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Development of Virtual Mentor-Based Chembo Learning Media to Improve The Learning Outcomes of Science Education Students

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Abstract. This study aims to develop Chembo (Chemical Bond) learning media based on Virtual Mentors to improve student learning outcomes in Science Education on Chemical Bonds. The research method used is research and development with 4D (four-D) design, namely definition, design, development, and deployment. The instruments used in this research were questionnaires and pretest and posttest questions. The results of the study show that the results of material validation by material experts are at number 72 which is in the "Very Eligible" category, while the validation results by media experts are 55, which is in the "Very Eligible" category. The results of students' assessment of the feasibility of learning media were in the "Very feasible" category with a conversion score of 33.82. Data on the results of student responses to chembo learning media get a value of 246.5 which, if converted, will get a value of 4.24 in the "strongly agree" category. Student learning outcomes after using Chembo learning media also experienced an increase seen from the comparison between students' pretest and posttest scores. The average score of students' pretest before using Chembo media was 48.97, while the average posttest score of students after using Chembo media was 80.86. The students' pretest and posttest gain test results scored 0.62 in the "Medium" category. Based on the study's results, it can be concluded that chembo learning media is very feasible to use in supporting the learning process and can improve student learning outcomes, especially in chemical bonding material.

Keywords: Chembo; Chemical Bond; Learning Media; Learning Outcomes; Virtual Mentors

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INTRODUCTION

One of the pillars of the success of a nation is education. Quality education certainly produces quality human resources. Through quality education, students gain knowledge in their field so that students can develop their potential to succeed in learning (Santoso & Ramadhani, 2019).

The rapid development of science and technology at this time has had a very big impact, especially on the world of education. One of them is in creating learning media by utilizing technology (Hakky et al., 2018). All tools teachers use to support the learning process are called learning media (Alhafidz et al., 2018). Adequate learning media is

needed to support a more effective and efficient teaching and learning process. There are two important aspects in the world of learning, namely learning media and learning methods teachers use in carrying out teaching and learning activities. Media Learning media is one of the supports for achieving learning objectives (Agustina et al., 2018). Therefore, teachers must be able to take advantage of developing technology to be used as learning media to improve student learning outcomes (Munadi, 2013).

Smartphones are an inseparable part of students, especially Bengkulu University students. Nearly 95% of students use Android-based smartphones. This is, of course, a very big opportunity to develop Android-based learning media to support the learning process among students. According to Astuti (2018), the use of Android-based learning media can divert negative views from the use of smartphones, which are usually used to play games but can also be used as learning media. This is what allows smartphones to be used as learning media (Sulisworo, 2012).

The use of Android-based smartphones as learning media is assessed from four aspects, namely cognitive, affective, socio-cultural, and metacognitive aspects that can positively impact. Android-based learning media can also transform student learning abilities (Chuang, 2014). The development of Android-based chemistry learning can also increase students' learning motivation and cognitive achievement (Lubis & Ikhsan, 2015).

Virtual mentor is a 21st-century technology that allows students to learn independently and be guided by a virtual mentor (Fong et al., 2013). The virtual mentor concept itself is very suitable to be combined with Android-based learning media to produce virtual mentor-based learning media. This combination is also expected to create an Android-based learning media that not only displays material in an interesting form but can also guide and talk like a virtual mentor. Virtual mentors are created by utilizing AI technology (Artificial Technology) or artificial intelligence so that the developed learning media can interact with users using voice.

Learning outcomes are changes in behavior obtained by students after participating in teaching and learning activities. More generally, learning outcomes can be defined as an assessment of student learning outcomes, which are manifested in the form of numbers after students follow the series of teaching and learning processes (Achdiyat & Utomo, 2018). The numbers obtained as student learning outcomes are used to determine the absorption or ability of students after receiving material lessons given by the teacher (Amir et al., 2021). The use of appropriate media greatly influences student learning outcomes. This is in line with Andriani's (2021) research on Android-based learning media to increase student motivation and learning outcomes. The research results show that using Android-based learning media can improve student learning outcomes and motivation.

As one of the newly established study programs, the S1 Science Education Study Program FKIP UNIB actively develops various learning media for students (Uliyandari et al., 2022). However, the development of learning media is still not very varied due to limited development time and not too many lecturers trying to develop it. The use of practical learning media is considered very important, especially in chemical bonding learning materials. Appropriate learning media is expected to attract interest and make it easier for

students to understand chemical bonding material.

