Designing Medume Media on Data Centering Materials Using Design Thinking Method

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Abstract
A teacher must be creative to get the attention of Generation Z students ("Gen Z") in the learning process. One of the things that can be implemented is using media that suits the needs of student participants. In this study, the media designed is medume media and applied to data centering material.The purpose of the research is to design learning media that focuses on students' needs. The process of designing this media uses the Design Thinking method. The research sample consisted of four students from grade 8 junior high school. The sample selection was based on extreme left and extreme right criteria. This method starts from the stages of emphatize, define, ideate, and prototype. Then, it concludes with the testing stage. This research was conducted at SMP Negeri 4 Palu. It included qualitative approach. The researchers created an interactive media medume board. After the medume board was formed, it was applied in a classroom which discussed the said material. The result is that students were very enthusiastic and could understand the data concentration material quickly. In addition, the concept of data concentration becomes more concrete and easier to understand. This is because students can see the media used and interact directly with the data presented.
Keywords: Media, medume, statistical material, design thinking

Introduction

Learning media plays a very important role in building student cooperation in the classroom, and can also facilitate interaction between students and teachers. In addition, it can also be used as a student learning experience. In this case, learning media is not only an instrument to deliver information, but also can involve students in the learning process. According to Mangelep (2017), a teacher must be creative and innovative when choosing learning media that match the teaching material so that the objectives of learning can be achieved. As a teacher, empathy for students is a fundamental thing that must be possessed. When developing meaningful learning, a teacher's thinking will be centered on the needs and learning experiences of students. This is found in the Design Thinking framework (Loescher, 2019; Fazlika, et al, 2023; Jannah et al, 2024). When a teacher's empathetic understanding of students has developed, the next step is to apply that understanding to the design of the learning process or learning media that suits the needs of students.

Design thinking is a problem-solving method that focuses on a deep understanding of user needs, then develops creative and innovative solutions through an iterative process. This involves empathy, ideation, prototyping, and testing. Additionally, design thinking emphasizes collaboration, experimentation, and critical thinking to create solutions that are

effective and relevant to the problems faced. Design thinking is an innovative method in solving user problems and developing creative ideas. In addition, it also produces effective learning media. In this study, the design thinking stage was used according to David Kelley a founder of IDEO and Stanford School of Design Thinking or usually abbreviated as (*d.school*). The design thinking process has five phases, namely; (1) empathize starts from building empathy, (2) define (formulate goals), (3) ideate (create solutions from ideas), (4) develop a prototype, and (5) test / evaluate (testing the prototype). Therefore, by applying the design thinking method, teachers can design learning media that suits the needs of students.

Research that has utilized design thinking can enhance creativity and innovation, especially in the context of art and design education (Aprianto, 2023). There is a research trend that combines design thinking with artificial intelligence (AI) to strengthen the innovation process and product development. This approach enables the exploration of more sophisticated and adaptive solutions to user needs (Suharto, 2025). Several studies have applied design thinking in the development of educational curricula, particularly to improve 21st-century skills such as problem-solving, collaboration, and critical thinking (Fazlika et al., 2023; Jannah et al., 2024; S. Pou, 2024).

Based on the observations done in grade 8 of Sis Aljufri, most of the students in Sis Aljufri's VIII class had visual and kinesthetic learning styles. Moreover, the students in this class were very interested in things that are exciting and fun, for example, media that is integrated with learning materials. Additionally, these students also experience difficulties in learning mathematical materials. Next, in the define phase, the researcher formulates the design objectives, which are commonly known as the design challenge. How to design medume media in data centering material for grade 8 Sis Aljufri so that learning becomes fun and can increase students' interest in learning?

Method

This research uses the depth interview method, similar to qualitative data collection. However, in design thinking, there is an enhancement in the interview procedure to better build empathy with the students**.** The samples in this study were selected using the *Extremes and Lenses strategy*. The assumptions used in this strategy were that (1) some populations have similar needs (*mainstream*), and (2) the most different needs in the outliers of the population (*extremes*) have the most different needs. Indicator points are a description of the Lenses that can be determined according to the sampling needs. Lenses in the field of

education include students' interaction with teachers, interaction with friends, compatibility of learning styles, teaching, and learning systems. In this study, a sample of 4 students was interviewed. The stages used are shown in Figure 1.

