



Development of Student Worksheets with Discovery Learning Models Based on Augmented Reality in Chemical Bonding Materials to Increase Learning Motivation and Learning Outcomes

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Abstract: This research aims to: (1) produce student worksheets with an augmented reality-based discovery learning model on chemical bond material that is appropriate for increasing student motivation and learning outcomes; (2) determine the effectiveness of Student Worksheets with augmented reality-based discovery learning models on chemical bond material in increasing student motivation and learning outcomes. This development research uses a 4D development model including the Define, Design, Development and Disseminate stages. The trial was carried out on Grade X Science students at SMA Sejahtera 1 Depok with a quasi-experimental design, nonequivalent control group design model. The research instruments used were validation sheets, learning motivation questionnaires and learning outcomes questions. The research results show that: (1) student worksheets with augmented reality based discovery learning model on chemical bonding material that has been developed has very decent quality, which can be proven by the results of the average validation value by material experts of 3.926, media experts of 3.969 and student responses of 3.93; (2) student worksheets with a discovery learning model based on augmented reality is effective in increasing student motivation and learning outcomes with the MANOVA test which obtained a significance value of 0.000 and had an effective contribution of 23.3%.

Keywords: Augmented Reality; Chemical Bonds; Discovery Learning; Student Worksheets

Introduction

Learning is an activity carried out with the aim of gaining knowledge, mastering certain abilities, and forming students' attitudes. Learning success can be recognized from changes in student behavior and learning outcomes (Puspitarini & Hanif, 2019). The learning process currently used should be in accordance with the essence of the 2013 curriculum which prioritizes student-centered learning (Saefuddin & Berdiati, 2014). The implementation of the 2013 Curriculum is expected to produce productive, creative, innovative and affective human resources, through strengthening attitudes, knowledge and skills competencies (Setiadi, 2016).

Teachers have a very important role in overcoming low student learning motivation, teachers must be able to arouse students' learning motivation to be active in learning. High learning motivation can be seen from student behavior when there is student involvement in the learning process, students have feelings of joy and enthusiasm in learning so that they can increase learning activities which will provide better learning outcomes (Saefuddin & Berdiati, 2014). Motivation can improve learning outcomes because students are able to achieve their goals which can improve student performance. In education, motivation also influences student success (Bakar, 2014). Success will be achieved if students have the will and encouragement to always learn, learning

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will take place more effectively if students have motivation to learn. One way for students to have motivation in learning is by using interactive multimedia in learning (Emda, 2017). Learning using interesting interactive multimedia can improve aspects of understanding the concept of the material and can increase student motivation in the learning process (Imamah, 2012).

The role of technology in the field of education consists of four things, namely as part of the curriculum, as an instructional delivery system, as an instructional aid and also as a tool to improve the learning process. The use of technology can help students understand and retain concepts better (Raja & Nagasubramani, 2018). In the learning process, using media can help teachers to create an effective learning atmosphere (Yusuf, Amin, & Nugrahaningsih, 2017). Chemical bonding material has abstract characteristics but so far it has not been taught using technology, even though to teach abstract material it will be easier to understand and look more real if you use technology with visualization. Chemical bonding material needs to be presented in a more concrete form, for example using student worksheets with a learning model accompanied by technology. Student worksheets are teaching materials in the form of sheets containing material, summaries and instructions that students must work on (Syafitri & Tressyalina, 2020). One of the student worksheets with technology is in the form of student worksheets with discovery learning models based on augmented reality. This is supported by research using student worksheets with a discovery learning model which reveals that students have a positive influence on the learning process, students experience increased learning motivation and improved student learning outcomes (Saridewi, Suryadi, & Hikmah, 2017). Other research reveals that learning tools developed based on discovery learning with the SAVI approach assisted by GeoGebra (DLSG) meet the requirements of being valid, practical, and effective for increasing MCS and student learning motivation (Perawansa, Minarni, & Surya, 2019). Other research also reveals that the application of student worksheets in the learning process can improve metacognitive abilities and student learning outcomes (Junina, Halim, & Mahidin, 2020).

Augmented reality provides a new way to interact with the real world and can create experiences that would not be possible in the real world. This type of learning experience can encourage thinking skills and increase conceptual understanding of phenomena that are invisible or difficult to observe and correct misconceptions that occur. Augmented reality overcomes frequently encountered learning difficulties by visualizing unobservable phenomena. The interaction features presented by augmented reality can encourage students to engage in learning activities and

can increase student learning motivation. Augmented reality provides a highly interactive experience and can produce authentic learning activities, interactivity, and a high level of realism (Khan, Johnston, & Ophoff, 2019). Some of these augmented reality applications have been used in previous research such as testing the impact of enhanced science textbooks for use by students in junior high schools in Malaysia, testing the use of augmented reality-based animation learning systems for natural science inquiry activities for fourth grade students in Taiwan (Chiang, Yang, & Hwang, 2014). Another augmented reality application in testing the use of laboratory manuals enhanced by augmented reality in science laboratories among first year students in Turkey. This study examined the impact of the Anatomy 4D mobile application on the learning motivation of undergraduate Health Sciences students at UCT (Akcayır, Akcayır, Pektaş, & Ocak, 2016).

