Development of brain-based learning teaching materials using crossnumber games in mathematics

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Abstract

Based on the results of the analysis of MTSN 2 Bandung, by using the learning media of the Ale application, the researcher developed teaching materials as a reference for learning media. Brain-Based Learning Teaching Materials Using Crossnumber Puzzle Games are developed using the Brain Based Learning approach. This research aims to find out: (1) the process of developing teaching materials; (2) the validity of the material; (3) material practicality; (4) the effectiveness of teaching materials. This method is used by the R&D Method with the ADDIE (Analysis, Design, Development, Implementation and Evaluation) model. The results of the study show that the validity of the media is very valid in the media aspect by media experts and the material aspect is in the valid category by material experts. Practicality of the media gets a very practical media category Effectiveness gets very effective results with a high category. However, there are shortcomings in teaching materials such as crossnumber practice problems cannot be used repeatedly, there is an assumption that students who do crossnumber may not necessarily be able to solve the problem, because crossnumber can use intuition.

INTRODUCTION

In building a country, the field of education is one of the most important areas that must be improved because a country can be seen to develop from its education (Tambunan, 2016). According to Langeveld (1980), education is a spiritual guidance needed in life, therefore education has an important role in life. The role of education includes the ability to produce individuals who are capable, imaginative, intelligent, competent, useful, concise, and wise, which are beneficial for development for the progress of the nation and state (Ariawan & Nufus, 2017:83). One of the important lessons is mathematics.

According to Sawyer (2007) Mathematics is the study of all patterns, patterns in mathematics must be understood by our minds and logic in order to be applied to other sciences (Herman, 1990 :74). The application of technology in mathematics subjects has changed rapidly. In this change, it is expected to be able to adapt to technology that will develop in the future. Thus, to improve a better standard of living, more efforts are needed by improving the quality of the mathematics learning process.

According to David Ausubel, the learning process can be classified into two ways of learning or delivering material from teachers to students, through discovery or acceptance in the learning process and the information or material enters the existing cognitive structure. The cognitive structure is divided into two, namely the knowledge that already exists in the self and the knowledge obtained from external information

forms a larger and more complex conceptual framework (Ausubel, 1968). According to Edward, sitting quietly with a lot of rules in a restricted place is a punishment for students. But that's what often happens in the classroom (Asizah, 2017). That way, learning is considered ideal referring to one's way of thinking.

Brain Based Learning is a learning method that adjusts the way humans learn to follow the way the brain thinks naturally (Jensen, 2008). By using the Brain Based Learning method in the learning process, the learning process can be maximized by using learning strategies that make students active in class and have a comprehensive experience. In the Brain Based Learning Method, students are divided into three groups, namely audiotory, visual and kinesthetic groups. By emphasizing the use of this method, it is hoped that it can help students develop skills that are relevant in the real world, such as solving problems related to the surrounding environment, working together, and finding creative and easiest ways to solve problems and being able to know how each one works or learns. To optimize brain development during the learning process, learning materials are needed that can stimulate the brain to think. This is why researchers use cross-number puzzles as a learning aid.

Crossnumber is a game that involves filling in letters in an empty box to form words that match the given clues. (Taufik, 2018). Crossnumber also helps train the brain, improve vocabulary, train memory, increase curiosity, expand vision, overcome boredom and improve concentration.

Based on the results of a preliminary study at MTSN 2 Bandung, by interviewing mathematics teacher Mrs. Aan at the mathematics learning school has used teaching materials such as package books, power points, LKPD, Alef applications, but there are no teaching materials based on Brain Based Learning using crossnumbers. Based on observations in schools, learning tends to make more use of the cerebellum, where the learning process is centered on the teacher with the main activity of memorizing the learning material, punishing if making mistakes, and receiving less appreciation for his actions. Every student with a different way of learning is required to follow the same way the brain works.

Based on the following description, teaching materials are needed and need to be developed in these schools because there are no teaching materials with the Brain Based Learning approach using crossnumbers, and as a reference for teachers, teachers become teaching modules that can focus on students, become a reference for teachers to find teaching modules that use the brain based learning method and teaching materials are needed as a means for students to learn independently, support learning differentiation and help teaching become more structured and effective. Assist students in finding the most effective way of learning for them (Sari, 2023).

