DEVELOPMENT OF ONLINE INTERACTIVE LEARNING MEDIA USING GeoGebra APPLET ON PROBABILITY

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ABSTRACT

This research is motivated by the absence of utilization and use of the GeoGebra Applet for probability as an online interactive learning media. The learning media developed for probability are conventional learning media such as manipulative materials, comics, and monopoly. In addition, the use and use of the GeoGebra Applet mostly discusses geometry, such as the area of plane geometry, spatial shapes, geometric transformations, area integrals, derivatives, and quadratic equations. Hence, an online-based interactive learning media is needed for probability, one of which is the GeoGebra Applet. This research aims to produce an online interactive learning media using the GeoGebra Applet on probability. The use of the model in this development research is the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The research subjects included three mathematics teachers and 29 Year 8 students. The data collection was done by observation in the form of needs analysis and interviews, and questionnaires. The study results were obtained based on the percentage of validation scores by two expert validators, including material experts, with results of 92.5% (highly feasible category), and language aspects, with a percentage of 100% (highly feasible category). The media expert validation result of the display aspect was 75% (feasible category), the interaction aspect was 66.67% (feasible category), the control aspect was 75% (appropriate category), and the form aspect was 75 % (appropriate category). In addition, the questionnaire responses from three mathematics teachers showed a percentage of 92.5% (highly feasible category), and the result from 29 students was 88.04% (highly feasible category). Thus, the GeoGebra Applet can be applied as an online interactive learning medium for probability in Year 8.

ARTICLE INFORMATION

How to Cite

Pebrianti, M., Handayani, I. (2022). Development of Online Interactive Learning Media Using GeoGebra Applet on Probability. *Kalamatika: Jurnal Pendidikan Matematika*, *7*(2), 143-162.

INTRODUCTION

Learning media is a component or tool that can convey notes about learning objectives (Ramdhani, 2017). Learning objectives can be implemented due to the use of learning media as a supporting tool in the learning process (Puspitarini & Hanif, 2019). Learning media are physical and non-physical facilities that cause students to receive learning materials as a whole and generate student interest in learning because teachers can communicate material effectively and efficiently to students (Musfiqon, 2012). So, learning media can be interpreted as a hardware or software tool used by teachers to communicate the material to students in a more effective and efficient learning process following learning objectives.

Media is divided into five: (1) human-based media; (2) visual-based media; (3) audio-visual-based media; (4) computer-based media (Leshin et al., 1992). One of the advantages of computer-based media is that it can make students regulate their own, deepening increased and comprehensive learning (Ramdhani, 2017). In addition, Mimbadri et al. (2019) explained that desire, interest, motivation, and information technology-based media could develop interest and motivation to learn. Meanwhile, Handayani & Sulisworo (2021) argued that creatively and interestingly delivering material can make learning more exciting and not boring due to conventional learning. Currently, various media or methods used in the learning process are still considered conventional, such as lecture, discussion, and question-and-answer methods without the use of learning aids or tools, thus making students find it difficult to interpret mathematical concepts (Sidabutar & Reflina, 2022). In addition, Aprillia & Zainil (2020) also stated that projectors and power points are still used as supporting media in the learning process. In addition, the use of markers and blackboards, as well as drawing media in the classroom, are also often used by teachers. This causes students to be less active (Andani et al., 2013).

A similar finding was also revealed by Fatoni et al. (2017) that in the learning process, the majority of students were not active because they were busy chatting and did not pay attention to the presentation of material by the teacher as a result of too often students only heard and memorized the learning material provided by the teacher. Besides, student learning activities were also neglected because teachers focus more on providing the main subject matter (Proklamanto & Rudhito, 2013). Therefore, creating interesting learning in the process of presenting material is supported by factors, one of which is the media, especially online-based interactive learning media. One of the computer programs that can be used as a medium for

learning mathematics is the GeoGebra program (Aprillia & Zainil, 2020).

GeoGebra is an online interactive learning media based on graphs and geometry that focuses on the problem of mathematical concepts so that it can be implemented in mathematics learning (Nur'aini et al., 2017). GeoGebra is an interactive geometry software aimed at students aged 10 to 18 years which can stimulate students to carry out an experimental approach by proposing algebraic opportunities by inputting equations directly into the software (Hohenwarter & Fuchs, 2005; Nababan, 2020). The development of this learning media requires students to play an active and creative role, so it is used as the reason for choosing GeoGebra as software that helps. Suryawan & Permana (2020), learning activities in the 2013 Curriculum prioritize learning with a scientific approach consisting of (1) observing; (2) asking; (3) collecting information; (4) associating; and (5) communicating, where the GeoGebra software is suitable and relevant to be used and utilized by students (Suryawan, 2019).

In the use and utilization of the online interactive learning media, the researchers chose probability materials that were considered difficult for students to understand. This was revealed by Putridayani & Chotimah (2020). She stated that the probability material was difficult because the process of understanding the concept of probability material was lacking, the implementation of formulas in solving problems that were not appropriate, and a lack of curiosity in studying probability material. In addition, Fitri & Abadi (2021) also explained that the difficulty of the probability material was due to students' understanding of the problem and process skills, and drawing conclusions in solving the problem of probability material was difficult. It is in line with Akbar et al.'s (2018) finding that students lack understanding in communicating information or probability problems. So, this proves probability is difficult for students to understand. In addition, the use of the GeoGebra Applet for probability materials is only available in the GeoGebra Classroom by other users who can be accessed the GeoGebra online site. However, there has been no publication regarding using the GeoGebra Applet for probability. This supports the novelty of this research, namely the use of the GeoGebra Applet for probability as an online interactive learning medium.