After researchers carried out direct observations at SMA Sejahtera 1 Depok, it was seen that the implementation of the 2013 curriculum in this school regarding chemistry learning was still teacher-centered and students were less active in the learning process due to low student motivation to learn, which had an impact on student learning outcomes. This school still uses student worksheets which do not use learning models or implement them with technology. Some teachers in schools experience difficulties in delivering and presenting material due to the lack of use of learning media in the learning process, because this has not been implemented, resulting in student motivation and learning outcomes being low. This research aims to produce student worksheets with an augmented reality-based discovery learning model on chemical bond material that is suitable for increasing student motivation and learning outcomes and to determine the effectiveness of Student Worksheets with an augmented reality-based Discovery Learning model on chemical bond material in increasing motivation and results. student learning. This research is very useful so that students can have experience of augmented reality technology and students can also know the 3D shape of molecules and the bonds that are formed so that student motivation and learning outcomes can increase.

Method

This research is Research and Development (R&D), namely a research method with the aim of producing certain products and testing the feasibility of these products. Research and Development also means that in a new product, there is investigation or improvement. Research can be defined as data and information that is systematically collected and advances knowledge in any field in the form of analysis. Research is conducted on the application of systematic methods to find answers to

intellectual and practical questions (Ebhotu & Williams, 2014). The product development in this research is a student worksheet with discovery learning models based on augmented reality. The material of this product is chemical bonds. The development model used adheres to the Four-D (4D) Model developed by

Thiagarajan. The stages of 4D development are the definition stage, design stage, development stage, disseminate stage (Thiagarajan, 1974). The following is the flowchart of the student worksheets development procedure:

