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THE DEVELOPMENT OF WEB-BASED CHATBOT AS A MATHEMATICS LEARNING MEDIA ON SYSTEM OF LINEAR EQUATIONS IN THREE VARIABLES

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Abstrak

Perkembangan teknologi kecerdasan buatan berkembang pesat, salah satunya yaitu chatbot. Meningkatnya intensitas percakapan digital mendorong berbagai pihak untuk mengembangkan potensi chatbot pada berbagai bidang, termasuk bidang pendidikan. Chatbot pada bidang pendidikan dapat dikembangkan untuk membuat kuis interaktif & tanya jawab otomatis, serta sebagai media yang dapat memberikan informasi secara instan sesuai dengan yang diminta oleh pengguna saat kapan saja dan dapat dapat diakses melalui ponsel pintar atau komputer. Oleh karena itu chatbot dapat menjadi alternatif media pembelajaran yang interaktif dan menarik. Penelitian ini bertujuan untuk mengembangkan chatbot berbasis web sebagai media pembelajaran matematika pada materi sistem persamaan linear tiga variabel yang layak digunakan dengan memenuhi kriteria kevalidan, kepraktisan, dan keefektifan. Pendekatan yang digunakan pada penelitian ini adalah deskriptif dan analisis data secara kuantitatif. Langkah penelitian pengembangan media chatbot dikembangkan sesuai prosedur model Borg and Gall yang dimodifikasi oleh Soenarto, yaitu: analisis produk, pengembangan produk awal, dan pengujian produk yang dikembangkan. Hasil penelitian menunjukkan bahwa media memenuhi kriteria valid dengan skor 77,08% yang didapat dari hasil penilaian oleh dua validator ahli media dan ahli materi. Media memenuhi kriteria praktis dengan skor 74,87% yang didapat dari hasil angket kepraktisan dari 33 siswa. Media memenuhi kriteria efektif dengan skor 75,75% yang didasarkan pada nilai siswa pada media chatbot yang menunjukkan 25 dari 33 siswa mendapat nilai lebih dari atau sama dengan 80 (kriteria ketuntasan minimal). Sehingga dapat disimpulkan bahwa media chatbot dapat menarik minat siswa dalam belajar matematika dan layak digunakan dalam pembelajaran materi sistem persamaan linear tiga variabel.
Kata Kunci: chatbot, media pembelajaran, sistem persamaan linear tiga variabel

Abstract

Artificial intelligence technology is growing rapidly; one of those is the chatbot. The increasing intensity of digital conversations encourages people to develop the chatbot potential in various fields, including education. Chatbots in education can be designed to create interactive quizzes & automatic Q&A and media that can provide information instantly as requested by the user and can be accessed through a smartphone or computer. Therefore chatbots can be interactive and interesting learning alternative media. The research aims to develop a web-based chatbot as mathematics learning media on the system of linear equations in three variables material worth using qualified by the criteria of validity, practicality, and effectiveness. The approach used in this study is descriptive and quantitative data analysis. The Chatbot development research steps are according to the Borg and Gall model procedures modified by Soenarto: product analysis, initial product development, and testing of the developed product. The results showed that media is valid with a score of 77.08% obtained from results of assessments by two media and material expert validators. Media is practical with a score of 74.87% obtained from the practicality questionnaire of 33 students. Media is effective with a score of 75.75% based on student scores on chatbot media which shows 25 out of 33 students scored more than or equal to 80 (standard of minimum completeness). So the researchers can conclude that chatbot media can attract students' interest in learning mathematics and is worth using in learning system of linear equations in three variables.
Keywords: chatbot, learning media, the system of linear equations in three variables

INTRODUCTION

In the era of globalization, technological developments are very rapid. The technology that is currently being intensively developed is artificial intelligence technology. We can find various implementations of artificial intelligence in the daily use of smartphones, one of which is chatbots. A chatbot is a computer program designed to simulate a conversation with a robot or machine, especially over the internet (Sutton & Cristianini, 2020). Various advantages of chatbots include saving time because chatbots can provide feedback immediately after the user sends the chat. After all, it can entertain users who seem to be chatting with someone and can answer complex questions without thinking about the right keywords to find the answer on the internet (Dahiya, 2017). The intensity of digital conversations increases in proportion to the trend of web and mobile applications, as reported by the official website of WhatsApp, the world's most popular messaging application; more than 2 billion users are sending more than 100 billion messages every day. Even that number has not been added to the number of messages sent from several other messaging applications. This number encourages people to develop the potential of chatbots to improve progress in business, government, and even education.