The application of Chembo (Chemical Bond) learning media based on Virtual Mentor is considered to be a learning medium that can help improve student learning outcomes, especially in chemical bonding material. Application designs that are unique and enriched with AI (Artificial Intelligence) technology have become a special attraction for students (Pakpahan, 2021). Virtual Mentor-based Chembo (Chemical Bond) learning media, which is equipped with AI technology, allows the Android-based Chembo application to carry out two-way communication between users, namely students with the Chembo (Chemical Bond) application like question and answer communication carried out by lecturers and students during lectures in class. Another advantage of Chembo's virtual mentor-based learning media compared to conventional learning is that Chembo uses a one-to-one approach between applications and students.

This virtual mentor-based Chembo learning media is also designed to be used without an internet network so that this media can be used in areas where there is no internet network at all. The Chembo application is also equipped with a QR code technology to make it easier to distribute it to users' cell phones.
Based on the background above, the purpose of this study was to develop Chembo (Chemical Bond) Learning Media Based on Virtual Mentors to Improve Student Learning Outcomes in Science Education in Chemical Bonds Material.

METHOD
This research was conducted from June to December 2022. The samples used in this research were 58 students in semester 1 classes A and B. These students are students of the Science Education S1 study program at FKIP University of Bengkulu, taking general chemistry courses in the odd semester of 2022/2023.

This study uses the Research & Development (R&D) or research and development method. This research aims to make a product and test the effectiveness of a product. Sugiono (2015) states that R&D research is research conducted to produce a product.

This research refers to the 4D (four-D) research model, which refers to 4 main stages, namely define, design, develop, and disseminate. The define stage is carried out by formulating learning objectives; the design stage is carried out by designing learning media; the developing stage is carried out by validating the content of learning media by media experts and material experts, after validation is carried out and declared "proper", then the media learning will be implemented. The final dissemination stage is carried out via YouTube and WAG for general chemistry courses. The variables measured in this stage are student responses to learning media and student learning outcomes after learning with Chembo (Chemical Bond) media. This stage uses a quasi-experiment with one group pretest-posttest.

The instruments used in this study were pretest and posttest questions that had been validated, questionnaires validating learning media by media experts and material experts, and questionnaires on student responses to learning media. A material expert validator is a person who is an expert in chemical materials, especially chemical bonding materials. Meanwhile, media experts are experts in creating and designing ICT-based learning media. In this study, the material expert validator was a science education lecturer at the teaching and education faculty, Bengkulu University, and the media expert validator was a lecturer at the

Informatics Study Program, Engineering Faculty, Bengkulu University.

The research data analysis technique used a Likert scale and converted to a scale table of 5.

Meanwhile, the pretest and posttest results were analyzed using a gain score. The scheme of this study, in general, can be seen in Figure 1.
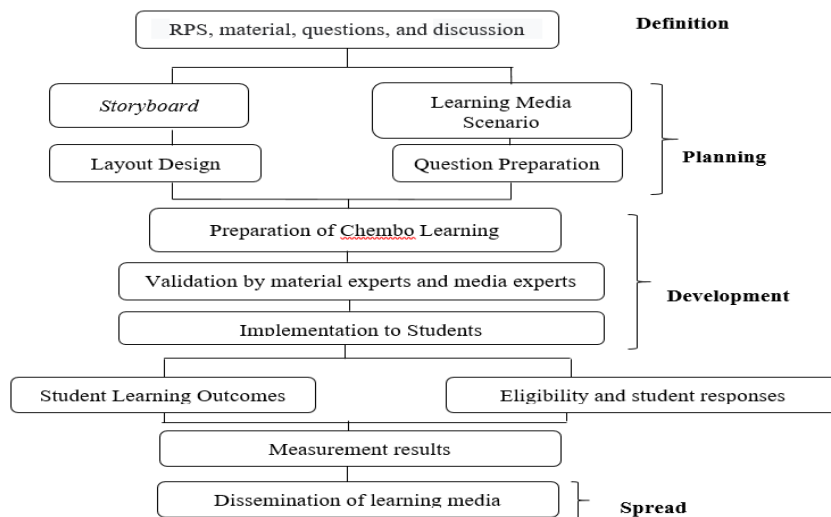

Figure 1 Research Scheme

RESULTS AND DISCUSSION
Development of Chembo Learning Media

This study aims to develop Chembo (Chemical Bond) learning media based on virtual mentors to improve learning outcomes for students of Science Education FKIP Bengkulu University on chemical bonding material. The development of this chembo media is carried out on chemical bond material in general chemistry courses. The development of this media is carried out in an interesting way and is developed based on a virtual mentor to help students understand the material being studied.

