suitability with advance organizer learning model. Many relevant activities had enhancement; 4) developed legibility of textbook and student worksheet were in good category; 5) students' learning concept after following Chemistry subject based advance organizer model in ion bond and covalent bond material had effective improvement; 6) students' response after following learning activity could be categorized good, most students were interested to learning activity. Based on the findings, it can be concluded that chemistry learning media based Advance Organizer model in material of ion bond and covalent bond is valid, practical and effective so it is proper to use for students' concept understanding.

Index Terms- Advance organizer model, Concept Understanding, Material of Ion and covalent bonds.

I. INTRODUCTION

Chemistry can be found in all aspects of life, culture and the human environment. The scope includes air, food, drinking water, clothing, shelter, transportation and fuel supplies, and living things other than humans. Chemistry is a science that describes the material, its properties, changes that occur, and changes in energy that accompany the process. The material encompasses everything real, starting from the body and various things in daily human life, to the massive object in the universe. Some parties assume that chemistry is the center of natural science. Chemistry rests on mathematics and physics, and then based on the knowledge of living things, namely biology and medicine, to fully understand the system of living things, it must first understand the chemical reactions and their effects that occur in the body living things. Chemical compounds that exist in the body are very influential on humans, even against their thoughts and emotions.

In Indonesia, students' interest in studying chemistry from 2007 to 2011 showed a decline. 2011 TIMSS (Trends in International Mathematics and Science Study) study showed that the average score of Indonesian students in the chemical domain was 378, 30 points lower than the 2007 achievement score, at 408, while on the other hand literary interest in Indonesian students from the year 2006 to 2011 showed an increase. The 2011 results of PIRLS (Progress in International Reading Literacy Study), showed that the average score of Indonesian students in reading the literature was 428, 24 points higher than the 2006 achievement score of 405.

This fact is contrary to Ausubel's (1963) opinion of meaningful learning. Meaningful learning occurs when students connect new material into their cognitive structure, and the material will be very meaningful to them because it has a link that connected with the structure of knowledge that they already have.

Students' minds that have been prepared to receive and process information, learning through listening, watching and reading will be able to develop the ability of students to be more active in processing information (Joice, 2009). The form of preparation is an effort to

improve the stability and clarity of the cognitive structure of students before getting a new subject matter. Increasing literacy interest in Indonesian students from 2006 to 2011, as shown by PIRLS research results should also be followed by an increase in their chemical learning outcomes.

The advance organizer model is a learning model designed to strengthen the cognitive structure of students, students' knowledge of specific lessons and how to manage, clarify and maintain that knowledge well (Ausubel, 1963). Several studies on advanced organizer models showed satisfactory results, one of which concluded that there were significant differences between conceptual understanding, and critical thinking skills of students using advanced organizer learning models with conceptual understanding, and critical thinking skills of students using direct teaching models (Budiartawan, Mursalin and Yunginger, 2013).

The chemical bonding material is one of the chemical materials that learned in class X high school, in the material of chemical bonds one of the students is required to be able to compare the processes of ion bond formation and covalent bonds. The concepts in ion bond material and covalent bonds must be challenging to understand if students only listen to explanations and memorize a verbal definition without understanding the contents. Therefore, advanced organizer learning models are very suitable to be applied in this learning material.

Based on data from daily test results of class X students, East Java Sports State High School, on chemistry subject matter, the overall average of class X, which is equal to 64.82 on a scale of 0 - 100 or equivalent to 2.59 on a scale of 1 - 4. The average has not reached the standard competency knowledge completeness score according to Article 9 paragraph 2 of Permendikbud No. 104 of 2014 amounting to 2.67 which is equivalent to 66.75 on a scale of 0 - 100 (Siamhady, 2018). The data shows that chemical bonding material is one of the chemical materials that are difficult to understand for students of East Java Sports High School.

Based on the results of interviews with chemistry teachers, information was obtained that the teaching and learning activities that carried out at East Java Sports State High School are conducted after the students' regular training in their respective sports branches, so that students' attention when exhausted during the teaching and learning process was very low in all subject including chemistry subject.

Learning materials are external factors of the students who can strengthen internal motivation to learn. The one way of learning that can influence learning activities is to include learning material in the activity. Learning materials are entirely designed, meaning that there are elements of media and adequate learning resources that will influence the learning atmosphere so that the learning process that occurs in students becomes more optimal. Learning materials in the context of learning is one component that must exist since learning materials are a component that must be studied, examined, studied and made into material that will be mastered by students and at the same time can provide guidance to learn it. Learning is carried out without using learning materials, so the learning will not produce anything. The introduction material presented by the teacher in the form of an advance organizer is one form of learning material.