METHOD

The research procedure using the ADDIE development model is explained with several stages of analysis first, after conducting analysis, designing, developing, implementing and finally evaluating, explained as follows:

Analysis

The first step in developing this educational material is analysis. The researchers conducted a need analysis to develop educational materials and analyzed their feasibility and requirements. According to Magdalena et al. (2020), the analysis carried out includes three main elements, namely needs analysis, program analysis, and student personality analysis. This analysis aims to ensure that the educational materials developed are in accordance with real needs and conditions.

a. Analysis Required

Analyze Needed was carried out to see the conditions in the field related to mathematics learning as the main information in MTSN 2 Bandung, then analyze the problems that occurred, the obstacles that arose in the field were one of the initial indicators of the need for the development of teaching materials. In the field, researchers found that children did not know the most effective way to learn for themselves. This analysis is needed to overcome existing challenges, the ability of researchers to implement teaching modules, and to find the effectiveness of teaching modules to be applied in the classroom.

b. Curriculum Analysis

Analyze Curriculum is carried out by considering the characteristics of the curriculum applied in schools today. The educational curriculum in Indonesia has changed rapidly over time. This change is based on the results of the analysis curriculum carried out by policy makers. Analyze Curriculum is important to adjust the learning instruments needed. This analysis is a reference for researchers to adjust teaching materials to suit the applicable curriculum. Furthermore, this analysis also helps in determining things related to learning in the classroom, such as formulating competencies, subject matter, learning strategies, and learning resources to be used.

c. Analysis of student characteristics

Analyzing the initial capacity of students is an activity to find out the needs and characteristics of students, in order to find out the criteria and level of change in behavior, goals and learning materials. Student characteristics include various aspects such as learning ability, age, maturity level, learning motivation, experience, psychomotor skills, collaboration skills and social skills (Atwi, 2001: 123).

Analysis of student characteristics is carried out to understand how mathematics learning can be adjusted to the characteristics of each student. The steps taken at this stage include looking at the characteristics, knowledge, thinking ability, and competence of students, to determine whether the learning is appropriate or not.

Design

After conducting the analysis stage, then design and design the learning teaching materials to be made. According to (Cahyadi, 2019), the design is designed by carrying out a systematic process that starts from the preparation of materials, concepts and instruments contained in teaching materials. The researcher makes the necessary instruments for the evaluation of the developed teaching materials. The instrument was prepared by looking at the aspects of assessing the teaching materials, namely the feasibility of the content of the material, the use of language, the feasibility of presenting the material, the feasibility of graphics, the ease of use and the suitability of the material. The instruments prepared are in the form of assessment sheets for teaching materials and student response questionnaires. Furthermore, the pre-prepared instruments should be tested to see which instruments are valid and can be used in the study. The design carried out in the preparation of Brain-Based Learning teaching materials using crossnumbers includes: (1) the concept of triangles contextually, (2) the concept of squares contextually, (3) triangles and quadrilateral problems in the form of crossnumbers. The design is carried out with the aim of media that is made according to the needs of consumers, in this case students.

Development

At this stage, the educational materials developed must be in accordance with the design that has been made. This development stage is the stage of making educational materials. In addition, educational materials will be verified by material validation experts and media experts. Validation of Material and Media Experts, if the educational document is considered invalid, the educational document will be changed in accordance with the recommendation of the document validation expert and document expert, which is then used as the basis for validation. See for modifications and improvements. The validation process is carried out with the aim of finding out the suitability of the media and obtaining opinions and input from experts to improve the quality of learning multimedia products before being tested on teachers and students.

Implementation

After the educational material is validated by material experts and communication experts, the next step is the implementation stage. At this stage, teaching materials have been tested both on a small and large scale as a mathematics learning tool in the classroom. Product testing aims to evaluate the response of teachers and students after using learning media products, as well as check the suitability of the media based on teacher and student assessments. In addition, to collect data on the effectiveness of educational materials, the results can be displayed and classified based on the value determined by the Ministry of National Education from students' responses to educational materials.