The development of instructional media is carried out by collecting materials used to compile learning media, such as curriculum, lesson plans, chemical bonding material, and assessment questions. In order to obtain quality learning media, the researcher also held discussions with academics from the same family. Based on the discussion results about the creation of

Android-based Chembo learning media, it is felt necessary to support the learning of science education students in general chemistry courses.

Making learning media is done by making storyboards and designing learning media scenarios. Storyboards are carried out by designing the layout of the Chembo application, while learning media scenarios are carried out in the form of compiling evaluation questions. The process of making Chembo learning media is based on the design that has been made. The design that has been made includes several menus, namely the CPL and CPMK menus, material menus, evaluation menus, about me menus, and share menus. The following presents several designs developed through chembo learning media (chemical bonds) that have been made:

1. **The main screen** is the initial page that is presented before starting to use the chembo application; this main menu page contains one button, namely the "menu" button,

which is used to access all menus contained in this learning media.

Figure 2 Main Screen Display

2. **Menu page**: this menu page contains all the menu buttons to access all the features contained in the chembo media. There are several menus on this menu page, namely the CPL and CPMK menus, the material menu, the evaluation menu, the about me menu, and the share menu.

Figure 3 Menu Page

3. **The CPL and CPMK menus** are menus that contain graduate learning outcomes and learning objectives. This menu is deliberately made so that students who use this

application understand CPL and the learning objectives that are expected to be achieved after the learning process is carried out.
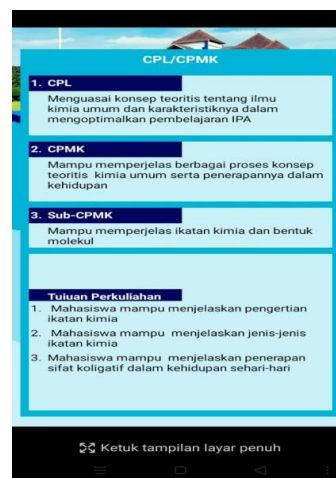

Figure 4 Display of CPL and CPMK Pages

4. **The material menu** is a menu used to access learning material. Several materials are presented in this material menu, namely material for the definition of chemical bonds, types of chemical bonds, ionic bonds, covalent bonds, metallic bonds, and hydrogen bonds.
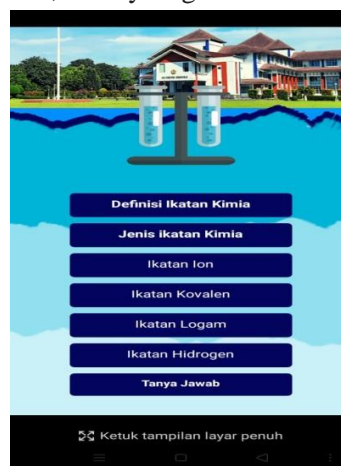

Figure 5 Material Menu Display

5. **Evaluation menu**: This menu presents two other menu buttons, where there are buttons for working on pretest questions and there are

buttons for working on posttest questions. A virtual mentor will direct students to work on the pretest questions and then on the posttest questions.
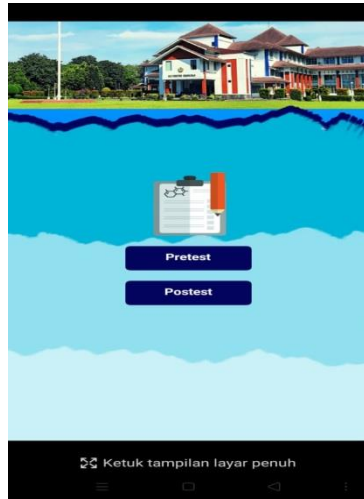

Figure 6 Evaluation Menu Page Display

6. **Ask menu**; this menu is designed so that students can ask chembo learning media by using voice. Chembo learning media will provide answers to questions posed by students.

Figure 7 Question Menu Display

7. **Share Menu** is a menu that distributes the chembo application to student smartphones. This distribution is very easy; students only need to scan the QR code on

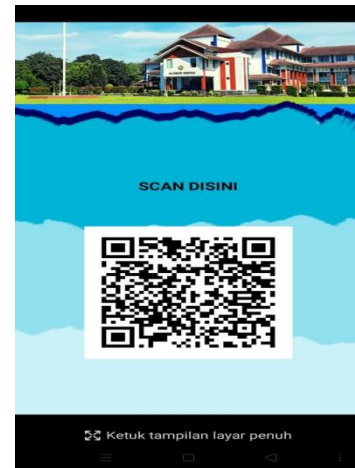the share page, then the chembo learning media can be directly installed on the student's smartphone.

