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Designing Biology Learning Media to Increase Student Interest using Design Thinking Method

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Abstract

Media is one of the components in learning that has a function as a means of non-verbal communication. In designing instructional media, a teacher needs to adapt to the students need. As a result, it can be effective and efficient. Students as learning centers are expected to develop and have better communication skills, so that they can participate actively, be able to analyze and be able to solve their own problems. Learning media that attracts students' interest will create creativity and innovation to themself which is in line with the challenges of the twenty-first century. On the other hand, the mindset that can bring out the creative potential in everyone is Design Thinking. In this research, we use a theoretical perspective from design thinking with activities that consist of 5 stages, namely empathize, define, ideate, prototype, and test. We conducted in-depth observations and interviews to identify problems in students of class X-4 at the Madani Integrated Model Senior High School. The sample used was 4 students. The sample selection was based on the extreme right and left extreme sample criteria. The findings in the interview formed an "empathy map" which then formulated insights and formed a design challenge. The result is a poster in Biology learning on growth and development material. The posters that have been made have gone through a series of trials. Furthermore, by following the observer suggestions and in accordance with the needs of students, the poste rwas improved. In addition, animated picture elements were added to the poster. The implication is that the media becomes interesting. In consequence, it raises students' reading interest in the content which is to be conveyed. Moreover, the media was designed according to the characteristics and conditions of students in the classroom. As a result, the media can be effective and efficient in its use. Furthermore, suggestions from observers and adjusted to students' needs, the poster is then repaired and ready to be used in learning.

Keywords: Learning Media; Interest; Design Thinking

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INTRODUCTION

Media is a means of effectively conveying information and messages to the audience. It can also serve as a non-verbal form of communication. Learning media, on the other hand, refers to the tools or methods used in the educational process to facilitate student learning and convey information. According to Tiwow (2020), the use of media can enhance students' interest in learning, leading to improved concentration on the material being taught. Additionally, Tiwow et al. (2022) discovered an interaction effect between learning media and students' interest in learning, impacting their learning outcomes. In order to achieve the objectives of learning, teachers must be creative and innovative in selecting appropriate models, methods, strategies, and learning media for teaching materials (Mangelep, 2017). The classroom offers various approaches to learning, and teachers play a crucial role in increasing

students' interest in learning, thus creating a comfortable environment where students can easily absorb knowledge (Magdalena et al., 2021).

Undoubtedly, media technology has a significant impact on school learning. According to Muhson (2010), the integration of information technology into the classroom has become a necessity and a demand in the global era. Therefore, it is essential to develop diverse and innovative learning media. The development of the Fourth Industrial Revolution has brought about substantial changes in providing students with additional information on technology and information skills, as highlighted by Sari et al. (2010). Furthermore, technological advancements need to be accompanied by the development of human resource skills in information management (Firmansyah & Sari, 2019).

For teachers, having empathy for students is fundamental. This means that when designing meaningful learning experiences, teachers should focus on students' needs and previous learning experiences. The Design Thinking framework, as outlined by Loescher (2019), exemplifies this approach. Once teachers have developed an empathetic understanding of their students, the next step is to apply this understanding to the design of the learning process or learning media that aligns with students' needs.

Design Thinking is a process that fosters the creation of innovative ideas to solve problems and is considered an effective tool in the teaching-learning process for developing twenty-first century skills (Luka, 2014; 2019). This approach involves collaboration to solve problems, gathering and processing information by considering real-world experiences and feedback from others, and applying creativity, critical thinking, and communication skills. David Kelley, the founder of the Institute of Design (IDEO) and Stanford School of Design Thinking (d.school), introduced the five phases of Design Thinking around 2019 and 2010. These phases, depicted in Figure 1, include Empathize, Define, Ideate, Prototype, and Test/Evaluate. Another term for design thinking in education is "design-based learning."

Figure 1. The stages of Design Thinking (Stanford d.school)

The theoretical perspectives of design thinking have been classified into five sub-fields: 1) design thinking as the creation of artifacts; 2) design thinking as reflective practice; 3) design thinking as a problem-solving activity; 4) design thinking as a way of reasoning/understanding something; 5) design thinking as the process of creating meaning (Johansson-Sköldberg, et.al, 2013; Cieminski, 2020). Observations and in-depth interviews were conducted by researchers with students at Madani Integrated Model Senior High School. The interview results revealed that students enjoy Biology lessons when accompanied by engaging media. Subsequently, the researcher identified the design challenge: "How can collaborative and interactive learning, as well as engaging Biology learning media, be designed for class XII-4 to make learning enjoyable and increase student interest in learning?"

METHOD

The sample selection for this study was conducted using the extremes and lenses strategy within the population. The extreme strategyinvolved selecting pairs of samples from the extreme left and extreme right. Following this selection, interviews were conducted. The main assumption underlying the extremes and lenses strategy is that most populations have both common needs (mainstream) and unique needs (extreme). The lenses used in this study were indicators of students' interest in learning Biology subjects. Additionally, during data collection, the researcher conducted interviews with subjects who fell within the outlier area of the population.

A total of 36 students from class X-4 of Madani Integrated Model Senior High School were included in the study. Interviews were conducted with four students who represented the outliers within the population. These four students were chosen because they exhibited similar patterns of needs, thus enabling them to better represent the needs of the entire population. The aim of these interviews was to determine students' interest in learning biology, which would serve as a foundation for designing engaging learning materials. The interviews consisted of light questions, key questions, and in-depth discussions. The sampling strategy is illustrated in Figure 2.