Many studies have been conducted (Deviana, 2018; Hanah et al., 2016; Septy et al., 2015), yet there is no use of GeoGebra Applets for probability as online interactive learning media. The learning media developed for probability materials are conventional learning media, such as learning materials. Manipulative, comic, and monopoly. In addition, there is no

development of learning media assisted by GeoGebra software for probability material. Most of them discuss geometry, such as the area of flat shapes, space shapes, geometric transformations, area integrals, derivatives, and quadratic equations (Aprilia & Zainal, 2020; Fatoni et al., 2017; Handayani & Sulisworo, 2021; Mimbadri et al., 2019; Proklamanto & Rudhito, 2013; Ramdhani, 2017). Thus, this study developed an online interactive learning media using the GeoGebra Applet for probability.

METHOD

This research uses Research and Development (R&D). R&D is one type of research aimed at producing a product and testing its effectiveness of the product (Sugiyono, 2015). The resulting product is an online interactive learning media using the GeoGebra Applet on probability material. The ADDIE (Analysis, Design, Development, Implementation, Evaluation) model by Robert Maribe Branch is used in this development research. Meanwhile, the approach used is a qualitative approach to examine the media obtained based on criticism and suggestions during the development process, as well as a quantitative approach to test the feasibility of the product. The following is an explanation of the ADDIE model research procedures carried out by researchers, including:

Analysis

The initial stage is the analysis stage analyzing the needs for developing teaching materials and product feasibility as a product development effort by researchers. At this stage, the researchers made observations in schools and interviews. Observations made were analyzing the needs of mathematics teachers and students and interviews with mathematics teachers to determine the characteristics or profiles of students and learning needs to achieve learning objectives.

Design

The second stage is the researchers designing the media to be developed by analyzing the identification points, which then finds the solution to be addressed by starting to design interactive online learning media using the GeoGebra Applet for the probability material to be developed.

Development

The third stage is the researchers conducting a validity test on two experts, material experts, and media experts, intended to assess online interactive learning media using the

GeoGebra Applet, developed before being implemented for mathematics teachers and students.

Implementation

The fourth stage is a trial of online interactive learning media using the GeoGebra Applet, developed for three mathematics teachers and 29 students.

Evaluation

The last stage is an evaluation by assessing mathematics teachers and students on the use of online interactive learning media using the GeoGebra Applet, developed through response questionnaires. Next, the results of the responses of the mathematics teacher and students were analyzed to describe research results. The explanation of the ADDIE model procedure can be described in Figure 1.
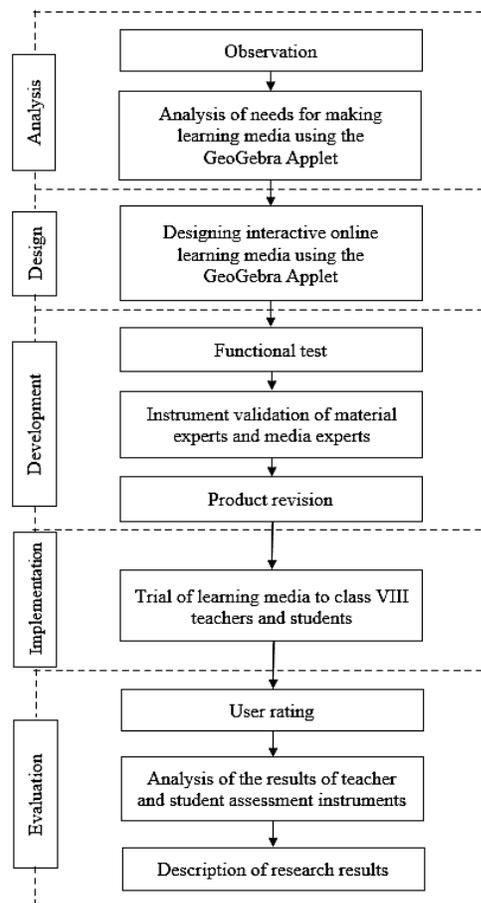

Figure 1. Addie Model Procedure by Researcher

The subjects of this study consisted of two expert validators, one material expert validator and one media expert validator, as well as mathematics teachers and students. The

target users of the product were three mathematics teachers and 29 Year 8 students. The data collection involved (1) observation in the form of initial data collection, namely conducting a needs analysis for mathematics teachers and students on the use of learning media, especially online interactive learning media using the GeoGebra Applet that will be developed; (2) interviews, conducted with mathematics teachers to obtain information related to the implementation of learning, especially learning media; and (3) a questionnaire, in the form of a material expert and media expert validation sheet as well as a response questionnaire for mathematics teachers and students.

Validation sheets by material expert validators and media experts, as well as a response questionnaire for mathematics teachers and students, were intended to test the feasibility of using interactive online learning media using the developed GeoGebra Applet. The instrument used a Likert scale structure with a scale of 1–4. To calculate the sum of the average for each assessment, the following is as follows shows (1) (Mashuri & Budiyono, 2020).

$$P(\%) = \frac{score\ obtained}{maximum\ score} \qquad (1)$$

The interpretation of the results of the Likert scale score after obtaining the percentage of eligibility (Purnama & Pramudiani, 2021) is as follows:

Table 1. Likert Scale Score Results

Assessment	Category
81.0 – 100.0	Highly Feasible
61.0 – 80.9	Feasible
41.0 – 60.9	Less feasible
21.0 – 40.9	Not feasible

RESULT AND DISCUSSION

The results of the development research are online interactive learning media using the GeoGebra Applet for probability can be applied as online interactive learning media for Year 8. This GeoGebra Applet contains probability, sample questions, and practice questions. Moreover, the systematic arrangement and clear instructions for use. This GeoGebra applet is a learning media that can be operated online via the web without downloading an application and does not require large storage space. In addition, online interactive learning media using the GeoGebra Applet can be used as a tool for teachers and students when learning probability material, especially in the section on throwing dice and coins and taking marbles. The results of student work or trials carried out by the teacher can be seen directly through the GeoGebra classroom as a lesson without any other supporting applications. Figure 2 displays the online