Table 1. Learning Outcome Category

Interval	Golongan
85-100	Very High
65-84	Tall
55-64	Keep
35-54	Low
0-34	Very Low

Source : Ministry of National Education (Rajid, 2018)

Evaluation

The final stage of this research is evaluation, which aims to evaluate each stage carried out as well as the products in the form of educational materials developed. At this stage, the researcher ensures that the educational material has achieved all the development goals that have been set. Evaluation includes the evaluation of learning materials by users, especially teachers and students. After being evaluated by teachers and students, the research data was analyzed using qualitative and quantitative methods so that conclusions could be drawn whether the learning media was in accordance with the learning process or not.

RESULTS AND DISCUSSION

In this research and development, the researcher chose the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model in designing a system-oriented education system. This system approach organizes the learning planning process into logical steps and uses it as input for the next steps (Janueszewski and Molenda, 2008). The development of teaching materials that are suitable using the ADDIE development model is suitable because the development process is arranged systematically and easily understood, consisting of five stages, namely analysis, design, development, implementation, and evaluation.

The first step in developing this educational material is analysis. According to (Magdalena et al., 2020), the analysis carried out includes three main aspects, namely needs analysis, program analysis, and student characteristics analysis. This data was collected through preliminary research by conducting interviews with teachers and students of MTSN 2 Bandung to identify problems in schools. In an interview with one of the mathematics teachers at MTSN 2 Bandung, Mrs. Dra. Aan Nurjanah, the researcher received information that mathematics learning in schools currently uses teaching materials such as package books, power points, LKPD, and

the Alphaf application, but there are no teaching materials based on Brain Based Learning using crossnumber puzzle games. And the teaching materials that are usually obtained by students are only package books which contain materials and competency tests without any visualization of illustrated stories related to the material.

Mulyasa (2013) clearly stated that the 2013 program is a competency-based program, namely a program concept that is more concerned with the development of students' character and the ability to socialize in carrying out group tasks with skills according to certain performance standards so that students can feel the results, in the form of mastery of the set given. Skills. The results obtained at the curriculum analysis stage are that the MTSN 2 Bandung school uses the 2013 curriculum. After knowing the curriculum used by the school, the researcher then analyzes the basic competencies and indicators of the ability to achieve competencies to be a reference for researchers in developing media. The next step is to determine the material that will be used for teaching materials for mathematics learning based on Brain Based Learning using the crossnumber puzzle game that will be developed. Based on the curriculum analysis that has been carried out, among the mathematics materials that refer to the curriculum is the 2013 curriculum.

Student characteristics are defined as characteristics of a student's personal qualities, which usually include academic ability, age and maturity level, subject motivation, experience, skills, and psychomotor abilities, cooperation skills, and social skills. (Atwi, 2001: 123). Student characteristics analysis is conducted to analyze students about how mathematics learning in the classroom is done. This is done so that the development is in accordance with the character of each student. Some of the things that must be done at this stage are to see the characteristics, knowledge, thinking ability, and competence of students whether they can be satisfied in learning or not. Characteristic analysis also affects learning styles, according to Neil Fleming, students' learning styles are divided into three learning styles, namely Visual explains students who prefer to get information through pictures, diagrams or graphs. Auditory explains students who prefer to get information through hearing. Kinesthetics describes students who prefer to get information from hands-on experience or physical activity. So in the characteristic analysis, the researcher conducted interviews with the mathematics teachers of the class concerned to find out that the average learning style in grades VII H and VII G is visual, which means that more students prefer to get information in the form of pictures, diagrams or graphs. Compared to using lecture methods and practice in real life.

The design stage aims to design the initial design of the product to be developed. According to (Cahyadi, 2019), design includes the implementation of a systematic process that begins with the preparation of ideas and materials included in the product. The product that will be developed