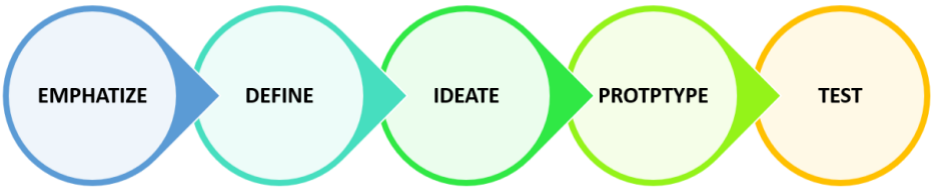

Figure 1. Stages of Design Thinking (Stanford d.school)

Results and Discussion

After the subjects had been determined, the initial stage of design thinking began

1. *Emphaty Phase*

This stage began with conducting an interview on the subject. In-depth interviews were conducted to gain a deeper perspective on the students' needs. Some questions that were considered in conducting the interview were: 1) introducing the researchers, 2) introducing the project, where the researcher briefly explained the usefulness of the interview, 3) building rapport, asking things related to the subject's background, 4) evoking stories, provide simple questions to build the researcher's closeness to the subject. For example, ask the most liked lesson? ", 5) exploring emotions, providing questions that must be answered clearly and in depth. Often also referred to as key questions, 6) question statements, trying to find emotional and personal answers. After getting the desired answer, the researchers can return to ask questions based on the interview results, 7) Thanks and Wrap-up, close the interview by appreciating the positive things done by the subject during the interview and thanking them. The highly capable students coded as FMH and ZRH were interviewed first, as shown in Figure 2.

Figure 2. High ability students coded as FMH, ZRH and HRA

FMH loved playing football and aspired to become an entrepreneur. Furthermore, the subject did not like religion and civic subjects because the teacher lectured and asked the students to memorize often. Additionally, English was the subject's favorite because it was

easy, so FHM's English proficiency was good. As for mathematics, FHM struggled learning it, but the subject liked the lesson. FHM was happy to learn mathematics because of the interesting quizzes, ice breaking, and games given by the teacher. FHM learning motivation could increase when the class was calm, full, and the classroom atmosphere was cool and comfortable. FHM could understand the material easily with frequent quizzes given by the teacher.

FMH's challenge in learning mathematics was lack of focus because he often played. When encountering difficulties in understanding mathematical material, FHM asked the teacher often. The subject also stated that he enjoyed learning in groups because it was easier and faster to complete a task. However, FHM had difficulty when solving questions in the form of stories. The learning methods expected by FHM were quizzes and integrating technology in learning. Furthermore, FHM had a kinesthetic learning style as he liked to use various media and move a lot. The most memorable learning experience for the subject was learning mathematics because his teacher usually gave him extra points. He also confessed to not really like presentations as he confused on how to explain something.

ZRH's hobby was taekwondo, and he aspired to become a soldier. The subject confessed that he did not like civic education because of the strict teacher. His preferred subject was mathematics because the teacher was fun and the material was challenging. ZRH felt motivated to learn mathematics because many of his friends said that mathematics was difficult. The positive influence of the use of technology also made learning mathematics more fun for him. According to the subject, the use of technology in learning mathematics made him less likely to take notes, making the materials to be easily forgotten. Furthermore, he liked to learn in groups because it was faster in completing the assigned tasks.

The effort made by ZRH to understand difficult material was by asking teachers, friends who already understand, and learning through YouTube. ZRH had an auditory learning style because he preferred to learn from YouTube. ZRH could understand the material easily by listening to explanations from teachers and friends. Learning strategies that make ZRH easier to understand and master mathematics were the teacher's detailed explanation, example of questions, and exercises given by the teacher. However, ZRH had difficulty in solving story form problems because they required analysis. When getting the best grades in class, it brought satisfaction to him in learning mathematics. The mathematics learning experience that was memorable for ZRH was algebra because the material had a lot to do with other mathematical materials.

Lastly, HRA had a hobby of drawing and aspired to become a successful entrepreneur.

The subject that he did not like was English because he thought it was difficult. The preferred subjects were ICT, science, and mathematics because they were fun. He liked mathematics because he liked counting, the teacher was fun, and gave a lot of games. HRA could understand the materials easily by taking notes and doing exercises. He was motivated to learn mathematics because it was widely used in everyday life. According to HRA, the mathematical material that was easy to learn was powers of numbers. When studying mathematics, HRA did not like the noisy and sleepy classroom atmosphere. The most memorable math learning experience for the subject was presentation. Moreover, HRA preferred to work independently and study in groups if the members were all female. The mathematics learning activities expected by HRA were quizzes. He also expected a teacher to explain in detail and write on the board. HRA had a visual learning style because he preferred to learn from books rather than videos. The interview continued with the subject who was on the extreme left. The subjects consisted of 3 people, namely NDR, ASK and STR. Figure 3 shows the three subjects that were interviewed. 3.