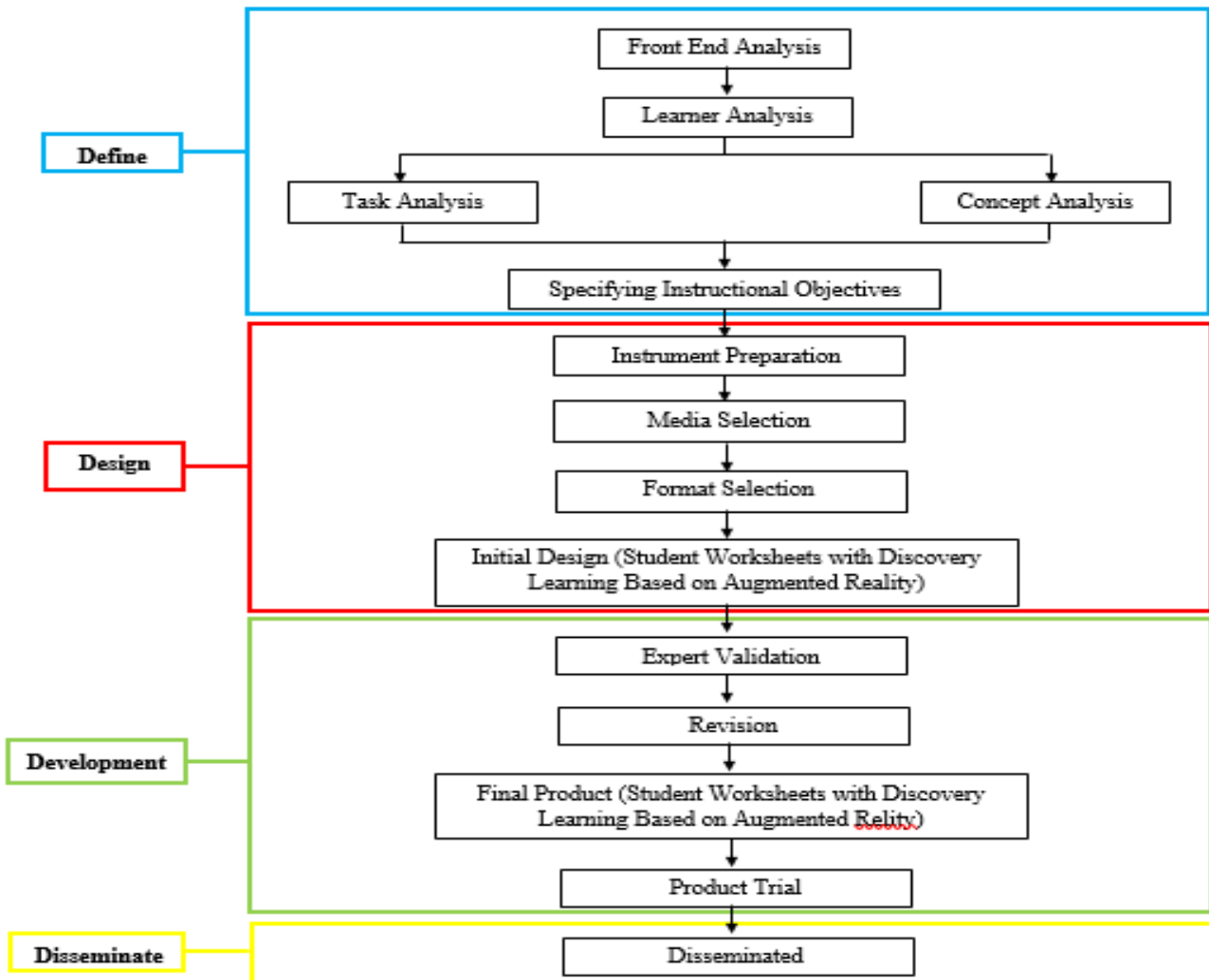


Figure 1. Development flowchart with 4D model

The criteria for the population in this study were to have the same sub-district, have a minimum of 3 science majors, be accredited A and have a minimum number of students in each class of 30. Based on these criteria, five schools were obtained that met the criteria, so 20% of the five schools were one school, namely SMA Sejahtera 1 Depok, using a sample of two classes X Science as the experimental class and two classes X Science as the control class. Sampling used a cluster random sampling technique. According to Sugiyono (2013), cluster random sampling is taking regional sample members which is used to determine the sample if the object to be studied or the data source is broad, for example residents from a city or district. A large sample size can

show significant differences (Bakker, Cai, English, Kaiser, & Mesa, 2019). Data collection techniques used in this research include tests, questionnaires and documentation. The test technique used to measure student learning outcomes consists of 26 multiple choice questions, while the learning motivation questionnaire consists of 30 statements. Before being used in trials, the instrument is validated by a validator first. The student worksheets that has been developed is validated by material experts and media experts and given responses by students. Data were analyzed using the MANOVA test. The following is the flowchart of the design of the trial implementation:

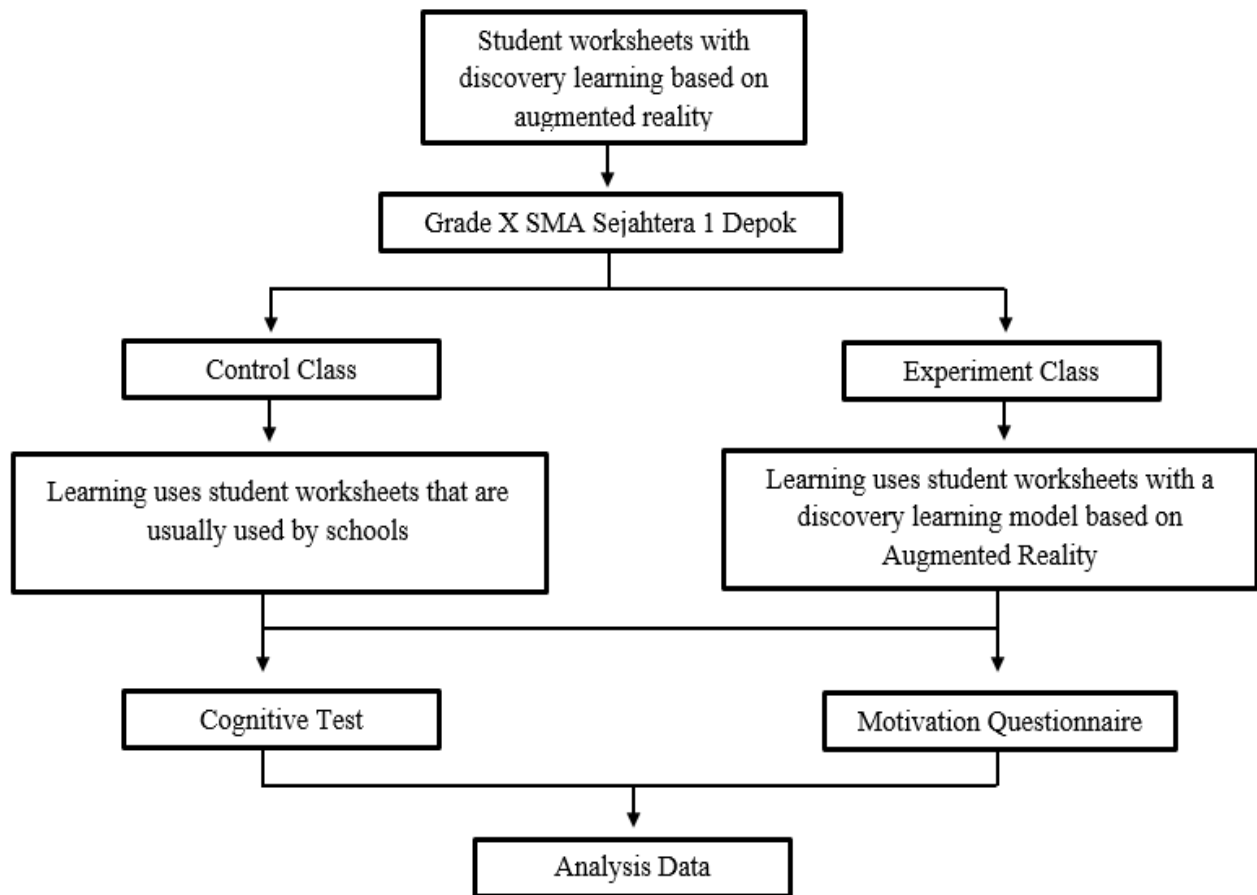


Figure 2. Design of trial implementation

In carrying out this research, for the experimental group learning was carried out using student worksheets with discovery learning models based on augmented reality on chemical bond material and for the control group learning was carried out using chemical bond student worksheets which is commonly used in schools. The following is a quasi-experimental design with a nonequivalent control group design model:

Table 1. Nonequivalent Control Group Design

Class	Pretest	Treatment	Posttest
Experiment	O ₁	X	O ₂
Control	O ₃		O ₄

(Sugiyono, 2010).