by the researcher is a Brain-Based Learning teaching material using crossnumbers. This stage is an advanced stage after passing the analysis stage. After obtaining sufficient information at the analysis stage, it is continued to start the initial design of the product which includes every step that will be carried out by the researcher, namely, test preparation, material design, flowchart making, storyboard making, drawing making, and image printing. At the analysis stage, it is known that more students have a visual learning style, so the module is made as attractive as possible by choosing colors that are adjusted to the alpha generation, namely dominant warm tone colors, as well as depicting stories in the form of comics.
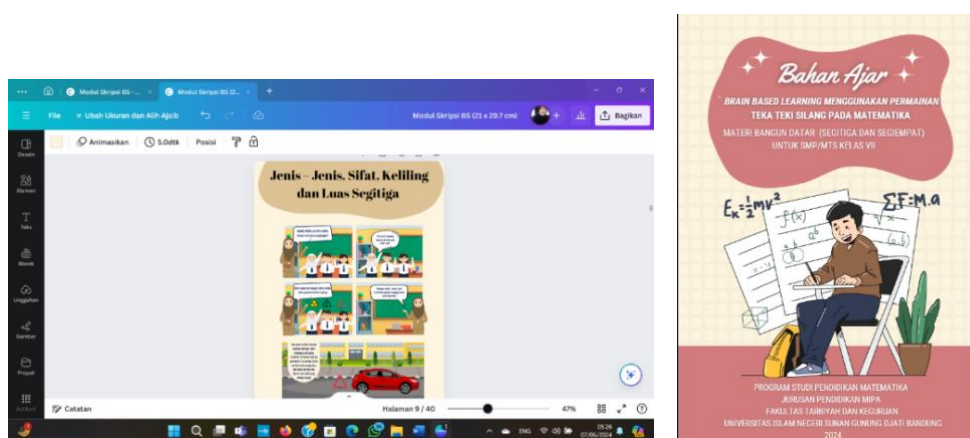

Figure 1. Designing the initial design

The next stage is to design the material that will be used in brain-based learning education materials using cross number puzzles. At the stage of designing this material, learning objectives will be developed, tests will be developed as guidelines for learning implementation, and student characteristics or behaviors will be presented based on the material. At this stage, the learning process will be detailed which is designed to achieve Core Competencies (KI), Core Competencies (KD), Learning Indicators, Learning Objectives, steps and integrated learning materials. This also includes the design of integrated student books with details of KI, KD, learning indicators and activity columns, in accordance with PERMENDIKBUD No. 22 of 2016 which regulates learning procedures including preliminary, basic and closing activities (Basyar, 2020).
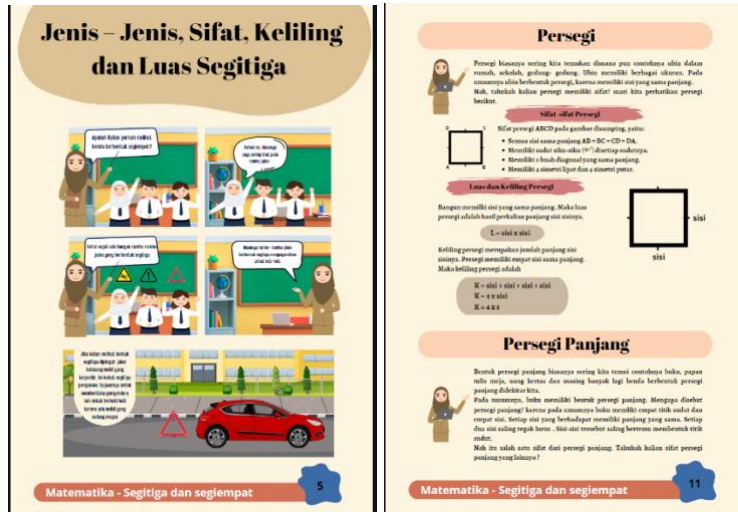
Figure 2. Material Design

The material used in this teaching material is based on the Brain Based Learning approach so that students can learn mathematics comfortably without difficulty and without being burdened according to their way of thinking, using the crossnumber puzzle game. These teaching materials will also include crossnumber games that will arouse students' curiosity, encourage them to think critically, and develop an interest in learning mathematics. The material that will be used in this teaching material includes the topic of triangles and squares for grade VII.