Figure 3. Low ability subjects of NDR, ASK and STR

NDR had an idol and a hobby of playing games. NDR wanted to become a medical doctor. Moreover, the subject liked mathematics and hated having to memorize theories. The subject felt happy to learn mathematics, if the teacher was favorable and the material was easy to understand. When the subject could understand the material, the subject felt excited. NDR was not comfortable learning when taking part in a group with classmates who were noisy and interfered with the learning process. The difficult mathematical material during grade 8 for the subject was function, because the subject did not understand algebra. Furthermore, the subject already mastered multiplication. The subject also preferred to ask friends. The subject enjoyed to discuss when it was difficult to understand a mathematical material. NDR was able to comprehend mathematical material quickly if it is explained directly by the teacher or friends. He did not have the preparation to study, because he did not study at home. Furthermore, the subject reported to utilizing google to help study the material and solve mathematical problems. When encountering difficulties in solving mathematical problems, NDR would ask friends or teachers. Additionally, the subject was

not yet trained to solve story problems. NDR was interested in learning if there were other friends who want to learn together.

The subject ASK had a hobby of swimming, and aspired to be a medical doctor. Furthermore, he enjoyed studying Indonesian. There were no lessons that ASK did not enjoy. ASK learned depending on the subject that was learned in school. The subject also preferred to memorize theories rather than counting. Aside from that, the subject also reported to prefer studying with a group, because any difficulties arose, he could ask the other students. ASK did not like presentation activities, because he was not confident. Furthermore, ASK had a desire and passion for learning, seen from the efforts made during class to complete assignments. As for socializations, the subject only socialized with close friends in class. ASK liked to learn mathematics if the mathematical material was easy to understand. ASK had difficulty counting, as the subject had not mastered multiplication and division. In addition, ASK needed the material to be explained in a detailed way. The subject also found the material of function to be difficult, as he did not understand the prerequisite material of the algebraic form.

STR had a hobby of swimming, and aspired to be an entrepreneur. The subject's favorite lesson was English, because it could support the learning process if he would continue his education abroad. Furthermore, he could study in groups as well as independently. If he had difficulty understanding, he asked his friends. It was reported that the subject also had a passion for learning in order to achieve his goals. He confessed to love learning mathematics, if the material was easy to understand. However, the subject did not master mathematical basic skills, such as multiplication and division. The subject also did not understand algebraic operations and concepts, as well as solving case studies. The reason he likes mathematics was because he preferred counting to memorizing theory

During the interview, the most dominant thought was that students would experience learning process constraints where they were bored and less interested in learning mathematics because it was often considered difficult. In addition, students had difficulty in understanding the material described due to lack of basic mathematical abilities. Students were interested in learning mathematics if the material was easy to understand and explained directly and in detail by the teacher. Therefore, it was important to have empathy to be able to build social relationships with students so that they could comfortably deliver answers honestly. PS was happy to learn mathematics because he often used interesting media so as to increase the involvement of students in the learning process.

The new thing that the researchers found after the interview was that high ability

students tended to understand the material easier if they took notes on the material provided. Meanwhile, low-ability students tended to understand the material more easily if the teacher explained it directly and in detail. Learners on the right and left extremes preferred to learn with diverse learning media. Our previous assumption had been validated that students need fun learning by utilizing technologies such as media, Quizziz, Canva, PowerPoint and others to increase students' activeness and engagement in learning.

Furthermore, the results of the interview findings were collected. All findings were written on sticky notes. Each finding was written in one sticky note. This stage was called the divergent stage. The following are the divergent stages of the subject from the right extreme, in Figures 4, 5 and 6

Figure 4. Divergent stages of ZHR

Figure 5. Divergent stages of HRA

Figure 6. Divergent stages of FHM

All findings obtained at this stage of divergence were analyzed. Findings that fall into one category were grouped. The thing that also needed to be considered was the relationship between these findings. In this study, the findings could be grouped into six different categories, namely teachers, methods, media, materials, motivation, and emotions. This is shown in Figure 7 All findings obtained at this stage of divergence were analyzed. Findings that fall into one category were grouped. The thing that also needed to be considered was the relationship between these findings. In this study, the findings could be grouped into six different categories, namely teachers, methods, media, materials, motivation, and emotions. This is shown in Figure 7.