Learning materials in the form of learning devices have been provided by the government in the form of student books and teacher books. However, the learning devices are still too general, in their application, the teacher must independently develop the device according to the conditions of each school, including a learning device plan (RPP)), quality teaching materials and student worksheets (LKS) so that they can achieve learning objectives that are in accordance with the basic competencies in the 2013 curriculum.

Based on this background, the authors are motivated to conduct research aimed at producing learning devices using a valid, practical, and effective advance organizer model to improve students' conceptual understanding of ionic bonding and covalent bonds.

II. METHODS

The test was carried out using the design of the One-Group Pretest-Posttest Design since the test conducted in one group without a comparison group. The design of this study was used to obtain input in the form of recording about the first test score (pretest) and the final test score (posttest) to see completeness and learning outcomes.

2.1 Research Subject

The subject of this study was an advanced organizer chemistry learning device which was tested on class X of East Java State Sports Senior High School.

2.2 Research Instruments

The instruments used to collect data in this experiment are as follows:

2.2.1 Learning Device Validation Sheet

This instrument is used by asking the experts to evaluate learning devices from aspects of content, construction and language. Based on the feedback, the learning device is modified so that it is more adequate, valid, effective and can be used properly. The validation sheet used to measure the feasibility of learning devices includes:

a. Student Learning Material validation sheet
b. Validation sheet of Learning Implementation Plan
c. Validation Sheet for Student Worksheets
d. Validation Sheet for Student Concept Understanding Tests

2.2.2 Observation Sheet for the Implementation of the Learning Process

This instrument or observation sheet is used to observe the feasibility of each step in the learning process made by the researcher and observed by the observer. This instrument contains the steps that must be taken by the teacher in the implementation of learning.

2.2.3 Student Activity Observation Sheet

Instruments or observation sheets of student activities in teaching and learning activities include the activities of students during the teaching and learning activities. Observations are made from the beginning of learning till the completion.

2.2.4 Readability Sheet for Student Learning Materials and LKS

Readability sheets are used to determine the level of readability of Teaching Materials and LKS. Readability sheet instrument in the form of a questionnaire.

2.2.5 Student Concept Understanding Test Sheet

This assessment sheet was developed by researchers and used to obtain information or data on the extent to which students understand concepts that have been mastered. This assessment sheet consists of 25 items consisting of objective questions to understand students' conceptual understanding.

2.2.6 Student Response Questionnaire Sheet

The student response questionnaire sheet developed by this researcher was used to obtain information or data on student responses to learning using an advance organizer learning model. The questionnaire responses students write instructions and requests to students to give their responses in their own opinion without being influenced by others, student responses consist of very agree, agree, disagree, and strongly disagree.

2.3 Data Collection Techniques

The techniques used to collect the data are:

2.3.1 Device Validation

The development of teaching materials and worksheets is a requirement of this study. Before the trial was conducted, the learning devices developed first were validated by experts or validators using the RPP validation instrument, Student Learning Materials, Student Worksheets and Student Concept Understanding Test Sheets. Data from the learning device validation results are collected after the validator provides an assessment of the learning device on the validation sheet.

2.3.2 Test Giving

The test given is done twice, namely before the learning process begins (pretest) to determine the level of readiness of students in learning the concept of ion bonds and covalent bonds, and after the learning process (posttest) to determine the level of achievement of learning indicators.

2.3.3 *Observation*

The data collection techniques used in the research development of this learning device are as follows:

a. Observation
   Observations were made to collect research data about the feasibility of RPP, student activities during the learning process, and the performance of understanding students' concepts. Observers are two observers who have been given direction first so that they can use the observation sheet correctly and precisely.
b. Distribution of Questionnaires
   The distribution of questionnaires aims to collect research data about student responses to the learning process that has been conducted. The questionnaire is filled with honesty and objectively without pressures from any party.

2.4 Data Analysis Technique

The data analysis technique to answer the proposed research questions is by descriptive analysis techniques. This technique describes the activities of teachers and students during the learning process takes place with an advance organizer model to improve students' conceptual understanding, which includes Analysis of Learning Device Validation Results, Analysis of Observation of RPP Implementation, Analysis of Student Response to Learning Activities, Observation Analysis of Student Activities, Analysis of Concept Understanding Students.

III. RESULT AND DISCUSSION

3.1 Learning Device Validation

Assessment given by validator in media developed was proper. It meant that all learning tool developed had been worth and they could be used with some revision. Learning media developed referred to 2013 curriculum. They are RPP, BAS, LKS and undestanding test question of students/ concept.