According to Indrajani (2011:22), a diagram is a representation of the steps and procedural sequence of a program. This often affects the resolution of certain problems that require further research and evaluation. Flowchart or commonly called the order of work in the creation of teaching materials has a sequence of making. The first order is to make a cover, after that make basic competencies and indicators of competency achievement, followed by the creation of material content, sample questions and practice questions. Then write down the author's personal data and finally print the teaching materials as shown in Figure 3.
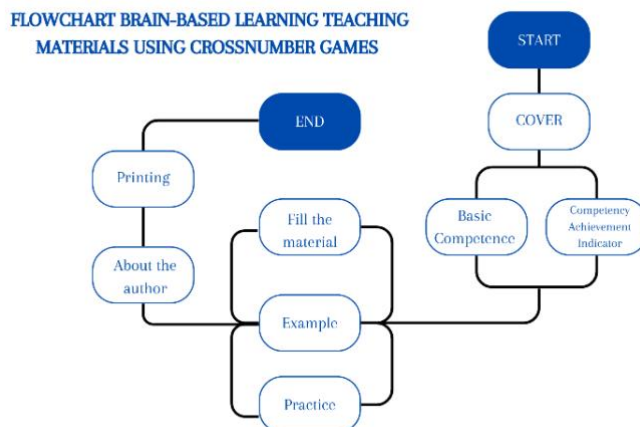
Figure 3. *Flowchart*

According to Restu et al. (2017:33), storyboarding is a way for a person to sort things according to the flow in the form of sketches. Thanks to storyboards, we can tell our ideas in a structured and easy way to others because we can accompany one's imagination through the images given, thus creating a perception that is identical to the idea of the story. The researcher concluded that the Storyboard is a description of the design that will be worked on from the cover to the last part to be discussed with media experts. In the display design, there is the creation of an image, which is done using the canva application. The creation of images is usually made to attract students to read mathematics teaching materials. Creations are usually on pages that contain stories so that students can imagine triangles and rectangles contextually or realistically in everyday life. Creating an image in canva is usually in the form of an animation provided in canva pro, the following animated animation is found in the canva feature, namely in the element. At this stage, the author thinks about the design that will be made according to what is popular with students now, from choosing warm tones, depicting comics as illustrations, and placing suitable images. Once all the designs were completed, the designs were printed using A4 size HVS paper in landscape format. It is printed in color, and given a clear cover so as not to damage the cover of the teaching material.

At the development stage, produce teaching materials. Then teaching materials are used in the mathematics learning process. In order for teaching materials to develop, teaching materials need to be validated by experts who know triangle and quadrilateral materials and teaching material media experts. The following steps are in accordance with the stages of development described by Branch which states that development needs to be validated by media experts and material experts and make a learning plan (Branch, 2009).

The results of the validation test by media experts showed an average result of 85.5%, which is included in the very valid criteria. Meanwhile, the results of the validation test by material experts showed an average result of 72%, included in the valid criteria. After the validation process was carried out, revisions were made so that the teaching materials for Brain Based Learning using cross-number puzzles could be used by students as a learning resource. This is in line with Fitriani's research which states that RRP with a Brain-Based Learning Approach is declared valid (Fitriani and Irawan, 2020). At this stage, the teaching module is handed over to validators who are material experts and media validators. Teaching materials written in Table 2.

Table 2. Media Expert Validation

It	Aspects	Indicator	Shoes	
			Validator 1	Validator 2
1	Ease and Practicality	Ease of learning media	80%	80%
		Practical, flexible and durable	85%	80%
2	Display Assessment	Coloring	93%	100%
		Of	85%	85%
		Design	100%	100%
		All-round view	84%	80%
3	Language Assessment	Word Selection/ Language	80%	96%
	Average score		86%	85%
			85,5%	
	Criterion		Highly Valid	

While the material validation grid has a content feasibility aspect that assesses the suitability of the material with the applicable KD has a score of 86%, the quality of the material presented in the teaching materials with a score of 88%, the presentation of the material in the teaching materials with a score of 76%, the comfort and attractiveness of the teaching materials with a score of 64%, after that there is also a language aspect that is assessed from the way the author communicates with readers in the teaching materials with a score of 64%, straightforwardness in teaching materials with a score of 70%, communication and interactivity with a score of 70% suitability of the material with previous analysis with 60%, and the use of terms, symbols and icons or images in teaching materials with 60%, and can be considered valid as shown in Table 3.