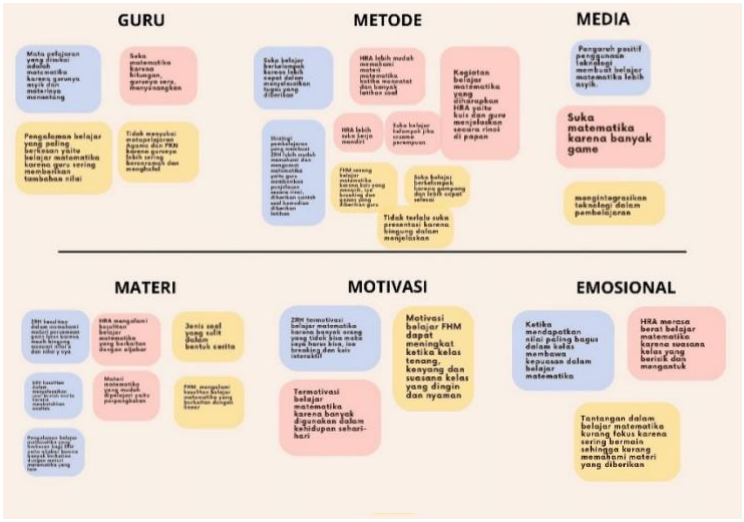

Figure 7. Grouping of Findings at the divergent stage of the Right Extermination Subject

The next stage was the divergent stage for the findings of the extreme right subject. Findings that fall into the same category were put together. The following present the divergent stages for the left extreme subjects in Figure. 8, 9 and 10.

Figure 8. Divergent stages of ASK

Figure 9. Divergent stages of NDR

Figure 10. Divergent stages of STR

The findings of interviews for extreme left subjects were also grouped in the same category by examining the relationship between these findings. In this study, the findings can be grouped into five points, namely method, media, material, motivation, and emotions. This is shown in Figure 11.

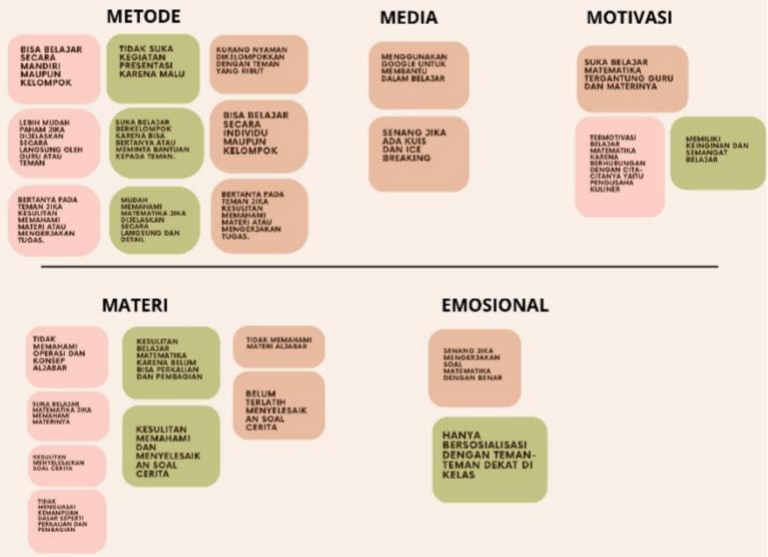

Figure 11. Grouping of Findings at the divergent stage of the Left Extreme Subject

The next step was to determine the most problematic findings. Then, it was continued by making it in the form of an empathy map (empathy map). The empathy map of the extreme right and extreme left subjects in Figure 12 and Figure 13 as follows.