Students generally do not like mathematics because it is considered difficult (Siregar, 2017). Challenges faced by students can make them unmotivated and discouraged in learning. Teachers can motivate students to learn by using exciting and effective learning media to engage and motivate students in a continuous learning process (Fadillah, 2018). Therefore, teachers must develop learning media in the mathematics learning process. Learning media is designed to allow teachers to send messages, information, or topics to students so that the material is more easily understood by students (Wijayanti et al., 2018). Learning mathematics in class will be easy and exciting for students if the teacher uses information and communication technology (ICT)-based media (Widjayanti et al., 2019).

A chatbot is one example of the application of ICT. Chatbot technology in education can be developed to create interactive quizzes & automated questions and answers. A chatbot can provide information instantly as requested by the user and accessed via a smartphone or computer. Therefore, chatbots can be an alternative learning media, reinforced by Widjayanti et al. (2019) that students prefer to use smartphones or computers to study rather than studying through books. Chatbots as learning media can present interactive and exciting materials and quizzes (Morales-Rodríguez et al., 2012).

The material for the system of linear equations in three variables (SPLTV) is an extension of the system of linear equations in two variables material that has been studied at the junior high school level and the equivalent. Based on research conducted by Kuswanti et al. (2018) at Madrasah Aliyah Al Irtiqo' for 18 ten-grade students, it was found that the most errors in solving SPLTV problems were errors in transforming the problems, processing skills, and writing the final answer. In line with Hasan & Rosyidi (2020) research, most students made mistakes in understanding problems, transforming errors, and errors in the process. Therefore, the solution to minimize student errors is to familiarize students with processing SPLTV problems, focus on avoiding negligence, remind students to write answers schematically, and ensure students understand the steps for completing SPLTV. A chatbot can be an alternative solution for these problems because chatbots can be a media to practice working on SPLTV problems interestingly and interactively. So students are motivated to learn mathematics.

Research related to the development of chatbots as learning media has been widely carried out, including the development of Messenger chatbots as Java learning media by Wijaya et al. (2018), which shows the media is very feasible to use. The development of the LINE chatbot as a media to improve the learning atmosphere in Japanese learning by Haristiani & Rifa'i (2020) shows satisfactory results for students. The development of Telegram chatbots as learning media in programming courses by Ardimansyah & Widianto (2021). Previous research shows that chatbots can be an alternative learning media and has advantages, namely practical, attractive, interactive, and can increase student motivation in learning. Therefore, we want to develop a web-based chatbot as a valid, practical, and effective mathematics learning media on SPLTV material. Researchers did not choose chatbots based on messaging applications because they required programming skills. Researchers wanted to develop chatbots that were easily accessible without installing additional applications. Researchers also hope that readers can imitate or modify chatbots developed without proficient programming.

METHODS

This research is development research. In this study, the web chatbot learning media development according to the Borg and Gall model procedures modified by Soenarto (2003) in Setyadi & Qohar (2017), namely: product analysis, initial product development, and testing of the developed product. The researchers choose the modified Borg and Gall model because the procedure was easy to understand and covered everything related to research and product development in education.

The product analysis stage consists of an analysis of the concept and design, then material collection. Researchers conduct literature studies and surveys to students and teachers about ten-grade mathematics material that ~~is~~ difficult to understand. Then, conduct surveys about chatbots (types, methods of making, designs, strengths, and weaknesses) and collect material and problems. In the initial product development stage, the researchers create a chatbot then integrate the materials and problems. This development results in a chatbot that can access via a share link for many users. The product testing phase consists of expert testing and revision and small-scale testing for ten-grade students. The expert test carries with the help of a lecturer with a Master's degree in Mathematics Education who has competence in computer application programming and a high school mathematics teacher with a Bachelor of Education degree.