Description:

- O₁ = Experimental group before treatment
- O₂ = Experimental group after treatment
- O₃ = Control group before any treatment
- O₄ = Control group that was not treated
- X = Treatment (use of student worksheets with discovery learning models based on augmented reality)

Before carrying out field trials, the student worksheets with discovery learning based on augmented reality was validated first by material experts and media experts, this aims to obtain the

suitability of the student worksheets data. In carrying out field trials, pretests and posttests are held before and after the learning process takes place. This aims to obtain data and information related to student motivation and learning outcomes. The data obtained by experts and students is averaged and then converted into qualitative scores on scale 4. The conversion of scores into scores on scale 4 is as follows.

Table 2. Conversion of Scores into Four Scale Values

Formula	Score Range	Value	Categories
$X \geq \bar{X}_i + 1 S_{Bi}$	$X \geq 3$	A	Very decent/ Very good
$\bar{X}_i + 1 S_{Bi} \geq (X_i - 1) S_{Bi}$	$3 > X \geq 2,50$	B	Decent/Good
$X_i > X \geq (\bar{X}_i - 1) S_{Bi}$	$2,50 > X \geq 2$	C	Decent enough/Good enough
$X \leq (\bar{X}_i - 1) S_{Bi}$	$X < 2$	D	Not worthy/Not good

(Djemari, 2008).

Description:

- X_i = average ideal score
- = 1/2 (ideal maximum score + ideal minimum score)
- S_{Bi} = ideal standard deviation
- = 1/6 (ideal maximum score-ideal minimum score)

The effectiveness of using student worksheets with discovery learning models based on augmented reality on chemical bond material to increase learning motivation and student learning outcomes can be measured through hypothesis testing with the MANOVA test. The MANOVA test was carried out to see the effectiveness of student worksheets with discovery learning models based on augmented reality to increase student motivation and learning outcomes. Before carrying out the MANOVA test, it is necessary to test the prerequisite hypotheses first, namely the outlier test, normality test, homogeneity test, Box's M test, linearity test and multicollinearity test. The MANOVA test carried out in this research was the Hotelling's Trace test because there were only two groups of independent variables, sample adequacy, and the requirements for homogeneity of the covariance matrix were met (Stevens, 2009).

Result and Discussion

The development of this product produces a student worksheet product with an augmented reality-based discovery learning model which is very feasible and effective in increasing student motivation and learning outcomes regarding chemical bonding material. The product development stages are as follows:

Define

The results of observations of chemistry learning at SMA Sejahtera 1 Depok that have been carried out are related to problems, obstacles, learning media and teaching materials, learning models used and the learning process in class. The results of the observations that have been made show that the learning media used to convey the material is PowerPoint and sometimes they don't use PowerPoint (only writing on a whiteboard). Teachers rarely use student worksheets and the student worksheets that are used do not use innovative learning models, they only contain ordinary questions. The learning process is carried out using the lecture method so that learning is still teacher-centered. This causes students to be less active and less enthusiastic in responding to the learning being carried out. Students' learning motivation is relatively low which can be seen from students' behavior when learning. Most class average scores only meet the Minimum Completeness Criteria set by the school, namely 75, which can be seen from the student learning results documents. This proves that chemistry is still considered a difficult and uninteresting subject. In chemistry learning that has been implemented in schools, chemical representation has not been fully implemented. The chemical representation that is often used is only a symbolic representation, sometimes

macroscopic representation may be added. Submicroscopic representation is rarely applied in schools. Delivery of material that only uses printed books and PowerPoint media is less effective in conveying abstract chemistry material that students need to imagine. When the teacher is explaining the subject matter, there are still many students who are not paying attention, daydreaming, propping their chins, feeling sleepy, chatting and joking with their friends. Students seem less enthusiastic about participating in learning. Students are also less active in learning which can be seen from their behavior which is reluctant and embarrassed to ask, answer, respond or express their thoughts. This shows the low motivation of students in learning. Some students have difficulty understanding chemistry as indicated by their low learning outcomes. Low chemistry learning outcomes can be seen from grades that have not reached the predetermined standard of completion. This greatly influences student learning outcomes. Students need help to understand abstract material, so the use of innovative learning media is one solution that teachers can use to overcome low student chemistry learning outcomes.