Figure 8 QR Code for Chembo Learning Media

To obtain learning media that are suitable for use by students, a validation is carried out on the design of the chembo learning media that has been made. Validation was carried out by two validators, namely the material expert validator and the media expert validator. These two expert validators are professional validators and experts in their respective fields.

Two main aspects are validated by material experts, namely the learning aspect, which consists of learning objectives, delivery of material, and evaluation, as well as material aspects, which include the relevance of material and selection of material. The media expert validator validates the appearance of learning media (text appearance, color combinations, images, and navigation buttons). It validates use aspects, such as instructions for use and interaction with learning media).

The validation results obtained are converted into quantitative data using the scoring method. The scoring results are then converted according to the five-scale table used. Based on the

conversion results in the scale five tables, the validation results were obtained by material experts and media experts as shown in Tables 1 and 2.

Table 1 Validation Results by Material Experts

Assessment Aspects	Number of Items	Score	Category
Learning	10	41	**Very Worth It**
Material	7	31	
Amount	**17**	**72**	

Table 2. Validation Results by Media Experts

Assessment Aspects	Number of Items	Score	Category
Media View	8	34	**Very Worth It**
Used	5	21	
Amount	**13**	**55**	

Based on Table 1 and table 2, the material expert validator gives a score of 72 and the score obtained from the media expert validator is 55 in the "very feasible" category, meaning that chembo learning media is very feasible to use in the learning process in general chemistry courses, especially in bonding material chemistry.

Based on the validation questionnaire by the material expert validator, it is known that the chembo learning media is in the very feasible category because the chembo learning media has learning objectives that follow the CPMK for general chemistry courses, the material presented in this learning media is clear and coherent and relevant to the learning objectives, besides that, the chembo learning media is also equipped with evaluation test questions to measure students' understanding of the chemical bond material that has been delivered.

Meanwhile, according to media expert validators, this chembo learning media is in the very feasible category because chembo learning media has a clear and neat text writing structure, has very good combinations and colors, and the navigation buttons are also arranged and can function very well, apart from that Chembo learning media also has very clear instructions for using the media, and is very interactive. This is in line with research conducted by (Windawati & Sukarmin, 2016) regarding the development of chembond interactive media as a learning medium for chemical bond material in class in the very decent category.

Assessment of media feasibility and student responses to chembo learning media

The feasibility assessment of the chembo learning media was carried out by semester three students of the Science Education Study Program, FKIP University of Bengkulu, who had previously taken general chemistry courses in the 2021/2022 odd academic year.

The results of the feasibility assessment of this chembo learning media are converted using a scale table of five to obtain the results as shown in Table 3.

Table 3 The Results of The Feasibility Assessment of Chembo Learning Media by Students

Rated Aspect	Amount
Learning	489
Material	487
Appearance	492
Used	494
Total	1962
Conversion Value	**33,82**
Category	*Very Worth It*

Based on Table 3, it is known that the chembo learning media is in the "very feasible" category with a conversion value of 33,82. This shows that according to the feasibility assessment by 3rd-semester students of FKIP University of Bengkulu, the chembo application developed is very suitable for use as a support for the learning process in class, especially in chemical bonding material.

In addition to the feasibility test of chembo learning media, a response test was also carried out. This response test was conducted to see student responses to the chembo application. The response test was carried out by distributing questionnaires to students who were respondents to this study. The distributed questionnaire contains several aspects, namely material aspects, learning aspects, usage aspects, and display aspects.

The results of the response test to the chembo learning media show a fairly good value, whereas the results of student responses to virtual mentor-based chembo learning media get an average score of 246,5, which, if converted, will get a conversion value of 4,24 with the category "Very Eligible" . This can be interpreted that in general, the students strongly agree with the aspects contained in this virtual mentor-based chembo application. So this learning media is very feasible to be used as a support in the learning process to improve student learning outcomes, especially in chemical bonding material in general chemistry courses. Data on student responses to virtual mentor-based chembo applications are presented in detail in Table 4.

Table 4 Student response data to virtual mentor-based chembo learning media

Aspect	Statement	Response Score	Conversion Rate	Conclusion of Student Responses
Learning	1	245	4.22	Strongly Agree
	2	236	4.06	Agree
Average learning aspect		340.6	4.14	Agree
Material	3	249	4.29	Strongly Agree
	4	252	4.34	Strongly Agree
The average score of student responses to material aspects		250.5	4.31	Strongly Agree
Display of learning media	5	254	4.37	Strongly Agree
	6	246	4.24	Strongly Agree
The average score of student responses to aspects of the display of learning media		250	4.30	Strongly Agree
Used	7	248	4.27	Strongly Agree
	8	242	4.17	Strongly Agree
The average score of student responses for aspect of use		245	4.22	Strongly Agree
The average response score on all aspects		246.5	4.24	Strongly Agree

The results of the questionnaire on the feasibility of chembo learning media by students are in the very worthy category. The students' responses to this chembo learning media are in the very good category, indicating that according to students the chembo learning media has very good material preparation and delivery techniques, the quality of the material delivered is easy to understand, The selection of material in the Chembo application is very important for students, and the text and images presented in the Chembo learning media are easy to read. The images used are appropriate to the learning material. According to Zaman (2009), good learning media must have aesthetic requirements, which include matching sizes and color combinations that are harmonious and attractive.