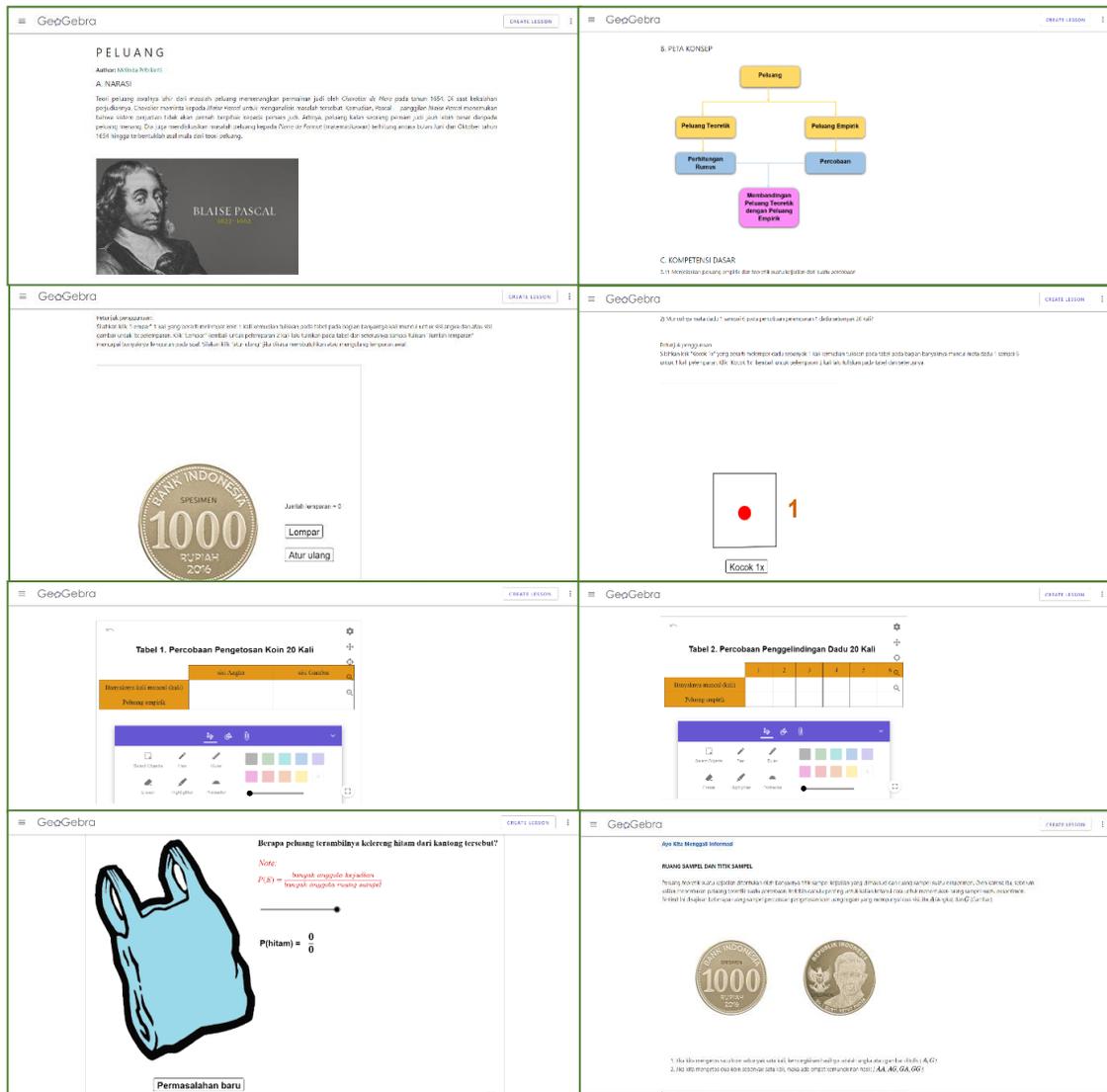interactive learning media using the GeoGebra Applet for probability.

Figure 2. GeoGebra Applet Display

In the initial data collection, observations were made in the form of an analysis of the needs of mathematics teachers and students and interviews with mathematics teachers. The instrument used is a needs analysis sheet that aims to determine learning needs, especially in the use of online interactive learning media using the GeoGebra Applet to be developed. Table 2 presents data from the analysis of the needs of mathematics teachers, adapted from Sukmanasa et al. (2020).

Table 2. Results of Mathematics Teacher Needs Analysis

Statement	Response (%)	Response Description
The use of learning methods in the learning process	100	Conventional

Statement	Response (%)	Response Description
in the classroom	0	Interactive (discussion and using ICT media)
The use of media in the learning process in the classroom	0	Book
	0	Student worksheet
	0	Whiteboard
	66.67	Student worksheet, book, and whiteboard
	33.33	Powerpoint, book, and whiteboard
Teachers have used ICT media in the learning process	100	Ever
	0	Never
ICT media used in the learning process	100	Powerpoint
	0	Videos
The use of interactive multimedia in the learning process	100	Ever
	0	Never
The need for the use of interactive multimedia in the learning process	100	Need
	0	No need
How teachers get interactive multimedia	0	Make your own
	100	Downloading from internet
	0	Provided by school
	0	No facilities
The teacher has received training in making interactive multimedia	66.67	Ever
	33.33	Never
Learning media using GeoGebra is an interesting media	100	Interesting
	0	No Interesting
The need for the use of learning media using GeoGebra in explaining mathematical material	100	Need
	0	No need
The use of GeoGebra-based learning media to explain mathematics material is approved by the teacher	100	Agree
	0	Don't Agree

The distribution of a teacher needs analysis questionnaire for online interactive learning media using the GeoGebra Applet to be developed and carried out to three mathematics teachers at Junior High School. Table 2 shows that the GeoGebra Applet learning media is interesting (100%). In addition, 100% of teachers agreed with the use of GeoGebra-based learning media to explain probability. This way, online interactive learning media using the GeoGebra Applet can be developed based on a mathematics teacher needs analysis questionnaire.