Design

The planning stage also includes planning and product content being developed in outline, planning learning tools, instrument preparation grids, and the instruments used. Planning is carried out so that the products developed are structured systematically, directed and well. The planned learning tools use the 2013 curriculum. The learning tools analyzed for learning planning include the syllabus, learning implementation plan, and learning materials. The selection of learning media is carried out based on the results at the define stage, namely at the initial analysis stage, student analysis, task and material analysis, and concept analysis. Based on the results of this analysis, the learning media developed to increase learning motivation and student learning outcomes is student worksheets with discovery learning models based on augmented reality on chemical bond material. The product being developed is made first in the form of a flowchart to provide an overview of the flow from one process to another so that it is more focused. In addition, the flowchart functions as a guide in developing the product content being developed. The next stage is implementing the design that has been created in a storyboard using Microsoft Word, Powerpoint, Unity Hub, Vuforia and Blender applications.

Development

Components that have been prepared and designed in the previous stage are combined into one at the development stage. The framework, which was previously still conceptual, was then designed and

realized into a product that was ready to be tested on students through the empirical testing stage.

Student Worksheets with Discovery Learning Models Based on Augmented Reality

The final product produced is a student worksheet with discovery learning models based on augmented reality on chemical bonding material which was developed to increase learning motivation and student learning outcomes that are suitable for use in chemistry learning. The product student worksheets with discovery learning models based on augmented reality is made in such a way that it can improve learning outcomes and student learning motivation which was developed using the Unity application which provides a user-friendly user interface with various tools and complete features, the 3D Blender application is a computer graphics application which makes it possible to produce high quality images or animations using three-dimensional geometry, Vuforia which is an SDK provided by Qualcomm to help developers create Augmented Reality (AR) applications on mobile phones (iOS, Android). Researchers also use Microsoft Word and Powerpoint applications in making student worksheets. The products developed are uploaded on the GDrive link so that they can be accessed anywhere and anytime by students. The product developed has several advantages. The appearance and presentation of the products developed are attractive so that they can increase learning motivation and provide a sense of enjoyment during the teaching and learning process. The product developed can visualize abstract concepts so that student understanding increases and has an impact on learning outcomes which also increase. The following are several displays of student worksheets with discovery learning models based on augmented reality on chemical bonding material at the beginning and end of the cover which contains the identity of the student worksheet.



Figure 3. Initial and final covers

The display of each chapter in the student worksheet is presented with the title of each chapter, the title of each activity is presented with an attractive display image and each chapter uses a different display image.



Figure 4. The display of each chapter

The following is the initial display of chapter 1, the introduction which contains an introduction to laboratory equipment, concept maps, a brief explanation of the discovery learning model and instructions for using student worksheets.

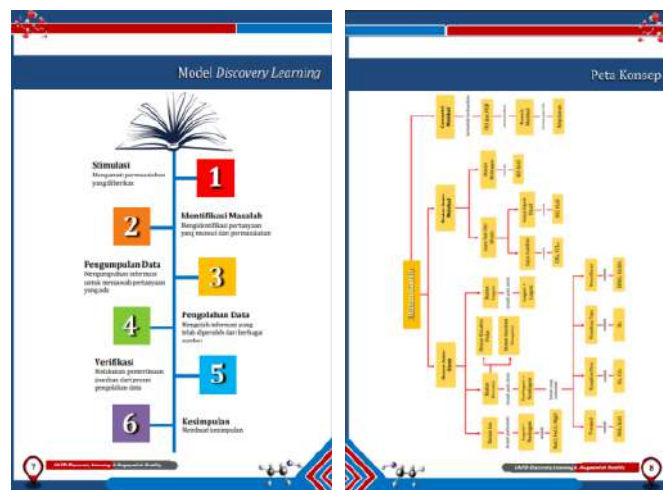


Figure 5. Display the contents of the introduction

The following is a display of learning activities using the discovery learning model which consists of six syntaxes, namely stimulation, problem identification, data collection, data processing, verification and conclusions.



Figure 6. Display of discovery learning model

The end of each chapter and activities in the discovery learning model will be presented in the form of material as student feedback.

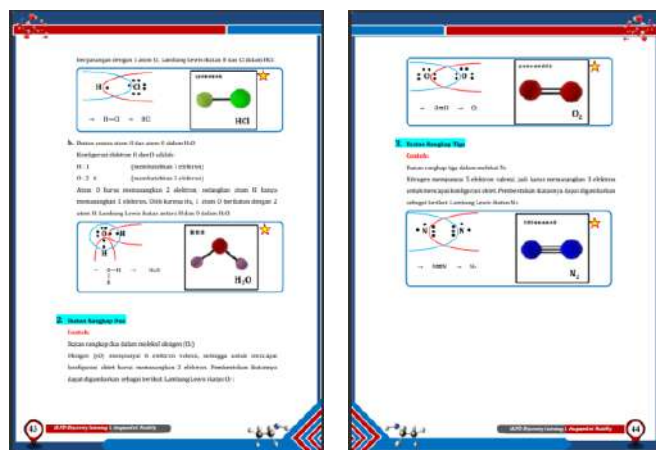


Figure 7. Display of brief content

The bibliography menu contains a list of references or sources used as references for material on the human reproductive system. The references listed are mostly obtained from related electronic books and printed books.