The data collection technique in this study uses expert testing to determine the validity of the chatbot material and media. The researchers give the questionnaire to students to assign the practicality of the chatbot media. The researchers use the final score of the students' test at the end of the chapter to determine the effectiveness of the chatbot media. Nieveen in Lestari & Ekawati (2019) explains the validity, practicality, and effectiveness as follows.

Validity

Validity consists of two aspects: curriculum or learning models developed based on understanding or knowledge of the material; and components of learning media that are consistently related to each other. The developed chatbot is valid if it follows the theory (material validity) and the chatbot components are consistently interconnected (media validity). The chatbot media can be declared valid if it qualifies the valid criteria adapted from Rahmata & Ekawati (2018).

Table 1. Validity Test Criteria

Validity	Level of Validity
85% < V ≤ 100%	Very Valid, or can be used without revision
70% < V ≤ 85%	Valid, or can be used but needs minor revision
50% < V ≤ 70%	Less Valid, it is not recommended to use it because it needs a major revision
0% ≤ V ≤ 50%	Invalid, or should not be used

The formula of validity:

$$\text{Validity } (V) = \frac{TES}{MTS} \times 100\%$$

Description:

Total Empirical Score (TES) = total value of the validation questionnaire results.

Maximum Total Score (MTS) = the maximum total value of the validation questionnaire.

Practicality

Measurement of practicality uses a user response questionnaire with indicators that experts have categorized. These indicators relate to an interest in learning, ease of use, user interest in chatbots, suitability of chatbots with learning, motivation, and user satisfaction. Chatbot media can be practical if the response questionnaire's value qualifies the practical criteria adapted from Rahmata & Ekawati (2018).

Table 2. Practicality Test Criteria

Practicality	Level of Practicality
85% < P ≤ 100%	Very Practical, or can be used without revision
70% < P ≤ 85%	Practical, or can be used but needs minor revision
50% < P ≤ 70%	Less Practical, it is not recommended to use it because it needs a major revision
0% ≤ P ≤ 50%	Impractical, or should not be used

The formula of practicality:

$$Practicality\ (P) = \frac{EAS}{MAS} \times 100\%$$

Description:

Empirical Average Score (EAS) = the average value of the practicality questionnaire results.

Maximum Average Score (MAS) = the maximum average value of the practicality questionnaire.

Effectiveness

Indicators of the product's effectiveness can be taken from student achievement, measured using an assessment instrument, namely the learning test results at the end of the lesson. The developed chatbot is effective if it can make students interested in learning mathematics and help students understand mathematics more efficiently. Chatbot media is effective if more than 60% of users have reached the Minimum Completeness Criteria (KKM), as in the effectiveness criteria adapted from Rahmata & Ekawati (2018).

Table 3. Effectiveness Test Criteria

Effectiveness	Level of Effectiveness
80% < E ≤ 100%	Very Effective, or can be used without revision
60% < E ≤ 80%	Effective, or can be used but needs minor revision
40% < E ≤ 60%	Less Effective, it is not recommended to use because it needs major revision
20% ≤ E ≤ 40%	Ineffective, or should not be used
0% ≤ E ≤ 20%	Very Ineffective, or should not be used

The formula of effectiveness:

$$Effectiveness\ (E) = \frac{The\ umber\ of\ subjects\ reached\ KKM}{Total\ of\ all\ subjects} \times 100\%$$

RESULTS AND DISCUSSION

Development Results

1) Product Analysis

In the concept analysis stage, the researchers chose the SPLTV (the system of linear equations in three variables) material because the material was complex for some students to understand from the literature study and survey results. The survey results showed that 11 out of 26 students said that SPLTV material was difficult to understand. According to students, some of the reasons that SPLTV material was difficult to understand: did not know the completion steps, the completion steps were too long and numerous, the calculations were branched, difficult to understand and memorize the completion steps, required high accuracy. This reason follows the research results conducted by Kuswanti et al. (2018) and Hasan & Rosyidi (2020), which stated that most students had errors in understanding and processing problems.