Table 3. Validation of materials experts

No	Aspects	Indicator	Shoes
1	Content Eligibility	Material compatibility with KD	86%
		Material quality	88%
		Penyajian	76%
		Convenience and attractiveness	64%
2	Language Assessment	Businesslike	70%
		Communicative and Interactive	70%
		Conformity with the level of student development	60%
		Use of terms, symbols and icons	60%
		Average score	72%
		Criterion	Valid

Once the educational material is validated by media experts and material experts, they move on to the implementation stage. At this stage, the teaching materials used are tested for practicality, which are divided into two, namely small-scale teaching material trials and large-scale teaching material trials (Mangelep, 2014). Testing is necessary to know if the product will be used successfully. If errors and shortcomings still exist, the product must be corrected. During the trial, teaching materials were tested as a tool for learning mathematics in the classroom. Testing of teaching materials is carried out to determine the validity of teaching materials, the practicality of teaching materials, and the effectiveness of teaching materials. From the data obtained based on the results of the tests that have been carried out, teaching materials can be used. Then to obtain data on the effectiveness of teaching materials, KKM scores and student response data from teaching materials can be considered. In a small-scale trial, the average practicality questionnaire was 87% with very practical criteria. So that the Brain Based Learning teaching materials using crossnumber puzzle games are very practical so that they can continue large-scale testing with an average practicality questionnaire of 87% with very practical criteria. So that the teaching materials for Brain-Based Learning using crossnumber puzzle games are very practical so that they can be continued to large-scale testing. Meanwhile, the results of the practicality test showed an average practicality questionnaire of 88% with very practical criteria. Based on these results, it can be seen in the aspect of a larger display on a large scale compared to a small scale. Meanwhile, in the presentation of the material, both in small-scale and large-scale testing, the

results are the same. For ease of language and practicality, it is the same in large-scale tests as compared to small-scale tests. The results of this practicality are in line with Oktaviana and Rohendi's research which states that they are practical and effective with their respective categories valid (Oktaviana and Rohendi, 2017).

In addition, the practicality of teaching materials was tested, which data was taken from a practicality test in the form of a student response questionnaire distributed to students who learned using Brain Based Learning teaching materials using crossnumbers. The practicality test was carried out twice with two different classes and a different number of students. First, a small-scale practicality test in class VII H with 10 students and a large-scale practicality test in class VII G with 25 students. Teaching materials as a learning medium.

Table 4. Small-Scale Practicality Score

It	Aspects	Score	Criterion
1	Display aspect	90%	Very Practical
2	Presentation of material	87%	Very Practical
3	Language assessment	86%	Very Practical
4	Ease and practicality	87%	Very Practical
	Average score	87%	Very Practical

Based on Table 3, the display aspect gave a higher assessment score than other aspects with a percentage of 90%. Aspects of material presentation, aspects of language assessment, and aspects of convenience and practicality.

Table 5. Large-Scale Practicality Score

It	Aspects	Score	Criterion
1	Display aspect	92%	Very Practical
2	Presentation of material	87%	Very Practical
3	Language assessment	87%	Very Practical

It	Aspects	Score	Criterion
4	Ease and practicality	88%	Very Practical
	Average score	88%	Very Practical

Based on Table 5, it can be seen that the average practicality questionnaire is 88% with very practical criteria. The following is a presentation of the data from the results of small-scale and large-scale practical trials.

The analysis of the effectiveness of learning teaching materials is by using a learning outcome test by answering the cross number puzzle contained in the learning teaching materials. According to Sodijono (2010:81) the formula for calculating the completeness of student presentations. The results of the effectiveness test stated that there were 18 students out of 25 students who got grades above average or students who completed. Based on the results of calculations on the teaching materials of Brain-Based Learning using cross number puzzle games, the percentage of student completion is 72% with the Effective category, this shows that the teaching materials of Brain-Based Learning using cross number puzzle games are effectively used for teaching materials.

The results of the effectiveness test stated that there were 18 students out of 25 students who got scores above average or students who were complete. So that it can be written in the formula Percentage of student completeness

$$P = \frac{P_a}{P_b} \times 100\%$$

$$P = \frac{18}{25} \times 100\%$$

$$P = 72\%$$

Based on the results of the calculation in the teaching materials *Brain Based Learning* using crossword puzzle games to determine the percentage of student completeness of 72% with the Effective category, this shows that the teaching materials *Brain Based Learning* Using crossword puzzle games is effectively used for teaching materials.