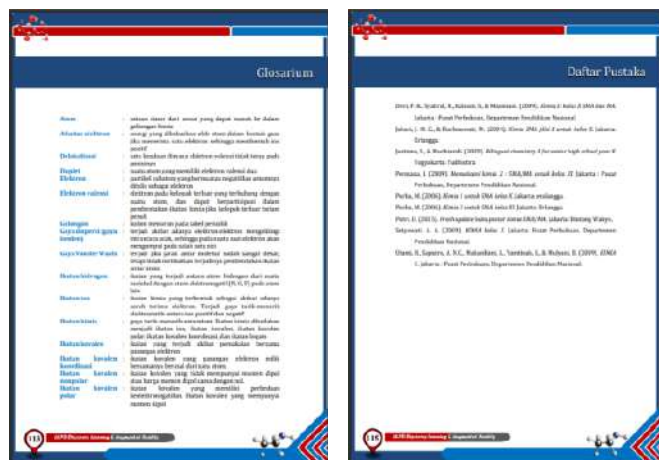


Figure 8. Bibliography Page

The following is the initial display when the augmented reality application is opened and the splash screen of the augmented reality application on student worksheets with discovery learning based on augmented reality on chemical bonding material.



Figure 9. Splash screen

When the Android-based smartphone camera in the application is directed at the 2D target image on the student worksheet, a 3D image of the shape of the molecule will appear. The molecular shapes that appear in the application can be zoomed in, zoomed out, pinch, rotate and shift their position.

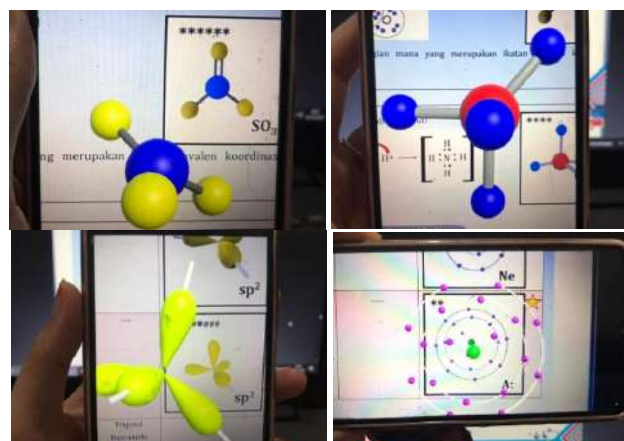


Figure 10. 3D view of molecular shape

Feasibility Test Results for Student Worksheets with Discovery Learning Models Based on Augmented Reality

The trial of student worksheets with discovery learning models based on augmented reality was carried out in two learning groups, namely the experimental class and the control class. The suitability of student worksheets is validated by two experts, namely media experts and material experts. The assessment of material aspects consists of four criteria, along with a description of the results of the material expert assessment in table 3.

Table 3. Recapitulation of Student Worksheet Assessment Results by Material Experts

Aspect	Score		Average	Category
	Expert 1	Expert 2		
Eligibility of content	4	3,7	3.85	Very decent
Language	4	3.714	3.857	Very decent
Presentation	4	4	4	Very decent
Characteristics of student worksheets	4	4	4	Very decent
	Average		3.926	Very decent

The assessment of media aspects consists of four criteria, along with a description of the results of the media expert assessment in Table 4.

Table 4. Recapitulation of Student Worksheet Assessment Results by Media Experts

Aspect	Score		Average	Category
	Expert 1	Expert 2		
Appearance	4	3.9	3.95	Very decent
Multimedia	4	3.857	3.928	Very decent
Practicality	4	4	4	Very decent
Characteristics of student worksheets	4	4	4	Very decent
Average			3.969	Very decent

Based on Tables 3 and 4, it is known that the four aspects of the feasibility assessment by material experts and media experts received the "Very Decent/Appropriate" category so that student worksheets with augmented reality-based discovery learning models on chemical bond material are very suitable for use in learning.

Disseminate

Thiagarajan (1974), divides the dissemination stage into three activities, namely: validation testing, packaging, diffusion and adoption (Maydiantoro, 2021). At the validation testing stage, the product that has been revised at the development stage is then implemented on the actual target. Once the product is implemented, developers need to see the results of achieving the goals. At this stage, trials will be carried out to measure goal achievement. This measurement is carried out to determine the effectiveness of the product being developed. The final product that has been developed is then disseminated to students in online form. The product trial implementation stage is carried out offline learning, namely students learn from school. Field trials were carried out at SMA Sejahtera 1 Depok. The time allocation used in the field trial is 3 class hours (135 minutes). Product trials were carried out on 72 class X Science students (X Science 1 and X Science 4). Field trials were carried out on two types of classes, namely the control class and the experimental class. The control

class conducted learning using LKPD provided by the teacher/school. The experimental class in its learning uses Student Worksheets (LKPD) with an augmented reality-based discovery learning model. This aims to determine the differences between the experimental class and the control class in learning motivation and student learning outcomes.