Chart 1. Comparison of Number of Student Opinions Regarding SPLTV Materials

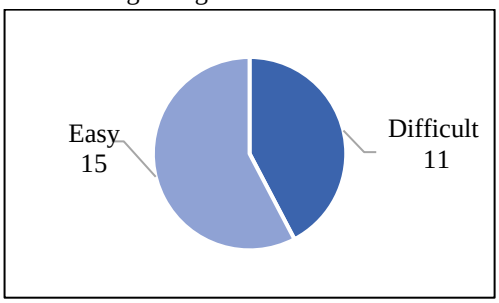
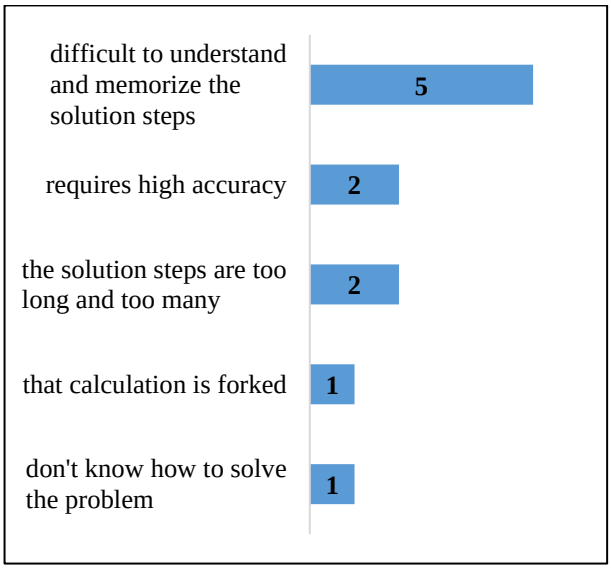


Chart 2. Comparison of Number of Reasons for Difficult SPLTV Materials



At the design analysis stage, the researchers chose Landbot as a web chatbot maker without programming because the researchers wanted to develop a chatbot that readers could imitate or modify without being proficient in programming. Landbot also provides a choice of free accounts whose features are pretty good, such as a feature to collect user responses and save them with certain variables to be called back into the chat or integrated with a spreadsheet. The chatbot display can arrange as desired to look attractive and interactive. Web-based chatbots made with Landbot can be accessed easily via a computer or smartphone do not require a lot of internet quota to access them. It can use to provide material in the form of reading texts in pdf files and as a media to practice working on problems. The disadvantage of a chatbot with a free account is that it can only respond to 100 users per month. Then the researchers began to plan the chat flow, the chatbot system flow, the display.

Chart 3. The flow of Chatbot System

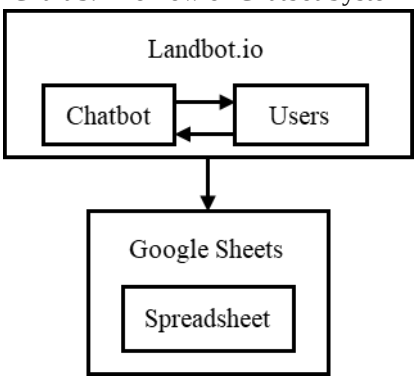
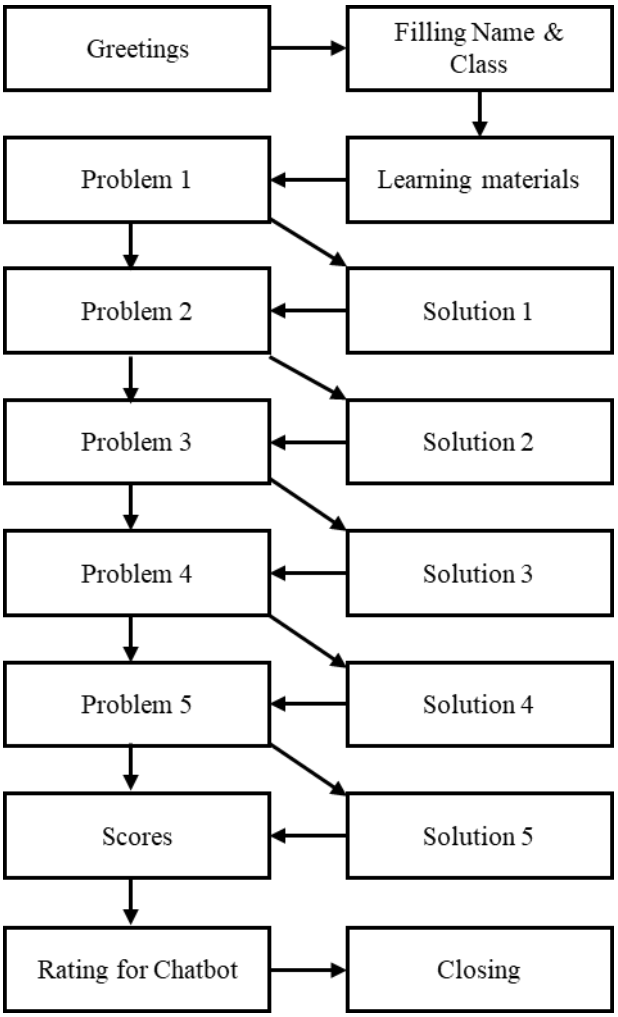