Table 1: Results of Learning Device Validation

No.	Device	Score	Category
1	Lesson Plan (RPP)	4	Very valid
2	Student Learning Materials (BAS)	3	Valid

No.	Device	Score	Category
3	Student Activity Sheet (LKS)	4	Very valid
4	Students' Concept Understanding Test Questions	4	Very valid

3.2 Implementation of Lesson Plan (RPP)

Based on data analysis of RPP implementation, it can be seen that the result of learning implementation using learning model of Advance organizers at the second meeting were higher than the first meeting. Nevertheless, learning in both meetings showed that learning activities have been conducted well. Thus all the steps listed in the learning tool which have been developed can be carried out very well by teachers and students and play an active role in the learning process.

Average value of RPP implementation in introducing aspect was the same between firs and meetings. On the other side, the average value of RPP implementation in the core and concluding aspects was achieved higher in the first meeting than the second meeting, whereas in the management aspect of the classroom atmosphere the average value of lesson plans was achieved higher than the second meeting. This showed that the delivery of implemented organizers was as good as the first and second meetings, whereas in terms of material delivery or the task of learning and strengthening cognitive processing, the first meeting was conducted better than the second meeting. This occurred because the energy of the instructor/researcher at the second meeting was more drained in the aspect of managing the classroom atmosphere for conducive learning, which when the second meeting focused on group learning activities, evidenced by the average value of managing the classroom atmosphere in the second meeting higher than the first meeting.

Table 2: Implementation of Lesson Plan (RPP)

No.	Observed Aspect	Mode
	Introduction	
Observation		
Clarifying the learning objectives		
1.	Greetings and greet the students.	4
2.	Deliver the learning objectives.	4
3.	Distributing the teaching material books and student worksheets to students or instructing them to prepare teaching material books and worksheets at each student's desk.	4
Display the graphic organizer and present it to students		
1.	Presenting the organizer to students	4
2.	Mention the concepts in the organizer and the specific or essential characteristics of each of these concepts.	4
3.	Provide examples of these concepts.	3
4.	Explain the connection between these concepts.	4
5.	Repeat the explanation of new terms or special terms in the organizer.	4
Questioning		
1.	Ask some of the students to recall by verbally mentioning the students' previous knowledge and experience relevant to the organizer.	3
	Main	
Collecting data (experimenting)		
1.	Presenting material through lectures, discussions, films, or reading.	4
2.	Provide logical and clear submission numbering in presenting learning material.	4
No.	**Observed Aspect**	**Modus**
3.	Explain the connection between the detailed material presented with the organizer.	4
Associating		
Using the principles of integrative reconciliation		
1.	Remind students about all the main ideas of learning material.	4
2.	Ask students to summarize learning material.	4
3.	Repeating the definitions of concepts.	4

No.	Observed Aspect	Mode
4.	Give students the task to write down differences that exist between concepts in the material that has been presented.	4
Organize the active reception learning sessions		
1.	Ask students to write additional examples of concepts in the learning material.	4
Closing		
Communicating		
1.	Ask students to restate learning material in groups in front of the class by using their language.	4
Generating a critical approach to learning material		
1.	Ask students to restate all the main ideas from the learning material that students note, in groups in front of the class, using the students' language.	4
Clarification		
1.	Ask each group of students to ask, and the question is answered by the teacher.	4
Classroom Management		
No.	**Observed Aspect**	**Modus**
1.	The suitability of KBM with learning objectives	4
2.	Management of teaching and learning time used in accordance with the RPP	3
3.	KBM tends to be student-centred	3
4.	KBM tends to be teacher-centred	3

3.3 Student Activity

Student's activity in this research was set of activities conducted by students during learning activity. Based on the results of data analysis, the dominant activity of students that occurred in the class at meeting 1 was to read or search for teaching material information according to the content, which was an average of 7.5. Whereas the dominant activity of students that occurs in class 2 was discussing assignments/questions in LKS, which are with an average of 6.

There were 2 activities centered in students that showed significance enhancement from metting 1 to meeting 2, namely activity 5) Record the observational data according to the LKS and 6) Discuss the tasks/questions in the LKS. These activities indicated an increase in the first to second meetings, while the activities conducted by the teacher indicate a decrease in each meeting. This showed that learning was more student-centered and the teacher only played role as a facilitator.