Presentation of examples of the formation of chemical bonds that have abstract concepts in the form of elements that form bonds packaged in the animated form presented in each sub-material on chembo learning media can help students more easily understand concepts because android-based learning media can teach abstract concepts which can then be concreted in the form of animated visuals and audio (Arsyad, 2009).

Student learning outcomes after using chembo learning media based on virtual mentors

The effect of using virtual mentor-based chembo learning media on student learning outcomes can be seen by making a comparison between the average pretest results and the average posttest results of students before and after carrying out learning activities using virtual mentor-based chembo learning media.

Based on the research results, it is known that the average pretest score of students before using virtual mentor-based chembo learning media is 48.97 while the average posttest score of students after learning using virtual mentor-based chembo learning media is 80,86. Comparison data between the average pretest and posttest scores of students as a whole is presented in Figure 9.
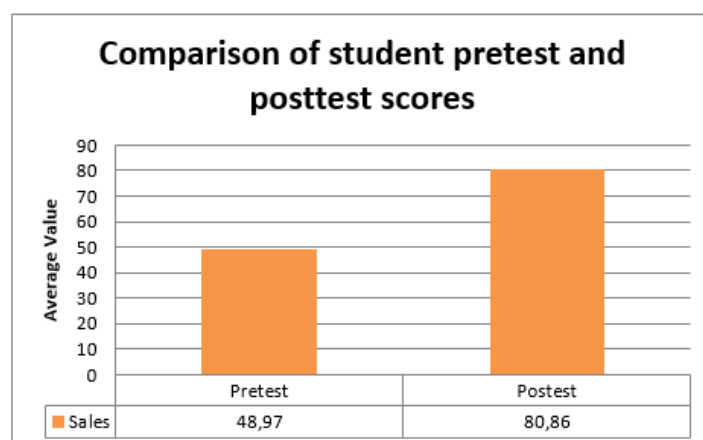

Figure 9 Histogram of Comparison of The Average Pretest and Posttest Scores of Students after Using Chembo Learning Media

To see how much student learning outcomes have increased after using virtual mentor-based chembo learning media, a gain test was carried out. The gain test results get a value of 0,62 in the "moderate" category. This shows that there has been an increase in student learning outcomes after using chembo learning media based on virtual mentors in the moderate category.

This increase in learning outcomes is thought to be due to virtual mentor-based chembo learning media that can increase students' curiosity about the media to increase their enthusiasm for learning. The material in the chembo application, which is presented attractively and combined with virtual mentor technology, has made it seem as if students are being guided by their lecturers or mentors in carrying out learning, which has provided a special attraction in the teaching and learning process.

In addition, because it is practical and can be installed on each student's smartphone, this learning media allows students to study and repeat parts of the material that have not been understood at their homes. If there are things that students have not understood, students can ask the chembo learning media through the Ask menu. The development of Android-based learning media, which is attractively packaged and based on virtual mentor technology, has been proven to improve the learning outcomes of science education students. This is in line with research conducted by Putri (2023) regarding the application of artificial intelligence as a medium for learning Arabic in the Society 5.0 era. The research results show that one of the artificial intelligence applications that can be used as a learning medium is virtual mentors combined with an Android-based operating system. Meanwhile, according to Khefrianti (2021), the development of Android-based learning media on chemical bond

material can increase student motivation and learning outcomes.

CONCLUSION

The development of virtual mentor-based Chembo learning media is carried out through four stages, namely the definition, design, development, and deployment stages. Some of the components developed in the chembo learning media are the main screen, menu pages, CPL and CPMK menus, material menus, evaluation menus, about me menus, Ask menus, and Share menus.

The feasibility test of learning media conducted by material experts, media experts, and students is in the "very appropriate" category. Student responses to the chembo application are in the "strongly agree" category, so the chembo learning media is very feasible to be applied as a support for the teaching and learning process in class. Student learning outcomes after using chembo learning media also experienced an increase in the moderate category.

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