The final stage of this research is the evaluation stage, which aims to evaluate each stage carried out on the developed teaching materials. This evaluation aims to evaluate the quality of teaching materials and the learning process, both before and after the implementation stage (Branch, 2009). At this evaluation stage, the researcher ensures that the teaching materials are in line with the product development goals that have been set. The evaluation is done by the

researcher and there are some suggestions for readers who want to develop the same as the author is advised by doing a correct and detailed preliminary analysis. And during field research, make sure the teaching materials have been validated by experts and that there are no revisions to make it easier and not to re-research. When collecting qualitative and quantitative data, be sure to keep it in the document box so that it can be included in the attachment as evidence. The results of the new research can be concluded when all stages of the ADDIE development method have been implemented properly. From the results of the analysis, it can be concluded whether the learning media is suitable for use in the learning process or not. This research is in line with the research that has been conducted previously by Nurhalijah which states that the Development of Mathematics Learning Teaching Module Based on Brain-Based Learning Using Crossnumber in Row and Row Courses at SMA Negeri 3 Luwu Timur shows validity, effectiveness and practicality (Nurhalijah, 2020).

CONCLUSIONS

Research and development of Brain Based Learning teaching materials using crossnumbers in mathematics, obtaining conclusions The development of Brain Based Learning teaching materials using crossnumbers in mathematics lessons was analyzed descriptively with the R&D method with ADDIE (Analysis, Design, Development, Implementation, Evaluation). All stages have been carried out so as to produce a product that is suitable for use. However, this study also acknowledges certain limitations, such as the limited sample size and the focus on a single specific context, namely the Siger Tower. Consequently, it is recommended that future research involve a larger sample size and incorporate a broader range of contexts in the development of PISA-type mathematics problems. Expanding the variety of contexts could provide a more comprehensive evaluation of the problem set's effectiveness across different scenarios.

The validity of the Brain Based Learning teaching material media using crossnumbers in mathematics lessons in the media aspect obtained a result of 85.5%, including in the very valid category. In the material aspect, 72% of the results were included in the valid category. This means that both in terms of material and media have met the criteria for validity and suitability for use.

The practicality of Brain Based Learning teaching materials using crossnumbers in mathematics lessons at the small-scale testing stage obtained a result of 87% with the category of very practical. Likewise, the results obtained at the large-scale testing stage obtained a result of 88% with the category of very practical. So it can be concluded that the teaching material for Brain-Based Learning using cross numbers in this mathematics lesson is very practical.

Analysis of the effectiveness of learning teaching materials, namely using a learning outcome test by answering the cross numbers contained in the learning teaching materials, the results of the calculation on the Brain-Based Learning teaching materials using cross numbers were determined to be the result of a student completion percentage of 72% with the Effective category, so it can be concluded that the Brain Based Learning teaching materials that use crossnumbers are effective.

In this teaching module, it uses a brain-based learning method that is more aimed at students with visual learning methods, for students with auditory and kinesthetic learning methods, this teaching module has not yet fulfilled its learning method. And to find out the learning style of students, teachers need to make observations in the harmony of students so that it cannot be done with questionnaires and need to take a long time to find out the learning style of students. For crossword puzzles in the module, it is better for researchers to use questions with easy to simple levels, because it will be difficult to make problems using crossword pattern numbers.

REFERENCES

Ariawan, R,. Dan Nufus, H. (2017). The Relationship between mathematical problem solving ability and students' mathematical communication ability. *Theorems (The Original Research of Mathematichs), I(2), 82-91*.

Atwi, S.M. (2001). Desain instruksional. Jakarta : Universitas Terbuka.

Ausubel, D.P. (1968). Educational psychology: a cognitive view. New York: Holt, Rinehart and Winston.

Basyar, M.K. (2020). Pengembangan pembelajaran pai model ADDIE di SMP Insan Cendekia Mendiri Boarding School Sidoarjo. *Jurnal Pendidikan Islam*, *11*(1), 44–57. https://doi.org/10.22236/jpi.v11i1.5033

Branch, R. M. (2009). Instructional design-The ADDIE approach. New York: Springer.