Chart 4. Flow of Chat



At the stage of collecting materials, researchers prepare SPLTV materials in the form of pdf files and prepare SPLTV problems which will then integrate with the chatbot. The material file in the form of a pdf will be uploaded first in Drive then the link will be copied to the chatbot.

2) Initial Product Development

Initial product development begins with creating an account on Landbot and then a chatbot according to the previous plan. The tutorial for making chatbots with Landbot can see on the official Landbot website (https://landbot.io/). Creating a chatbot with Landbot is very easy because we only need to drag and drop chat blocks and define the chat flow we want (Jassova, 2021).

Furthermore, the SPLTV materials and problems prepared were integrated into the chatbot. The link to access chatbot shortened through the S.ID become (https://s.id/MATBOT) that was easy to remember and distribute to students.

When we access the link, the initial display is the chatbot web page, which contains the name of the chatbot, namely "MATBOT" with the slogan "Yuk Berlatih Soal" and greetings from MATBOT shown in Figures 1 and 2.

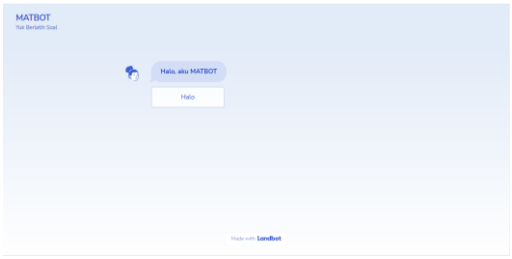


Figure 1. Initial Display on the Desktop

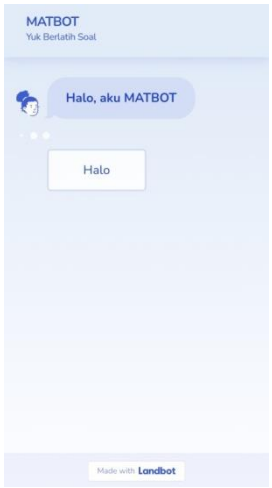


Figure 2. Initial Display on a Smartphone

Figure 3. Identity Filling

If the user presses the "Halo" button, a chat will appear to fill in the user's identity in the form of name and class origin, as shown in Figure 3. Then after pressing the "Continue" button, chatbot info will appear as shown in Figure 3. 4. If the user presses "DI SINI" it will be directed to a material file in the form of a pdf which can be downloaded via Drive. The material will look like in Figure 5.

Figure 4. Chatbot info

Figure 5. Material Display

Then if the user presses the "Aku Siap" button, question 1 will appear as in Figure 6. After the user selects

one answer option, feedback will appear. Different feedback depending on the answer chosen is right or wrong. Two buttons will appear after answering one question: a button to discuss the previously answered question and a button to move on to the next question, as shown in Figures 7 and 8. After the discussion appears For the question, a button will appear to continue the next question, as shown in Figure 9.