Results of Student Responses to Student Worksheets with Discovery Learning Models Based on Augmented Reality

Student response data was obtained from the results of filling out response questionnaires by students. The student response questionnaire consists of 16 statement items which are classified into three aspects, namely software engineering, learning design and visual communication. The results of filling out student response questionnaires become readability data for student worksheets with discovery learning models based on augmented reality that have been developed. The data obtained is quantitative data which is then converted into qualitative data with a scale of four with the provisions in table 2. The recapitulation of the readability results of student worksheets with discovery learning models based on augmented reality on chemical bond material by students is shown in Table 5.

Table 5. Results of Student Responses to Student Worksheets

Grade	Aspect	Average	Category
X Science 1	Software engineering	3,85	Very good
	Learning design	3,96	Very good
	Visual communication	4,00	Very good
	Average overall score	3,93	Very good
X Science 4	Software engineering	3,88	Very good
	Learning design	3,94	Very good
	Visual communication	3,99	Very good
	Average overall score	3,93	Very good
X Science 1 & 4	Software engineering	3,87	Very good
	Learning design	3,95	Very good
	Visual communication	4,00	Very good
	Average overall score	3,94	Very good

Models of teaching materials added with augmented reality technology have become a learning trend in the 21st century. Several experts have validated student worksheet models equipped with augmented reality to be able to build High Order Thinking Skill (HOTS) thinking for high school students (Bakri, Pratiwi, & Mulyati, 2020). The use of augmented reality technology in education aims to achieve better learning effects compared to using traditional teaching and learning methods, creating educational content that can be applied in an augmented reality context can be a challenging task for an educator (Pantelić & Vukovac, 2017).

A study shows that augmented reality-based student worksheets are very easy for students to use. Augmented reality-based student worksheets must use language that is easy for students to understand, and 2D and 3D videos and images can be accessed easily. The practicality of learning media is important to know because one of the important points in choosing a good learning media is its ease of use (Fendi et al., 2021). This is also in accordance with the development carried out by Yusro (2023) student worksheets which were developed equipped with augmented reality which are used to make it easier for students to understand abstract material in the form of structures in the human excretory system organ material and create a pleasant learning atmosphere so they can practice certain material and skills. to meet learning objectives (Yusro et al., 2023).

In line with research conducted by Syamsu (2020) which states that learning activities through student worksheets with the discovery learning model are able to recognize and differentiate the cause and effect of a complex problem, analyze incoming information, identify patterns or relationships, and identify or formulate questions. Discovery learning model can help students build knowledge independently through various activities based on existing previous knowledge. Hilmi et al. (2017) & Masril et al. (2018) also said that the discovery learning model can help students build knowledge independently through various activities based on existing previous knowledge (Rizki et al., 2021). The other research supports the statement that learning using the discovery learning model can improve student learning outcomes (Farid et al., 2018).

Results of the Effect of Student Worksheets with Discovery Learning Models Based on Augmented Reality on Student Motivation and Learning Outcomes

Before testing the hypothesis, the analysis prerequisites are first tested. Analysis requirements tests need to be carried out to determine whether the data to be analyzed can be continued or not (Rosana & Seyawarno, 2016). Analysis prerequisite tests for the MANOVA test include the outlier test, normality test, homogeneity test, Box-M test, linearity test and multicollinearity test.

Outliers Test

The results of the univariate outlier testing in this study found no outliers, which can be seen from the box plot that there are no points above or below the whiskers representing outliers so there is no data that needs to be removed. Multivariate outliers are identified by comparing the Mahalanobis distance with chi square (for each group. The data does not have multivariate outliers if the Mahalanobis plot against chi square approaches a straight line.

Normality Test

The results of the multivariate data normality test using scatter plots tend to form a straight line and more than 50% of the mahalanobis distance values are less than or equal to chi square for the entire data, so that all data is declared to be normally distributed. There are several points that come out of the straight line, but the data does not contain multivariate outliers because it can be shown through the Pearson correlation value, where the Pearson correlation value is > 0.005 , so it can be concluded that the data is normally distributed.

Homogeneity Test

The homogeneity test results obtained a Sig value. > 0.05 for all data, so that all data is declared homogeneous.

Box-M test

The results of the Box-M test show the Sig value. is 0.450 where this value is greater than α (0.05) so there is no difference in covariance between the two groups so the sample is homogeneous. This means that the dependent variables, namely learning motivation and learning outcomes, have the same variance - covariance matrix as the independent variables.

Linearity Test

There is a linear relationship between each pair of dependent variables and independent variables. This prerequisite can be done by plotting a scatter plot matrix for each group of independent variables.

Multicollinearity Test

The results of the multicollinearity test show that the Variance Inflation Factor (VIF) value for the learning motivation and learning outcomes variables is 1.022 which is less than 10 and the tolerance value is 0.978 which is more than 0.1. From the obtained values, both learning motivation and learning outcomes have tolerance values > 0.1 and $VIF < 10$ so it can be concluded that the data as a whole does not have multicollinearity.