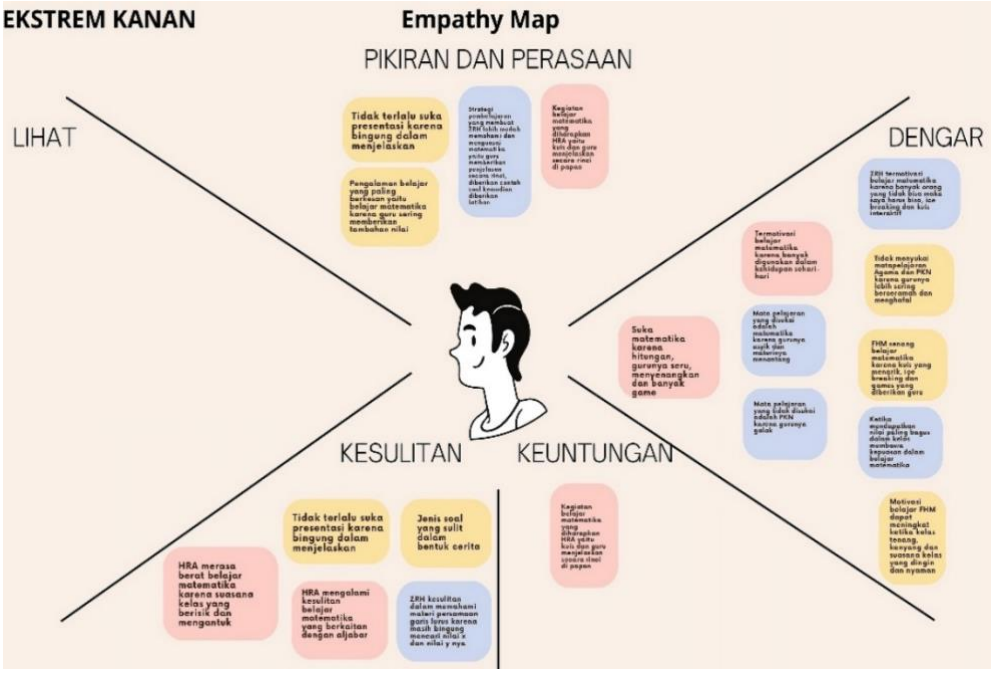

Figure 12. Empathy map of extreme right subjects

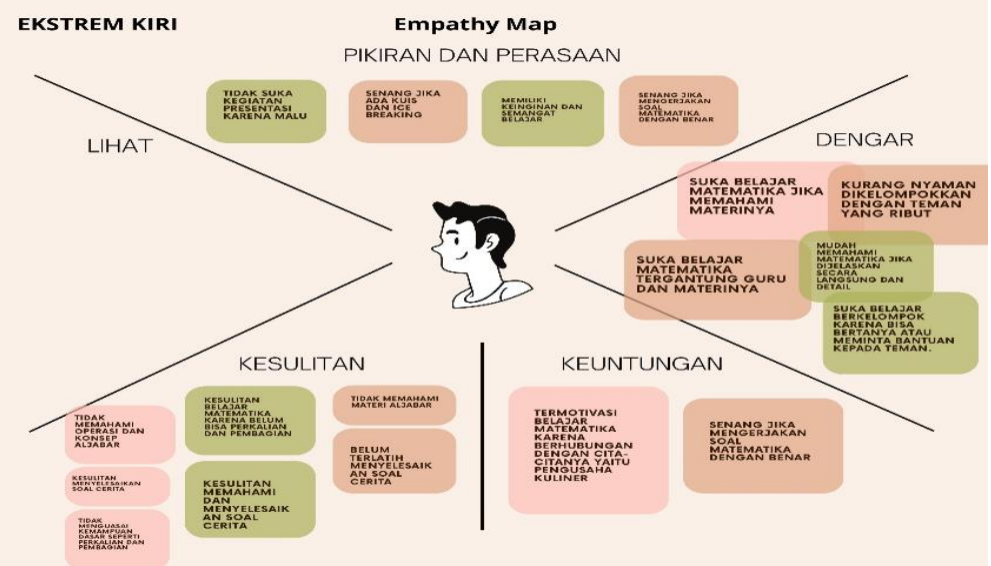

Figure 13. Left extreme subject empathy map

In Figure 12 and Figure 13, we could see the findings that are the subject's problems. Furthermore, from the Empathy map, the researchers entered a convergent stage to formulate insights/understanding. Based on this, ideas would emerge that would be the solution to the problem. According to Sekarwulan and Josephin (2022), insights are assembled based on patterns and trends that emerge from interview findings in the emapati phase. The stages of assembling understanding/ Crafting Insight in this study were: 1) It turns out that students were interested in learning mathematics if the material is easy for them to understand, 2) students were happy to be given quizzes and Icebreaking, 3) students needed the opportunity to take notes of written material in order to be re-learned, 4) students had difficulty understanding problems and solving story questions, 5) students preferred to work with friends or groups in order to ask if they have difficulty learning, 6) students needed more practice in order to understand and master mathematical material, 7) the use of technology could provide students with enthusiasm in learning mathematics, 8) students had difficulty learning mathematical material because they had not mastered basic mathematical skills, such as multiplication, division, and algebra, 9) students were less able to understand literacy, 10) students could understand mathematical material easily if explained directly and in detail, and 11) students were still confused to do presentations.