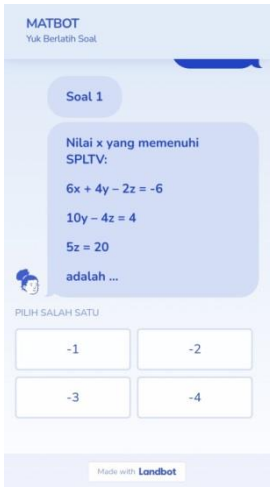


Figure 6. Question 1

Figure 7. Correct Answer

Figure 8. Wrong Answer

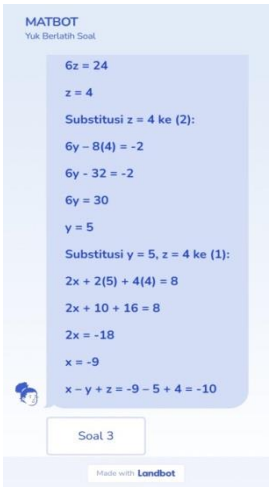


Figure 9. Discussion of the Problems

After answering question 5, the "Nilai" button will see the value, as shown in Figure 10. Then information about the value obtained will appear, and the "Beri Penilaian MATBOT" button appears to find out User ratings of chatbots, as shown in Figure 11.

Figure 10. Rating Button

Figure 11. Chatbot Rating Button

Then an option will appear to rate the chatbot and a suggestion column as shown in Figures 12 and 13. After the user presses the "Selesai" button, MATBOT will end the chat with closing greetings, as shown in Figure 14.

Figure 12. Rating for Chatbot

Figure 13. Suggestion Column

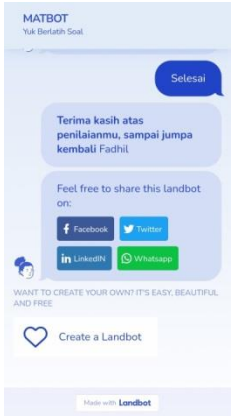


Figure 14. Closing Greetings

Chat data from chatbot users can be seen in a spreadsheet (https://s.id/DATAMATBOT) integrated with the chatbot. The data is stored in the name, class, grade, and assessment of the chatbot, as shown in Figure 15.

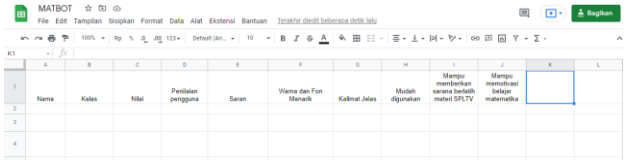


Figure 15.Spreadsheet

3) Testing of Developed Product

After the initial product development has been completed, a product test is carried out. The test includes two stages: (1) Expert test consisting of material validation and media validation to determine media validity; (2) Small-scale trial to ten-grade students of SMA Muhammadiyah 10 GKB Gresik to determine the practicality and effectiveness of the media. The assessment results of the two validators (V1 and V2) on the media can be seen in Table 4 below.

Table 4. Expert Validation Results

Criteria Assessed	Points V1	Points V2	Max. Points
The attractiveness of chatbot colors and fonts	2	3	8
Clarity of sentences used	3	4	8
Ease of using the chatbot	4	4	8
Ability to provide training tools for solving SPLTV problems	2	4	8
Ability to motivate to learn mathematics	2	3	8
Satisfaction with the use of chatbots	2	4	8
Total	15	22	48

Description of points: (4) Very good, (3) Good, (2) Fairly good, (1) Not good

Based on Table 4, the validity value is 77,08%. A revision was made to the developed chatbot media in the expert test. Several revisions to the media were adding the SPLDV problems as students' prerequisite knowledge, integrating the SPLTV material directly on the chatbot instead of in a pdf file, and making the questions random every time a user accesses the chatbot and enters random numbers. The revisions can be seen in Figure 16, Figure 17, Figure 18, and Figure 19.