Furthermore, the data from the analysis of student needs, adapted from (Dadi et al., 2019), are presented in Table 3.

Table 3. Results of Student Needs Analysis

Statement	Response (%)	Response Description
Students love math	69.2	Yes
	30.8	No
The use of learning methods by teachers in the learning process in the classroom	7.7	Conventional
	92.3	Interactive (discussion and using ICT media)
The use of media by teachers in the learning process in the classroom	65.4	Book and whiteboard
	3.8	Student worksheet
	7.7	Whiteboard
	23.1	Laptop
	0	LCD
Students have been taught to use ICT media in the	96.2	Ever

Statement	Response (%)	Response Description
learning process	3.8	Never
The means used to display ICT media in the learning	73.1	Powerpoint
process	19.2	Videos
	3.8	LCD
	3.8	No facilities
Students have been taught to use interactive	96.2	Ever
multimedia in the learning process	3.8	Never
The use of interactive multimedia helps students in	92.3	Yes
learning the concept of the material	7.7	No
The need for the use of interactive multimedia in the	92.3	Need
learning process	7.7	No need
Students have been taught to use GeoGebra-based	96.2	Ever
learning media	3.8	Never
Learning media using GeoGebra is an interesting	100	Interesting
media	0	No Interesting
The need for the use of learning media using	73.1	Need
GeoGebra in explaining mathematical material	26.9	No need
Parental permission to use laptop/smartphone for	100	Allow
study	0	Doesn't Allow

Analysis of student needs for online interactive learning media using the GeoGebra Applet to be developed was carried out by administering questionnaires to 29 Year 8 students. Based on Table 3, 92.3% of students stated the need for using interactive multimedia in the learning process. In addition, 100% of students stated that the learning media using the GeoGebra Applet was interesting. Thus, online interactive learning media using the GeoGebra Applet can be developed based on a student needs analysis questionnaire.

The following are the results of interviews conducted with mathematics teachers.

R : What learning methods do you usually use in learning mathematics?
T : It's varied. Sometimes conventional, project-based learning, and others adjust to the material only.
R : Do you use learning media when learning takes place in class?
T : Love to use it, especially in this digital age.
R : What forms and types of media are often used, Mr/Mrs?
T : Have you ever used quizizz, Kahoot, or word wall?
R : How is the learning situation in the classroom when you use learning media?
T : I'm enthusiastic, so students no longer use doodles when they answer or solve problems, let alone math problems.
R : Then, what is your response to computer-based media?
T : Agree; in today's era, full of digital technology and supported by conditions that are still not normal, it's good when there are computer-based media. Plus, today, many children use gadgets, and they are their own.
R : Have you ever used a learning media called GeoGebra, especially in the GeoGebra Applet section?
T : Yes, I have. Usually used the GeoGebra application for material related to Cartesian diagrams, namely looking for x and y points, for example, line equations. However, the Applet does not yet know what it looks like.

R	:	How would you respond if GeoGebra, namely the GeoGebra Applet, is used in mathematics learning as an online-based interactive learning medium?
T	:	Good. So students no longer need to doodle or interpret problems in notebooks because they have been helped by GeoGebra, especially for the linear equation material.
R	:	In your opinion, what are the criteria for good computer learning media? Especially online-based interactive learning media using GeoGebra?
T	:	First, it is easy to operate by students, of course, and effective. Then, the supporters can choose an attractive color for the important parts. Finally, it is easy for students to understand so that they are responsive and can interact with each other, which is important when the learning process uses GeoGebra. So it creates a sense of enthusiasm for students and stimulates learning to emerge.
R	:	In your opinion, what things should be displayed in the GeoGebra Applet?
T	:	Of course, there is material. For material, if possible, don't display too much writing or reading because students will be lazy to read. Better to give examples and practice questions. Then the explanation of the concept is also clear.
R	:	How are students prepared for digital technology-based learning like this, Mr/Mrs?
T	:	They are ready. Students are also used to learning to use digital media based on this digital technology.
R	:	How is the readiness of digital technology-based learning facilities and infrastructure in schools?
T	:	They are ready. Each student has been given a Chromebook that can be used immediately. The school also has a computer lab. The number of computers here is also sufficient.

The results of interviews with mathematics teachers concluded that teachers used digital technology-based learning media to support the learning process. In addition, the teacher also briefly knows about the GeoGebra application and its use. It is also supported by enthusiastic student responses when the teacher uses GeoGebra in certain materials, such as line equations. This is in line with Khasanah & Nugraheni (2022), revealing that 68.04% of students were interested in using the GeoGebra application. In addition, the facilities obtained by students from the school were also adequate, such as giving Chromebooks to each student. Thus, the results of the interview support researchers being able to produce a product in the form of a GeoGebra Applet on probability material as an online interactive learning medium.