Insights were presented in the form of Figure 14. Information, inspiration, and memorability were to make it easier to come up with ideas. In the information and inspiration column, it contained all the understanding gained from the findings. Meanwhile, the memorability column was a series of lighters for creative thinking.

Figure 14. Information, Inspiration, and Memorability from Insight

Based on the information, inspiration and memorability in Figure 14, it can be seen that there was a lot of insight or understanding, then an understanding will be chosen to find a solution. The five sets of understanding can be seen in Figure 15 below.

Figure 15. Selected Summoning Sequence

Five sets of understanding were selected and further specified into a series of understanding by paying attention to 3 things, namely, the most problematic, most valuable, and in accordance with mathematics. In this study, the most problematic was the fact that students were interested in learning mathematics if the material was easy for them to understand. After examining the findings again, it was determined that the most valuable one was the fact that students were happy if given a quiz and icebreaking. Meanwhile, the one that was in accordance with mathematics was the fact it that the use of technology could

provide enthusiasm for students in learning mathematics. The intersection of these three things was the fact that the use of media coukd increase the activeness of students in learning mathematics so that it was easy to understand mathematical material well. At this stage, an understanding of empathy had been formed towards the problems faced by students. The next phase was define which aimed to formulate the purpose of the design known as the Design Challenge.

2. Define Phase

In this phase, the researcher formulated a formulation to clarify the design to be made. From the selected understanding/insight, a formulation was then made in Figure. 16 as follows.

Figure 16. Formulate design challenges based on understanding/insight

The design challenge in Figure 16 had been prepared and adapted to the needs of grade 7 students of SMP 6 Palu. Furthermore, the selected design challenge was "How can we create innovative mathematics learning media so that students of grade 8 of Sis Al-Jufri can increase participation in data concentration size material". Mastery of empathy competencies was closely related to the define stage. This was because teachers must understand the emotions or actors of students, so that they could design learning that is in favor of students. When a teacher could design learning and assessment that favors students, what must be done first was to analyze the characteristics of students. This phase could be considered the most challenging part of the Design Thinking Fcycle, because in defining problems, a designer needs to synthesize his findings in the Empathize phase. Synthesis means connecting pieces of information in a creative way so as to produce a unity/big picture that makes sense (Dam & Siang, 2020). The formulation of a good Design Challenge would trigger the emergence of various creative answers and open up spaces for ideas. A good Design Challenge formulation is necessary (Dam & Siang, 2020; S.Pou et al. 2024).

3. Ideation Phase

The Ideate phase in Design Thinking is about how we explore various alternative radical ideas that can be the solution to a problem/need (Doorley et al., 2018). Usually, the ideas generated could be in the form of digital products or software, products or hardware, systems, and services. In the context of education, ideas can be in the form of curriculum development, changes in the atmosphere of teaching and learning activities, school programs, development of rules, objectives, and systems in schools (IDEO, 2013). In the ideation phase, the researchers looked for ideas from the results of the design challenge. This idea was certainly specific and related to students' needs in mathematics learning.

This phase also had two stages, the first of which was the divergent stage of collecting as many ideas as possible. At this stage, various types of ideas were issued based on the teacher's experience and references. Second, the convergent stage conveyed ideas to be selected. At this stage, processing, analysis, and selection were used to select creative methods and media ideas. Based on Design Challenge, namely "how can we create innovative mathematics learning media so that students of class VIII Sis Al-Jufri can increase students' participation in data centering material?". At the divergent stage, the researcher collected seven ideas, as seen in Figure 17.