Figure 16. Random Number Filling Column

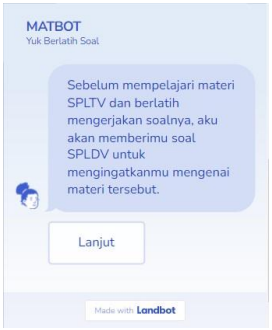


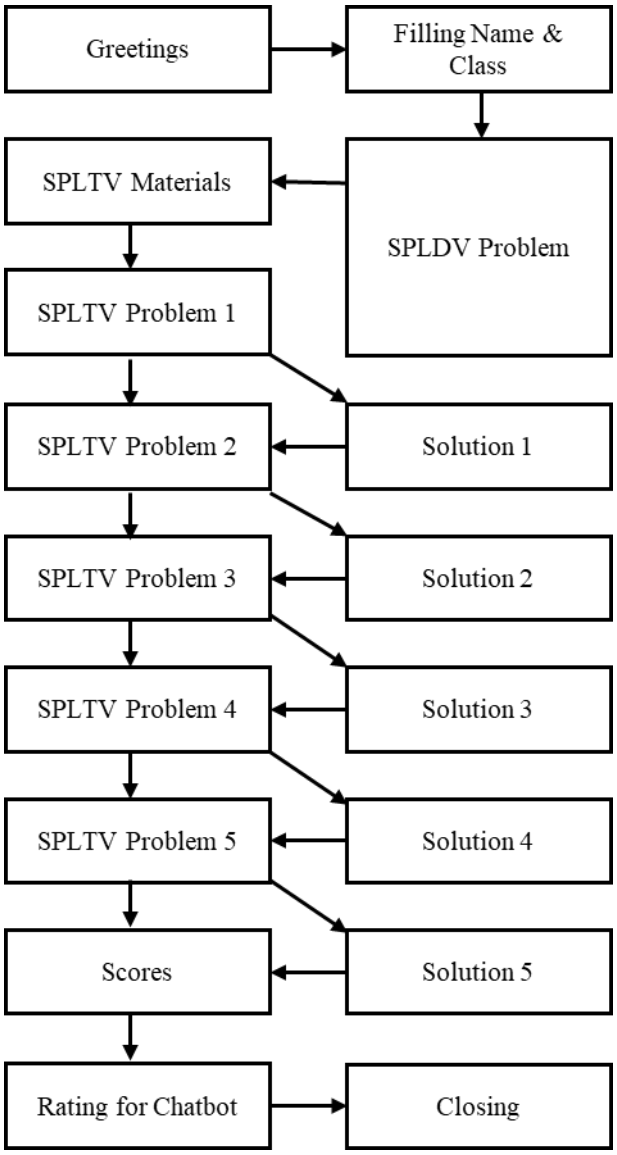
Figure 17. Menu for Prerequisite Problems

Figure 18. Menu Material

Figure 19. The initial view of Material

The chat flow revision chart can be seen in Chart 5 below.

Chart 5. Revised Chat Flow



From the validity test results, it can be concluded that the media is valid and can be tested on students. Questionnaires were given to collect student assessments of the media developed as material for evaluating the media. Table 5 below shows the results of the questionnaire response analysis of 33 ten-grade students of SMA Muhammadiyah 10 GKB Gresik.

Table 5. Student Assessment Questionnaire Results

Criteria assessed	Points	Max. Points
Display chatbot	88	132
Chatbot uses clear sentences	102	132
The chatbot is easy to use	106	132
Chatbot as a means of practicing SPLTV problems	97	132
The chatbot can motivate students in learning mathematics	96	132
Satisfaction with use chatbot	104	132
Total	593	792

Full point description: 4 points x 33 (Number of Subjects)

The practicality of the chatbot media is determined based on the results of a practicality assessment questionnaire by students. The practical value of the chatbot media obtained is 74.87%. The effectiveness of the chatbot media can be taken from the results of students' scores on the chatbot media because students work on the questions on the chatbot media individually and under the supervision of researchers. An accurate level of effectiveness will be obtained. The KKM for the questions on the chatbot media is 80. Based on student scores, it is known that 25 out of 33 students scored more than or equal to 80, or about 75.75% of students reached the KKM.