The results of the assessment of online interactive learning media using the GeoGebra Applet by validators of material experts and media experts. For material experts, the instrument given is a validation sheet consisting of two aspects, material and language, using a 1–4 Likert scale structure. Figure 2 displays data obtained in terms of the assessment results of the material expert validator, adapted from Kurniawati & Koeswanti (2021).
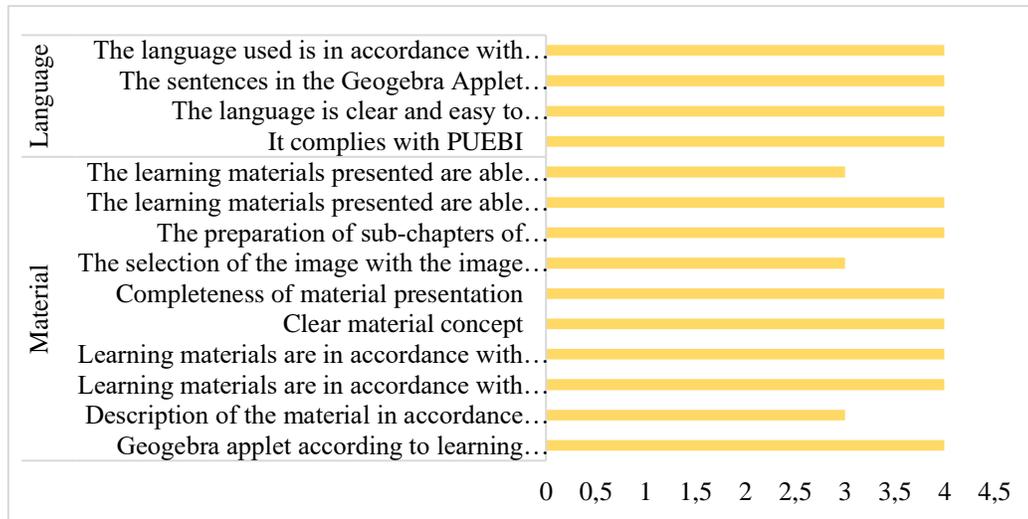
Figure 2. Material Expert Valuation Bar Chart

Based on Figure 2, the material expert validator's assessment results are viewed from two aspects, namely the material aspect, with 37 scores obtained from 40 maximum scores. While in the aspect of language, 16 scores were obtained from the maximum of 16 scores. The results of the material expert validator's assessment can be written in Table 4.

Table 4. Recapitulation of Material Expert Validator Assessment Results

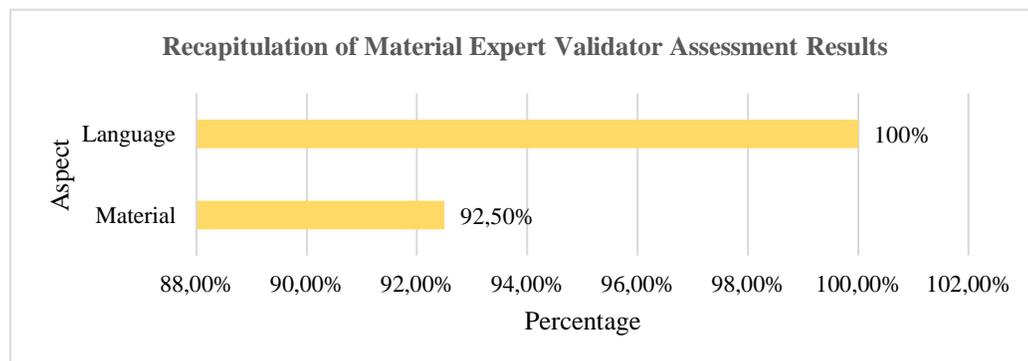| Aspect	Total Statements	Score Obtained	Max Score	Percentage	Category
Material	10	37	40	$\frac{37}{40} \times 100\% = 92,5\%$	Highly feasible
Language	4	16	16	$\frac{16}{16} \times 100\% = 100\%$	Highly feasible

Figure 3. Bar Chart Recapitulation of Assessment Results of Material Expert Validators

Figure 3 shows the percentage of the assessment results of the material aspect assessment of 92.5% (highly feasible) and the language aspect of 100% (highly feasible).

Furthermore, to the media expert, the instrument given was in the form of a validation sheet consisting of four aspects, namely display, interaction, control, and form, using a Likert scale structure 1–4. Figure 4 illustrates the data obtained based on the results of the media expert validator's assessment, adapted from Kurniawati & Koeswanti (2021):
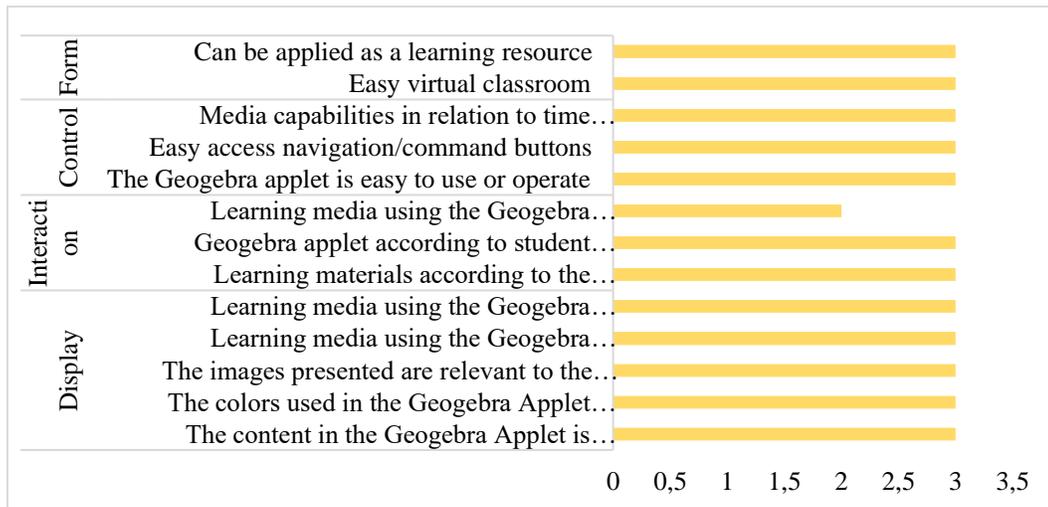

Figure 4. Media Expert Valuation Bar Chart

Based on Figure 4, the media expert validator's assessment results are reviewed from four aspects. The first aspect is the display, with 15 out of 20 maximum scores; the second is the interaction with the score obtained by 8 out of 12 maximum scores; the third is control, with a score of 9 out of 12 maximum scores; and the fourth is the form with a score of 6 out of 8 maximum scores. The results of the media expert validator's assessment can be written in Table 5.