Figure 17. Ideas at Divergent Stage

References from selected ideas included various sources, such as idea 1 and idea 3 from journals, and ideas 2 and 5 from YouTube. In addition, ideas 4, 6, and 7 were developed by referring to the circumstances or conditions in an area, such as the 3T area that utilized objects around the school environment. After the ideas were collected, a convergence stage was then carried out to pursue the selected ideas. At this stage, four ways were carried out, namely grouping votes, voting, discussion, and developing ideas. Fromthe results of voting and discussion, all the researchers chose the second idea. When developing ideas, it was very

necessary to know the ideas that underlie the idea of learning media. An innovative learning media should 1) increase students' interaction, both with teachers, friends, and the material; 2) increase students' enthusiasm for learning, so they are interested in learning mathematical material, 3) be easy to use by students.

Ideas had been selected in the form of creative learning media. This phase was also related to how a teacher in preparing a learning media design that suited the needs of students, according to the characteristics and needs of learning styles, interests, and motivations. Learning was designed to facilitate the needs of students so that a balance was achieved between academic competence and students' emotional problems. In addition, a teacher must be able to make learning fun by designing a learning media that is in accordance with the characteristics of students.

The development of ideas in this learning media still paid attention to the usefulness of the media, the features needed in making ideas. The usefulness of this media was to help students understand complex concepts in more ways, improve student interaction, both with teachers, friends, and materials. In addition, it also increased students' enthusiasm for learning, so they were interested in learning mathematical materials, and it was easy for students to use. The selected media in this study was the Medume board, which was based on the idea that featuresare needed, namely, (1) Poles that represent the presentation of data, so that students could easily present the data; (2) the materials were easy to get such as styrofoam, wire, flower stems, paperboard, beads, and glue; (3) simple and colorful, so that it can attract the attention of students, and (4) can be used in the 3T area. The next step was to realize the idea that had been planned at the prototype stage

4. Prototype Phase

The prototype phase was a tangible result of the ideas in the previous stage. Prototype development is an integral part of design thinking and user-centered design, because prototypes allow us to test ideas and improve them in a short time (Dam & Siang, 2021). Furthermore, according to Kelley and Kelley (2022), great designers are not the ones who never fail, but those who often fail, so they do not stop trying. This is the basis for thinking in the prototyping phase that failures in designing can occur. Good innovation does not arise from nothing, but is the result of repeated experiments.

The prototype produced at this stage was a Medume board for learning Statistics material. This media helped students to learn and be directly involved in data presentation, concept understanding and problem solving related to the size of data concentration. This media could also connect students from abstract concepts to congress. The use of this media

could increase the interaction of students with students, learners and teachers, as well as learners and material. In addition, students got meaningful experience so that it was easier to understand the material size of data concentration. Medume board is an innovative learning media, where the tools and materials to make it were easy to obtain. The tools and materials used were styrfoam, flower wire, cardboard, beads, and scissors as shown in Figure. 18 as follows

Figure. 18 Medume Board tools and materials

The results of the set of tools and materials and forming the Medume Board can be seen in Figure 19

Figure 19. Medume Board

The following is an example of a problem that can be solved using the Medume Board, as seen in Figure 20.

In order to improve the daily examinations score of mathematics, Mrs. Restin held a remedial for students in class 8 of Tadulako. There were 7 students who participated in the remedial with the following grades:

8 7 7 9 8 8 9

Determine the mode, median, and mean of the above mathematical remedial score data!

Figure 20. Example Question Using Medume Board

There are several reasons why researchers chose the Medume board prototype, namely that tools and materials are easy to obtain, light power, and not much cost in making it. This tool was believed to be interactive. Furthermore, medume boards are also easy to use. Furthermore, the procedure was 1) students present the data that has been given on the medume board. The data will be represented by beads with different colors for each data, the beads are inserted on the pole (Wire); 2) The students followed the directions on the LKPD to determine the Mean, Median or Mode; 3) To determine the mode see the pole that had the

same number of beads with the highest frequency; 3) To determine the median first sort the data from the pawned to the highest based on the data that has been presented on the medume board. If a lot of the data is odd, the median was the middle value. Meanwhile, if the amount of data was even, the median was the average of the two values in the middle; 4) To determine the mean, the beads on each pole must be the same amount/the same height.

5. Testing Phase

In the testing phase, there were four steps that were taken:

The first step was to reach agreement on the test results with three methods, (1) Exploratory Method by providing feedback in any form: comments, suggestions, emotional responses, and so on to identify potential and new ideas for the design. (2) Comparative Method by measuring competitors (in the context of commercial products), also identifying specific features that users prefer/need. (3) The Assessment Method was to test the level of user satisfaction with the design. Generally, it was intended to measure the functionality of a design.