Table 3: Student Activity

No.	Activity	First Meeting		Second Meeting	
		Mean	Pa	Mean	Pa
1	a1	6	83,33	4,5	88,89
2	a2	7,5	93,33	3,5	85,71
3	a3	2	100,00	2	100,00
4	a4	3,5	85,71	2,5	80,00
5	a5	2	100,00	3,5	85,71
6	a6	4,5	88,89	6	83,33
7	a7	2	100,00	2	100,00
8	a8	3	100,00	3	100,00
9	a9	4,5	88,89	2,5	80,00
10	a10	2,5	80,00	2,5	80,00

3.4 Readability of Student Teaching Materials (BAS) and Student Activity Sheets (LKS)

Based on result of data analysis, most students considered that BAS and LKS developed by researcher were interested either in content or presentation. The level of understanding of students in understanding questions at BAS and LKS was also high. The illustrations/images used by researchers also make it easier for students to understand these learning model. The difficulty of students in understanding the description in BAS and the presence or absence of questions in LKS that were not understood obtained the lowest score of 63% and 67%. The reason for the low percentage was because students were not fully familiar with the terms ionic and covalent bonding material used in BAS. Thus, for future improvement, researchers will provide language that is easier for students to understand. Based on these results, it can be concluded that the level of readability of BAS and LKS is good (strong) because it is worth $\geq 60\%$.

Factor affecting this legibility level was the interest of students in the model given in terms of the appearance of the layout and the image. This can be seen from the percentage of students' interest in the appearance of BAS and LKS with a high score of 100%. According to Nieven (in Nufus, 2013), it was concluded that BAS developed both in content and appearance was very interesting for

students even though there were some students who felt a little difficulty. The given image or illustration could clarify the description of BAS readability in general so that it was categorized as good and suitable for use in learning.

Table 4: Readability of Student Textbooks (BAS)

No.	Question Description	Percentage of Student Answer Options (%)	
1	Is the content of this Teaching Material interesting?	Interesting	Not Interesting
		80%	**20%**
2	Is the appearance of this Teaching Material interesting?	Interesting	Not Interesting
		100%	**0%**
3	Is the description/explanation of activities in this Teaching Material difficult?	Hard	Easy
		37%	**63%**
4	Are the illustrations/images in this Teaching Material easy to understand and clarify the description?	Easy	Hard
		67%	**33%**
5	Are there any questions in this Teaching Material that you don't understand?	Yes	No
		30%	**70%**

Table 5: Readability of Student Worksheets (LKS)

No.	Question Description	Percentage of Student Answer Options (%)	
1	Are the contents of this LKS interesting?	Interesting	Not Interesting
		87%	**13%**
2	Is the appearance of this LKS interesting?	Interesting	Not Interesting
		100%	**0%**
3	Is the description/explanation of activities in this LKS difficult?	Hard	Easy
		20%	**80%**
4	Are the illustrations/drawings on this LKS easy to understand and clarify the description?	Easy	Hard
		93%	**7%**
5	Are there questions on this LKS that you don't understand?	Yes	No
		33%	**67%**

3.5 Student Concept Understanding Test

Test question of valid concept leaning was used by reseacher in measuring understanding level of student concept. The initial activity conducted by the researcher was to conduct a preliminary test (pretest) on students who would be given treatment. The average pretest score of students 'understanding of the concept of ion bonding and covalent bont as shown in the Table is 41.33 with a low category, while the average posttest score of students' conceptual comprehension level was 89.07 with a high category. The value of increasing the percentage of students 'understanding of concepts during the posttest showed that the learning conducted by the teacher goes well and effectively increases students' conceptual understanding.

Table 6: Students' Concept Understanding Test Results

No.	**Student Initials**	**Pretest**	**Posttest**
		N	**N**
1	S 01	40,00	92,00
2	S 02	52,00	92,00
3	S 03	44,00	96,00
4	S 04	52,00	92,00
5	S 05	48,00	80,00
6	S 06	44,00	92,00
7	S 07	40,00	88,00
8	S 08	48,00	84,00
9	S 09	36,00	88,00
10	S 10	32,00	84,00
11	S 11	36,00	80,00
12	S 12	48,00	92,00
13	S 13	36,00	84,00

No.	Student Initials	Pretest	Posttest
		N	N
14	S 14	32,00	84,00
15	S 15	44,00	96,00
16	S 16	56,00	92,00
17	S 17	36,00	88,00
18	S 18	40,00	88,00
19	S 19	32,00	92,00
20	S 20	64,00	96,00
21	S 21	16,00	88,00
22	S 22	36,00	88,00
23	S.23	40,00	84,00
24	S.24	40,00	96,00
25	S.25	44,00	88,00
26	S.26	56,00	84,00
27	S.27	52,00	88,00
28	S.28	52,00	88,00
29	S.29	24,00	92,00
30	S.30	20,00	96,00
Mean		**41,33**	**89,07**