Discussion

The chatbot media has been developed according to the Borg and Gall model procedure modified by Soenarto, with the following process:

1) Product Analysis

The product analysis process consists of 3 stages: concept analysis, design analysis, and material collection. At the concept analysis stage, the researchers chose SPLTV material because, for some students, the material was difficult to understand. The researchers chose Landbot as a web chatbot maker at the design analysis stage because its features were sufficient to create an attractive and interactive chatbot. The researchers also planned the chat flow, chatbot system flow, display. At the material collection stage, the researchers prepare SPLTV materials and problems that will be integrated with the chatbot.

2) Initial Product Development

Initial product development begins with creating an account on Landbot and then a chatbot according to the previous plan. Furthermore, the SPLTV materials and problems that have been prepared previously are integrated into the chatbot. The link to access the chatbot was shortened through the S.ID become (https://s.id/MATBOT) that was easy to remember and distribute to students. Chat data from chatbot users can be saved and viewed in a spreadsheet (https://s.id/DATAMATBOT) integrated with the chatbot. The data is stored in the form of name, class, grade, and assessment of the chatbot.

3) Testing of Developed Product

The product testing processes are in two stages: (1) Expert test consisting of material validation and media validation; (2) Small-scale trial to ten-grade students of SMA Muhammadiyah 10 GKB Gresik.

Based on the results of the product testing, the developed chatbot obtained:

1) The validity value is 77.08%, so based on the validity test criteria in Table 1, the chatbot media is said to be valid or can be used but needs minor revisions;
2) The practicality value is 74.87%, so according to the practicality test criteria, it can be concluded that the chatbot media can be said to be practical or can be used with a few revisions;
3) The effectiveness value is 75.75%, so based on the effectiveness test criteria, the chatbot media can be effective or used but needs minor revisions.

The validity of the chatbot media is based on the results of two expert validators conducted with the help of a lecturer with a Master's degree in Mathematics Education who has competence in the field of computer application programming and a high school mathematics teacher with a Bachelor of Education. The practicality of the chatbot media is based on a small trial on 33 ten-grade students of SMA Muhammadiyah 10 GKB Gresik. The effectiveness of the chatbot media is based on students' scores, which shows 75.75% of students scored more than or equal to 80 (KKM). The questionnaire results also show that the media can motivate students to learn mathematics. These results strengthen the conclusion from (Ardimansyah & Widianto, 2021) that chatbots can be an alternative learning media. The interactive and interesting chatbot learning media can present SPLTV material and provide a means to practice SPLTV problems.

CLOSING

Conclusion

The chatbot media has been developed according to the Borg and Gall model procedure modified by Soenarto. The researchers chose SPLTV material, Landbot as a web chatbot maker, and prepared SPLTV materials and problems in the product analysis stage. In the initial product development stage, the researchers created a chatbot through the Landbot web by integrating SPLTV materials and problems into the chatbot and integrating user responses into a spreadsheet. In the testing phase of the developed product, the researchers conducted an expert test with the help of two media expert validators and a material expert and conducted a small-scale trial on 33 ten-grade students of SMA Muhammadiyah 10 GKB Gresik.

Based on the validity, practicality, effectiveness test results, the chatbot media got a validity score of 77.08%, practicality score of 74.87%, and effectiveness score of 75.75%. So it can be concluded that web-based chatbot media is feasible to use in learning the system of linear equations in three variables materials because it has qualified the criteria of being valid, practical, and effective.

Suggestions

In the research process, researchers have carried out development, and there are several shortcomings from the results of this study. So the researchers provide suggestions in developing the next chatbot as follows.

1) Making the question and answer feature on the chatbot to make it more interactive,
2) Adding a chat section to guide,
3) Displaying material more attractive not as a textbook
4) Adding variations on SPLTV problems,
5) Adding step by step solutions for SPLTV or an improvement of SPLDV solutions,
6) To improve the quality of the chatbot display like adding images, videos, or audio to make it more attractive.

The researchers hope these suggestions can be realized in the subsequent chatbot development or future works.

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