The second step was to plan a trial in class 8 of Ahmad Dahlan on the Data Centralization material. The third stage tested the Medume board in determining the median. This medium was tested once in a different large class. From the test, it was found that there was a need for a filling scenario and the use of medume board media. Interaction Scenarios for the Use of Learning Media Ideas.

1. The teacher explained the use of Medume board Props
2. The teacher distributed medume board props to each group
3. The teacher shared the student worksheet containing problems that students must solve using medume board props
4. The teacher directed the students to use the props that had been given to
5. solving problems in the worksheet
6. The teacher provided necessary guidance to the students
7. The teacher provided reinforcement of what students had completed.

The use of Medume boards for students was somewhat different from that for teacher props. When using this board, the students sit in a circle, so that the use of props could be clear from all directions. Furthermore, the Medume board testing was carried out in two different classes, namely in grade 8 Ahmad Dahlan, as seen in Figure 21, and grade 8 Sis Aljufri, as seen in Figure 22.

Figure 21. Medume Board Testing in grade 8 Sis Aljufri

Figure 22. Medume Board Testing in grade 8 Sis Aljufri

After the test stage was completed. The last stage collected user response data in the form of an evaluation matrix as seen in Table 1 below.

Table 1. User Response

User Response Data	Results obtained
Things that were good/successful	• The students were enthusiastic about using medume board props so that they were actively involved in learning. • The instruments were easy to use and interactive • This also made it easier for students to understand the concepts of median, mode, and mean. • This can also be used in 3T area.
However, there were some things that were not good/less successful.	• The color of the paper used was still not interesting. • Stalks on the medume board often came off due to lack of strength • Students were confused in filling out data due to lack of data information on the medume board
Emerging Ideas	• Using a striking paper color that attracts students' attention. • The stalk of the Medume board was added with glue so that it was sturdier. • Adding Remarksto the medume board. • Giving prizes to the group that could answer the questions on the props correctly the fastest.
Questions or queries that arise	What if the Medume board is limited in solving the given problem? Directing students to use formulas in solving the given problems

Based on the user responses of the medume board in Table 1. It can be seen that students get a meaningful experience. So that it is easier to understand the material on the size of data concentration. The use of medume boards is also connected to technology in innovative learning, PPT, Learning Videos. As for the 3T area, it can utilize technology in the form of learning media that is easy to make or that is in the surrounding environment so that learning mathematics is more interesting.

Conclusion and Suggestion

At the empathy phase, when conducting interviews, a social relationship can be built with the students so that they feel comfortable giving honest answers. In addition, the students enjoy learning mathematics because it uses engaging media, which increases their involvement in the learning process. In addition, students felt happy learning mathematics because of using interesting media so that it increase the involvement and engagement of students in the learning process. The new thing that the researchers found after the interview was that high ability students tended to understand the material easier if they took notes on the material provided. Meanwhile, low-ability students tended to understand the material more easily if the teacher explained it directly and in detail.

The define phases was a way of thinking critically about the results of the empathy stage which was the basis for formulating design objectives at the define stage. The dynamics of the perceived process are the process of increasing the ability to formulate the objectives of the Challenge design that are in accordance with the characteristics of students and are adjusted to the main problems obtained from the empathy phase. Therefore, through the define phase, a teacher must be able to think critically and creatively to formulate the objectives of designing a design challenge to design student-centered classroom learning. The new thing that affects the researcher's perspective in the formulation of goals was that through this define topic, the formulation of goals does not only pay attention to students' learning readiness and competencies that must be achieved. However, it is also necessary to pay attention to what student need from the mathematics material that a teacher will teach and also involve activities that they like in the learning process.

The ideate phase in design thinking is an important step where creative ideas and solutions are generated to solve existing problems. By conducting the ideate phase, teachers can create a stimulating, inclusive, and innovative learning environment in schools. In addition, the ideation phase has several benefits that can help when teaching in schools, including increasing creativity, thinking skills, collaboration, analysis, and adaptation. In this phase, interesting ideas to answer the design challenge are very helpful in designing classroom learning. The prototype phase is the stage to develop the physical form of the ideas that have been found. Then, in the testing phase, experiments were conducted to see the shortcomings that need to be corrected and the advantages that must remain, both in the physical form of the idea and the usage scenario. By using the prototype and testing phases, a teacher can improve and improve the quality of learning for the better. This phase can also be useful for reflecting and increasing teacher creativity.

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