Table 5. Recapitulation of Media Expert Validator Assessment Results

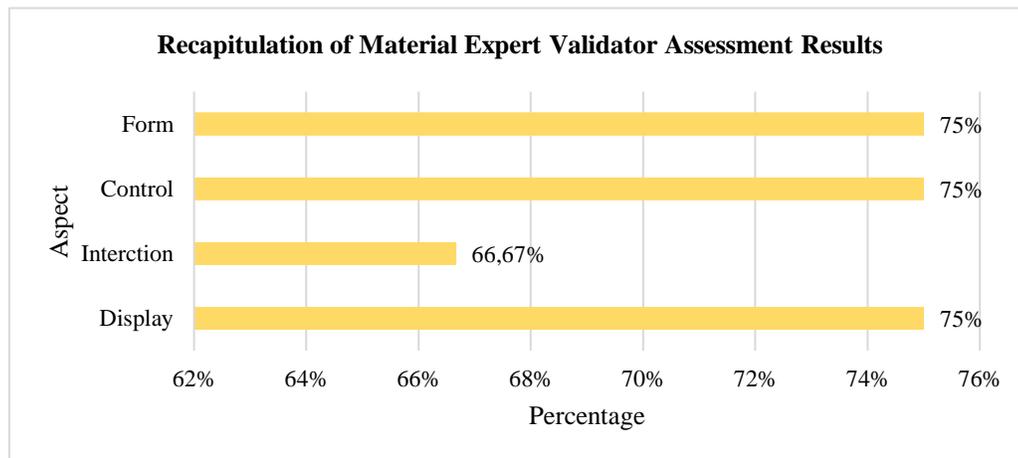| Aspect	Total Statements	Score Obtained	Max Score	Percentage	Category
Display	5	15	20	$\frac{15}{20} \times 100\%$ $= 75\%$	Feasible
Interaction	3	8	12	$\frac{8}{12} \times 100\%$ $= 66,67\%$	Feasible
Control	3	9	12	$\frac{9}{12} \times 100\%$ $= 75\%$	Feasible
Form	2	6	8	$\frac{6}{8} \times 100\%$ $= 75\%$	Feasible

Figure 5. Bar Chart Recapitulation of Assessment Results of Media Expert Validators

Figure 5 shows the results of the display aspect assessment with a percentage of 75% (feasible) from a total of 5 statements, interaction aspects with a percentage of 66.67% (feasible) from a total of 3 statements, control aspects with a percentage of 75% (feasible) from a total of 3 statements, and form aspect with a percentage of 75% (feasible) from a total of 2 statements.

From the results of the expert validator's assessment, the following comments were obtained, as displayed in Table 6.

Table 6. Comments of Expert Validators

Comment	Description
Material Expert	
1. In the "toss" section, the results are always "Pictures." 2. The image of the coin is not clear/clear. 3. The dice section is inconsistent in the mention of the terms "singing," "throwing," "shaking," and "rolling." 4. Fiersa Bestari's quote is irrelevant to the content of the material.	1. The coin toss applet has been revised so that the results are not always "Image." 2. The coin image has been fixed. 3. The mention is consistent. 4. Quotes are deleted because they are not appropriate and support the learning material.
Media Expert	
1. Applet is appropriate but still too few in giving examples. 2. For the narration, a picture of the figure who discovered opportunities and material benefits can be added.	1. Sample questions have been added that match the material. 2. The narration in the GeoGebra Classroom has also been added to the image of the inventor and the benefits of the probability material.

The comments of expert validators indicate that online interactive learning media using the GeoGebra Applet for probability was adequate but required some revisions.

Then, the assessment of online interactive learning media using the GeoGebra Applet was also obtained from mathematics teachers and students. The use of instruments in the form of a response questionnaire adapted from Sukmanasa et al. (2020). Tables 7 and 8 present the

data from the questionnaire responses of mathematics teachers and students.

Table 7. Results of Mathematics Teachers Response Questionnaire

Statement	Score Total
Indicators according to the level of development of students	12
The selected indicators are in accordance with the Basic Competence	12
The delivery of learning materials is interactive so that it motivates students to study independently	10
Learning materials presented using the GeoGebra Applet can increase students' learning motivation	11
The arrangement of activities in the GeoGebra Applet directs students to think coherently based on the five stages (observing, asking, gathering information, associating, and communicating)	11
The material presented is easy to understand	10
GeoGebra applets make it easier for students to learn	10
The suitability of the practice questions with the indicator formula	12
The suitability of the practice questions with the material presented	12
The sentence structure of the practice questions is easy to understand	12
Increase students' knowledge of the material presented	11
GeoGebra applets can increase student effectiveness in learning	10
In general, the GeoGebra Applet has good visual quality (display)	11
The contents of the GeoGebra Applet consist of materials for students and teachers (guide for teachers and student books)	12
Font selection accuracy	12
Ease of operation of the GeoGebra Applet feature	10
The words, terms, and sentences used are consistent	11
Facilitate the learning process	11
Make it easier for teachers to deliver material	11
Learning media using the GeoGebra Applet is safe for students to use	11
Total	222
Percentage	92.5%
Category	Highly feasible