Cahyadi, A. (2019). Pengembangan media dan sumber belajar: teori dan prosedur. Serang. Penerbit Laksita PT. Diakses pada tanggal 25 PT 2022 di https://idr.uin-antasari.ac.id/16140/1/Ani%20Cahyadi%20Pengembangan%20Media%20%28book%29.pdf

Fitriani, A., Irawan, E. (2020). Development of junior high school mathematics teaching tools with a brain-based learning approach oriented to mathematical connection ability. *Journal of Mathematics and Natural Sciences Education 10, No. 1.*

Herman, H. (1990). Strategi belajar matematika. Malang : IKIP Malang.

Hidayat, T. (2018). *Penggunaan media teka-teki silang untuk meningkatkan penguasaan kosakata bahasa arab siswa kelas V Madrasah Ibtidaiyah Nurul Ihsan Telanaipura Kota Jambi*. UIN Sulthan Thaha Saifuddin Jambi.

Indrajani. (2011). Perancangan basis data dalam all in 1. PT: PT Elex Media Komputindo.

Januszewski , A,. Molenda, M. (2008). Educational technology: a definition with commentary, New York: Routledge.

Jensen, E (2008). *Brain-based learning : pembelajaran berbasis kemampuan otak : cara baru dalam pengajaran dan pelatihan*. (N. Yusron, Penerjemah) PT : Pustaka Pelajar

Langeveld, M. J. (1980). *Pegadodik sistematik teoritis*. Bandung : Jermmars

Lubis, A M,. Saragih, A H,. Sitompul, H. Hidayat, T. (2023). Development of student worksheet helped phet simulation on the study of physics. KnE Social Sciences

Martatiyana, D R,. Usman, H,. Lestari, H D. (2023). Application of the addie model in designing digital teaching materials. Jurnal Pendidikan dan Pengajaran Guru Sekolah Dasar (JPPGuseda)

Magdalena, I., Sundari, T., Nurkamilah, S., Amalia, D. A., & Tangerang, U. M. (2020). Analisis bahan ajar. Nusantara : Jurnal Pendidikan Dan Ilmu Sosial, 2, 311–326.

Mangelep, N. O. (2014). Implementasi workshop pembelajaran bangun datar dengan pendekatan PMRI bagi Guru Sekolah Dasar. Engineering and Education (E2J), 2(2).

Mulyasa, E. (2013). Pengembangan dan implementasi kurikulum 2013. PT. Remaja Rosdakarya

Nurhalijah. (2020). Pengembangan modul pembelajaran matematika berbasis brain based learning menggunakan permainan teka-teki silang pada pokok bahasan barisan dan deret di SMA Negeri 3 Luwu Timur. Institut Agama Islam Negeri Palopo

Oktaviana, S.E., & Rohendi, E. (2017). Brain based learning model to improve students' understanding of the water cycle concept. *Journal of Anthology of the University of Education Indonesia, Vol 3, no.1*

Samyn, D.B. (2005). Friction of polyoxymethylene homopolymer in highly loaded applications extrapolated from small scale testing. Tribology Letters

Sari, N. M., Yaniawati, P., Firmansyah, E., Mubarika, M. P., Assegaff, N., Septiyani, N. (2023). Pelatihan pembuatan storyboard dan games interaktif untuk guru dan mahasiswa magister pendidikan matematika. Transformasi: Jurnal Pengabdian Masyarakat, 19(1), 153-166.

Sawyer, S. C,. & Williams, B. K.,. (2007). Using information technology: a practical introduction to computers & communications (7th ed.). New York: McGraw-Hill.

Siswosuharjo, P,. Al-Bahra, S., Abas, A. (2024). Development of learning videos for natural science subjects in junior high schools. Computer Science and Information Technologies

Sudijono. (2010). Pengantar statistik pendidikan. Jakarta: Rajawali Press.

Sugiyono. (2016). Metode penelitian kuantitatif, kualitatif dan R&D. Alfabeta.

Restu, D. (2017). Penerapan model ADDIE dalam pengembangan multimedia pembelajaran berbasis adventure game untuk meningkatkan pemahaman pemrograman dasar siswa. Universitas Pendidikan Indonesia

Tambunan, N. (2016). Pengaruh strategi pembelajaran dan minat belajar terhadap kemampuan berpikir kreatif matematis peserta didik. Formatif: *Jurnal Ilmiah Pendidikan MIPA*, 6(3), 207-219.