MANOVA Test

In the MANOVA test, the results were obtained in the form of a Multivariate Tests table. These results are used to test the hypothesis of the two variables, namely motivation and student learning outcomes. The following are the results of the MANOVA test.

Table 6. MANOVA (Multivariate Test)

Effect	Sig.	Description
Hotelling's Trace	0.000	H ₀ rejected

Based on Table 6 Multivariate Tests, it is known that in Hotelling's Trace the significance value is $0.00 < 0.05$, meaning that H₀ is rejected so that there is a significant

difference in learning motivation and learning outcomes between students who are taught using student worksheets with discovery learning based on augmented reality in the experimental and student classes. worksheets that schools usually use in control classes.

Improvement is felt when teachers use visual media, when explaining the material students listen well and are interested, students' increased attention has a positive impact on improving student learning outcomes (Purwono et al., 2014). Visual-based learning can be used to illustrate material, increase student attention, provoke curiosity and help students relate to the real world (Mowat, 2002). Visually assisted learning can increase student involvement in learning (Iswandari, 2013). This sense of satisfaction is possible because students have good motivation in the aspect of self-confidence regarding learning outcomes that match their efforts (Cahyana, 2017). If students are motivated in learning then their learning achievement will be good (high), whereas if students have bad habits in studying then their learning achievement will be bad (low) (Agustina & Ghullam, 2011). Therefore, students' motivation to learn needs to be strengthened continuously. Students who have strong learning motivation will study hard and focus on the material, so that learning runs optimally which has an impact on increasing students' cognitive values (Saridewi, Suryadi, & Hikmah, 2017). One way that teachers can increase intrinsic motivation is by using various interesting presentation methods. An interesting presentation in the learning process using various materials and methods can increase students' motivation to pay attention. This is also confirmed by research conducted by Ilafi (2023) stating that the results of the analysis that has been carried out can be concluded that augmented reality-based student worksheets are very valid for increasing student learning motivation (Ilafi, Saputri, Nurohman, & Jumadi, 2023).

When students are interested in learning, their understanding will increase and have an impact on their learning outcomes. By utilizing student worksheets in the discovery learning model in the knowledge aspect of learning, students obtained a higher average final exam score than students in classes that only used student worksheets from school. The application of the discovery learning model can change passive learning situations into active and creative ones. Using student worksheets also helps students become more independent and find their own thoughts. This causes student learning outcomes to increase. The application of student worksheets in the discovery learning model has a positive influence on learning outcomes (Nehe, Gusnedi, Hufri, & Sari, 2023). Learning based on the discovery learning model used in learning by carrying out the stages of discovery learning can improve student

learning outcomes. Thus, the results of developing student worksheets in this research can be used as an alternative in helping teachers to improve students' mastery of concepts (Ceriasari, Sunyono, & Rudibyani, 2019).

Result of Effect Size

The Effect Size calculation aims to see the magnitude of the influence of student worksheets with discovery learning based on augmented reality on the chemical bond material used on student motivation and learning outcomes. To find out the percentage of effective contribution of student worksheets to student motivation and learning outcomes, this is by multiplying the partial eta squared value by 100%. If you multiply the partial eta squared value by 100%, you get a partial eta squared value of $0.233 \times 100\% = 23.3\%$. This means that the percentage of effective contribution of student worksheets with discovery learning based on augmented reality on chemical bond material to student motivation and learning outcomes is 23.3%. The results of effective contributions obtained by researchers are in line with the findings of Maypalita et al. (2018) and Maida et al. (2019), namely that the student worksheets developed have a positive and effective contribution to student motivation and learning outcomes towards understanding chemical concepts.

The final activity of the development stage is packaging, diffusion and adoption. This stage is carried out so that the product can be used by other people. After conducting trials and revisions, the next stage is to disseminate the results of developing student worksheets with discovery learning based on augmented reality on chemical bonding material. At this stage, product distribution is carried out online and downloaded in .pdf format on a GDrive link created by the researcher.

Conclusion

Student Worksheet media has been produced with discovery learning models based on augmented reality on chemical bond material which is very suitable for increasing student motivation and learning outcomes based on expert assessments, which can be proven by the average validation score by material experts of 3.926. media expert was 3.969 and student response was 3.93 so it was in the very appropriate/very good category because the score obtained was greater than 3 ($X \geq 3$). The learning media for Student Worksheets with the Augmented Reality-based Discovery Learning model on chemical bond material is effective in increasing student motivation and learning outcomes with the MANOVA (multivariate test) test which gets marks. (2-tailed) of $0.000 < 0.05$ and has an effective contribution of 23.3% to student motivation and learning outcomes.

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Author Contributions

This research provides a learning contribution in the form of student worksheets with an augmented reality-based discovery learning model on chemical bonding material that can be used by teachers in secondary schools. The main author was involved in the entire creation of this media and article. The second author contributed to the writing of this scientific work, namely guidance in ideas, conception, data collection, analysis and interpretation of results and preparation of the article manuscript.

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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