Table 8. Results of the Student Response Questionnaire

Statement	Score Total
The images presented look very clear and follow the material	108
Presentation of the layout of the material is appropriate	102
The choice of colors presented is appropriate and attractive	106
The use of type and size of letters is clear and easy to read	108
The use of language is not difficult to understand	96
The content delivered is in accordance with the learning material	104
The content delivered is useful for learning probability materials	110
The applet used is in accordance with the current student learning conditions (flexible)	100
Students can use Applets without having to install apps	106
Students can operate in each of the steps presented easily	97
The suitability of the GeoGebra Applet used with my wants and needs	96
Penggunaan *Applet GeoGebra* memberikan pengalaman belajar yang positif	111
Learning media using this GeoGebra Applet can encourage students to be more active and independent in completing assignments	98
For students who rarely use this media, students like to use learning media using the GeoGebra Applet	97
Through this GeoGebra Applet, students have an idea about handling student assignments	97
After students use and operate this GeoGebra Applet, students are sure that they can complete the task well	98
Total	1634
Percentage	88.04%
Category	Highly feasible

Table 9. Recapitulation of Test Results for Mathematics Teachers and Students

Subject	Total Statements	Score Obtained	Max Score	P (%)	Category
Math Teacher	20	222	240	92.50	Highly feasible

Subject	Total Statements	Score Obtained	Max Score	P (%)	Category
Students	16	1634	1856	88.04	Highly feasible

Table 7 shows the results of the trial of three mathematics teachers and obtained a percentage of 92.5% (highly feasible). Furthermore, the results of the trial of 29 students showed a percentage of 88.04% (highly feasible).

CONCLUSION

It is concluded that this research produces the GeoGebra Applet as an online interactive learning media for probability. The use of the ADDIE model in this study consisted of Analysis, Design, Development, Implementation, and Evaluation. The data collection techniques were carried out through three stages: observation in the form of needs analysis and interviews and questionnaires. The results of media validation carried out by material expert validators were in a highly feasible category, and media experts were in a feasible category. Media trials were conducted on three mathematics teachers and 29 students by distributing a questionnaire, and the results were highly feasible. This shows that the use of the GeoGebra Applet for probability is feasible to be applied as an online interactive learning media in Year 8 and can overcome some problems elaborated in the background of this study.

REFERENCE

Akbar, P., Hamid, A., Bernard, M., & Sugandi, A. I. (2018). Analisis Kemampuan Pemecahan Masalah dan Disposisi Matematik Siswa Kelas XI SMA Putra Juang dalam Materi Peluang. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *2*(1), 144–153. https://doi.org/https://doi.org/10.31004/cendekia.v2i1.62

Andani, M., Herawati, S., & Edrizon. (2013). Pengembangan Perangkat Pembelajaran Matematika Interaktif Berbasis Edutainment Pada Materi Pokok Peluang untuk Siswa Kelas IX SMP. *Jurnal Fakultas Keguruan Dan Ilmu Pendidikan*, *2*(1), 1–12. https://ejurnal.bunghatta.ac.id/index.php/JFKIP/article/view/1640

Aprilia, D., & Zainal, M. (2020). Pengembangan Media Pembelajaran Bangun Ruang Berbasis Geogebra untuk Meningkatkan Hasil Belajar Peserta Didik Kelas V SD. *E-Jurnal Inovasi Pembelajaran SD: Jurnal Ilmiah Pendidikan Dasar*, *8*(8), 1–12.

http://ejournal.unp.ac.id/students/index.php/pgsd/article/view/10390

Aprillia, D., & Zainil, M. (2020). *Pengembangan Media Pembelajaran Bangun Ruang Berbasis GeoGebra untuk Meningkatkan Hasil Belajar Peserta Didik Kelas V SD Development of Learning Media for Building Space Based on GeoGebra to Improve Learning Outcomes of Class V Students in Elementary Scho*. 8.

Dadi, I. K., Redhana, I. W., & Juniartina, P. P. (2019). Analisis Kebutuhan Untuk Pengembangan Media Pembelajaran Ipa Berbasis Mind Mapping. *Jurnal Pendidikan Dan Pembelajaran Sains Indonesia (JPPSI)*, *2*(2), 70. https://doi.org/10.23887/jppsi.v2i2.19375

Deviana, D. R. E. P. (2018). Pengembangan Media Monopoli Matematika Pada Materi Peluang untuk Siswa SMP. *Jurnal Review Pembelajaran Matematika*, *3*(2), 114–131. https://doi.org/https://doi.org/10.15642/jrpm.2018.3.2.114-131

Fatoni, M. faizal, Dafik, & Fatahillah, A. (2017). Pengembangan Media Pembelajaran Interaktif Online Menggunakan KelasKita Berbantuan Software Geogebra pada Materi Persamaan Kuadrat. *Kadikma : Jurnal Matematika Dan Pendidikan Matematika*, *8*(2), 24–33. https://jurnal.unej.ac.id/index.php/kadikma/article/view/6070/4489

Fitri, A., & Abadi, A. M. (2021). Kesulitan Siswa SMA dalam Menyelesaikan Soal Matematika Pada Materi Peluang. *Jurnal Riset Pendidikan Matematika*, *8*(1), 96–105. https://doi.org/https://doi.org/10.21831/jrpm.v8i1.17004

Hanah, R., Muhsetyo, G., & Sisworo, S. (2016). Penggunaan Bahan Manipulatif untuk Memahamkan Materi Peluang pada Siswa SMP dengan Pendekatan Pendidikan Matematika Realistik. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *1*(5), 927–939. https://doi.org/10.17977/jp.v1i5.6312

Handayani, I. M., & Sulisworo, D. (2021). Pengembangan Media Pembelajaran Matematika Berbantuan Geogebra Pada Materi Transformasi Geometri. *Jurnal Equation: Teori Dan Penelitian Pendidikan Matematika*, *4*(1), 47–59. https://doi.org/DOI: http://dx.doi.org/10.29300/equation.v4i1.4027