3.6 *Students' Respond*

Based on analysis result of student's respond toward the development of learning model (including: teaching material and student activity sheets) was obtained average of 88.67% students considered interesting and 93.33% of students respond to the novelty in other words students responded positively to the learning process that had been conducted (Riduwan, 2010), while the results of the analysis of student responded to the learning components obtained results of 95.33% of students responded interested in it (students respond positively) with very strong criteria (Riduwan, 2010). Based on the results of the analysis, it can be seen that students' responses to the development of media and the implementation of learning during the trial were positive in the very strong category. This meant that students supported, felt happy, and were interested in learning by applying learning based on an advanced organizer model.

Table 7: Students' Respond

No	Description of Question	Assessment/Opinion	
1	**What is your opinion toward following components:**	**Interested**	**Not Interested**
		P (%)	**P (%)**
	a. Material	90,00	10,00
	b. Teaching Material (learning media)	93,33	6,67
	c. Student Activity Sheets (LKS)	76,67	23,33
	d. Learning atmosphere	93,33	6,67
	e. The way teacher teaches	90,00	10,00
	Average	88,67	11,33
2	**Have you just known about the following components:**	**New**	**Have known**
		P (%)	**P (%)**
	a. Material	90,00	10,00
	b. Teaching material (learning media)	93,33	6,67
	c. Student Activity Sheets (LKS)	90,00	10,00
	d. Learning atmosphere	93,33	6,67
	e. The way teacher teaches	90,00	10,00
	rata-rata	91,33	8,67
3	**Can you understand the following components easily:**	**Easy**	**Difficult**
		P (%)	**P (%)**
	a. Language in bool	96,67	3,33

No	Description of Question	Assessment/Opinion	
	b. Material/book content	96,67	3,33
	c. Exercise	93,33	6,67
	d. Student activity sheets	96,67	3,33
	e. Guide of practice in LKS	93,33	6,67
	Average	95,33	4,67
4	**What is your opinion about following statements:**	**Clear**	**Unclear**
		P (%)	**P (%)**
	a. Explanation of teacher during teaching and learning activity	90,00	10,00
	b. Teacher's guidance when you find concept through trial.	90,00	10,00
	c. Teacher's guidance when you finish LKS	96,67	3,33
	Average	92,22	7,78
5	**What do you think about the way teacher uses learning model of Advance Organizer:**	**Good**	**Not Good**
		P (%)	**P (%)**
	a. Classifying learning objectives	93,33	6,67
	b. Identifying organizer concepts	90,00	10,00
	c. Presenting organizer context	93,33	6,67
	d. Encouraging the awareness of knowledge and students' experience	90,00	10,00
	e. Presenting material	96,67	3,33
	f. Making logic and clear material order	93,33	6,67
	g. Using integrative reconciliation principles	100,00	0
	h. Suggesting active reception learning	93,33	6,67
	i. Arising critical approach in learning material	93,33	6,67
	j. Clarifying	90,00	10,00
	Interview	93,33	6,67
6	**What do you think if:**	**Agree**	**Disagree**
		P (%)	**P (%)**
	a. Further chemical subject used learning like this way?	90,00	10,00
	b. Other subjects are taught as this learning?	96,67	3,33
	rata-rata	93,33	6,67
7	**Do you feel easy to:**	**Easy**	**Difficult**
		P (%)	**P (%)**
	a. Answer test question concept knowledge ?	96,67	3,33

IV. CONCLUSION AND SUGGESTION

4.1 Conclusion

Based on the result of analysis, discussion and findings in research, it can be concluded that learning model using advanced organizer models on ion bond material and covalent bonds are valid, practical, and effective. Thus, it is feasible to be used to improve students' conceptual understanding.

4.2 Suggestion

Based on suggestions which can be revealed by researcher according to research conducted are as follow:

a. Teacher should be able to manage time during learning because high school students of sport are athletes who prior to teaching and learning activities always practice exercise that consumes stamina. This can be dealt with by taking into account the time at the presentation and allocating more time to group discussion activities which require student activity.
b. Division of BAS, LKS, and groups should be conducted before the implementation of learning activities. It is to make it easier for students to learn aspects to be condjucted such as the scientific approach used during learning activities.
c. Students need to be given more time in understanding the organizer because students have just known about the organizer.

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