Hohenwarter, M., & Fuchs, K. (2005). Combination of dynamic geometry, algebra, and calculus in the software system GeoGebra. *Computer Algebra Systems and Dynamic Geometry Systems in Mathematics Teaching Conference 2004*, *2002*(July), 1–6. http://www.geogebratube.org/material/show/id/747

Khasanah, U., & Nugraheni, E. A. (2022). Analisis Minat Belajar Matematika Siswa kelas VIII Pada Materi Segiempat Berbantuan Aplikasi Geogebra di SMP Negeri 239 Jakarta. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *6*(1), 181–190. https://doi.org/https://doi.org/10.31004/cendekia.v6i1.813

Kurniawati, U., & Koeswanti, H. D. (2021). Pengembangan Media Pembelajaran Kodig Untuk Meningkatkan Prestasi Belajar Siswa di Sekolah Dasar. *Jurnal Basicedu*, *5*(2), 1046–1052. https://doi.org/10.31004/basicedu.v5i2.843

Leshin, C. B., Pollock, J., & Reigeluth, C. M. (1992). *Instructional design strategies and tactics*. Educational Technology.

Mashuri, D. K., & Budiyono. (2020). Pengembangan Media Pembelajaran Video Animasi Materi Volume Bangun Ruang untuk SD Kelas V. *JPGSD: Jurnal Pendidikan Guru Sekolah Dasar*, *8*(5), 893–903.

Mimbadri, Y., Suharto, S., & Oktavianingtyas, E. (2019). Pengembangan Media Pembelajaran Matematika Interaktif Online Classflow Berbantuan Software Geogebra pada Materi Integral Luas Daerah. *MAJAMATH: Jurnal Matematika Dan Pendidikan Matematika*, *2*(2), 121. https://doi.org/10.36815/majamath.v2i2.410

Musfiqon, H. M. (2012). Pengembangan media dan sumber pembelajaran. *Jakarta: PT. Prestasi Pustakaraya*.

Nababan, N. (2020). Pengembangan Media Pembelajaran Berbasis Geogebra dengan Model Pengembangan Addie di Kelas XI SMAN 3 Medan. *Jurnal Inspiratif: Jurnal Pendidikan Matematika*, *6*(1), 37–50. https://doi.org/https://doi.org/10.24114/jpmi.v6i1.19657

Nur'aini, I. L., Harahap, E., Badruzzaman, F. H., & Darmawan, D. (2017). Pembelajaran Matematika Geometri Secara Realistis Dengan GeoGebra. *Matematika*, *16*(2), 1–6. https://doi.org/10.29313/jmtm.v16i2.3900

Proklamanto, A. R., & Rudhito, M. A. (2013). Efektivitas Pemanfaatan Program Geogebra Pada Pembelajaran Matematika dalam Upaya Membantu Pemahaman Materi Turunan. In *Prosiding Seminar Nasional Sains dan Pendidikan Sains VIII, Fakultas Sains dan Matematika, UKSW* (No. 2087–0922; Vol. 4, Issue 1).

Purnama, S. J., & Pramudiani, P. (2021). Pengembangan Media Pembelajaran Interaktif Berbasis Google Slide pada Materi Pecahan Sederhana di Sekolah Dasar. *Jurnal Basicedu*, *5*(4), 2440–2448. https://doi.org/10.31004/basicedu.v5i4.1247

Puspitarini, Y. D., & Hanif, M. (2019). Using Learning Media to Increase Learning Motivation in Elementary School. *Anatolian Journal of Education*, *4*(2), 53–60.

Putridayani, I. B., & Chotimah, S. (2020). Analisis Kesulitan Belajar Siswa dalam Pelajaran Matematika Pada Materi Peluang. *MAJU: Jurnal Ilmiah Pendidikan Matematika*, *7*(1), 57–62. https://www.ejournal.stkipbbm.ac.id/index.php/mtk/article/view/426

Ramdhani, S. (2017). Pengembangan Media Pembelajaran Konsep Luas Bidang Datar Berbasis Perangkat Lunak Geogebra. *JES-MAT (Jurnal Edukasi Dan Sains Matematika)*, *3*(2), 95. https://doi.org/10.25134/jes-mat.v3i2.684

Septy, L., Hartono, Y., Ilma, R., & Putri, I. (2015). Pengembangan Media Pembelajaran Komik Pada Materi Peluang Di Kelas Viii. *Jurnal Didaktik Matematika*, *2*(2), 16–26. https://doi.org/10.24815/jn.v

Sidabutar, N. A. L., & Reflina, R. (2022). Pengembangan Media Pembelajaran Matematika SMA dengan Aplikasi Animaker pada Materi Vektor. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *6*(2), 1374–1386. https://doi.org/10.31004/cendekia.v6i2.1362

Sugiyono, P. D. (2015). *Metode Penelitian Pendidikan: Pendekatan Kuantitatif, Kualitatif, dan R&D*. Alfabeta.

Sukmanasa, E., Novita, L., & Maesya, A. (2020). Analisis Respon Guru Terhadap Pelatihan dan Pendampingan Media Pembelajaran Berbasis Powtoon Pada Guru Gugus 1 Kota Bogor. *Indonesian Journal of Primary Education*, *4*(111–117). https://doi.org/https://doi.org/10.17509/ijpe.v4i1.25098

Suryawan, I. P. P. (2019). Rancang Bangun Dan Implementasi Media Pembelajaran Matematika Berbasis Lectorainspire Dengan Pendekatan Saintifik. *Jurnal Santiaji Pendidikan (JSP)*, *9*(2), 177–188. https://doi.org/10.36733/jsp.v9i2.399

Suryawan, I. P. P., & Permana, D. (2020). Media Pembelajaran Online Berbasis Geogebra sebagai Upaya Meningkatkan Pemahaman Konsep Matematika. *PRISMA*, *9*(1), 108. https://doi.org/10.35194/jp.v9i1.929