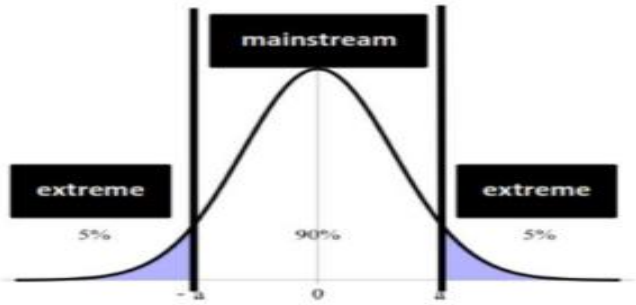

Figure 2. Extreme Strategy

Figure 2 depicts a normal curve illustrating the extremestrategy. From the graph, it can be observed that the majority of students (approximately 90%) fall within the mainstream area, while the remaining students lie within the extreme area. Therefore, it is more appropriate to sample from the extreme areas in order to capture the needs of a broader population (d.school, Bootleg Deck, 2018)..

RESULTS AND DISCUSSION

This research process adheres to the stages of design thinking, which consists of five distinct phases. Each stage of Design Thinking will now be described in detail. The primary goal of this research was to investigate students' interest in learning biology. Data collection commenced through interviews conducted with 36 students from class X-4 of Madani Integrated Model High School, each possessing a diverse educational background. The interviews aimed to ascertain the students' levels of interest in biology, which would subsequently inform the design of engaging learning experiences.

Empathize

The interviewed students were divided into two groups: extreme right and extreme left. The researcher posed a series of questions, including light questions, key questions, and closing questions. Light questions pertained to basic background information, such as the student's name, well-being, family, and their likes and dislikes in terms of academic subjects. Further, key questions were presented to elicit specific answers, such as "What makes you enjoy learning biology? Is it different from other subjects?" Open-ended questions were also utilized to encourage the participants to express themselves freely. Additionally, in-depth interviews were conducted with a select few from both the extreme left and extreme right groups. In the empathy stage, the first step entailed conducting in-depth interviews with the chosen subjects. In-depth interviews are a qualitative research technique that focuses on a small sample size, tailored to the researcher's requirements (Rutledge et al., 2020).

The left extreme subjects were identified as NF and NM. The interview results for the extreme left group indicated that NF approached learning activities merely as a student obligation, with no specific preference for any subject. Furthermore, FN preferentially engaged in kinesthetic learning approaches. Additionally, FN found it challenging to grasp the material quickly, requiring more time than their peers. Filza's understanding of biology remained at a general level. On the other hand, NM displayed an interest in arts and culture, Indonesian language, and biology. NM enjoyed learning through instructional videos but sought additional

explanations to fully comprehend the content. Given NM's aptitude for art, they excelled in design-related tasks and preferred a hands-on learning approach. NM struggled with evaluation activities due to a lack of comprehensive understanding of the material. They preferred a calm and quiet environment to maintain focus during learning sessions. NM possessed a relatively strong knowledge base in biology.

Figure 3. Interview with Samples FN and NM

Furthermore, the interview results of the extreme right samples, namely KA and AD, have been examined. KA expressed a preference for certain subjects depending on the teacher. Specifically, KA enjoyed Biology and Chemistry, while arts and culture and maths were disliked. KA also participated in Olympiads, indicating a stronger understanding of Biology material. Additionally, KA favored interactive and communicative learning methods that actively engaged her in the learning process. However, KA faced difficulties in comprehending scientific terminology in Biology and sought to overcome this challenge by independently memorizing abbreviations through learning videos or PPTs provided by teachers.

Similarly, sample AD exhibited an affinity for Biology and English. AD consistently sought out challenging tasks and favored learning through hands-on lab work and interactive methods. AD's learning style was predominantly audio-visual, as evidenced by a preference for teacher-led learning videos. AD also embraced lessons that incorporated group work and practical applications outside of the classroom. Notably, AD took diligent notes during learning sessions. AD expressed happiness and ease in understanding Biology, attributing this to frequent group assignments and collaborative efforts facilitated by teachers at school. In Figure 4, the interview findings from samples KA and AD are presented.

Figure 4. Interview with Samples KA and AD

The findings gleaned from the interviews revealed that students encountered difficulties in grasping Biology material due to its extensive theoretical content. Moreover, students expressed concerns over the fast-paced nature of evaluations, as they felt they had not fully mastered the material. Furthermore, students reported struggling when solely relying on learning videos without additional explanations from the teacher. The researcher posits that these challenges are closely related to students' dominant learning styles, namely kinesthetic and audiovisual preferences, as well as a preference for group learning over individual study. Based on the interview results, it was concluded that students in class X-4 predominantly exhibited kinesthetic and audiovisual learning styles and demonstrated a reasonable level of independence in their learning approaches. Additionally, these students faced difficulties in comprehending Biology material when solely relying on learning videos without teacher explanations, indicating a need for sufficient time to grasp the subject matter.

Following the successful collection of interview data, the next step in the empathetic process involved categorizing the findings. The researcher compiled the interview findings from both extreme left and extreme right students and proceeded to organize them using sticky notes, a technique known as the divergent stage. The findings obtained from the interviews with extreme students were categorized into different categories, such as thinking and feeling, hearing, seeing, pains, and gains.The researcher collected all interview findings and recorded them on sticky notes. The results of the interviews with extreme left and extreme right students were then categorized based on feelings, hopes, and fears. Additionally, an "empathy map" was created from the grouped results of these interviews (see Figure 5).

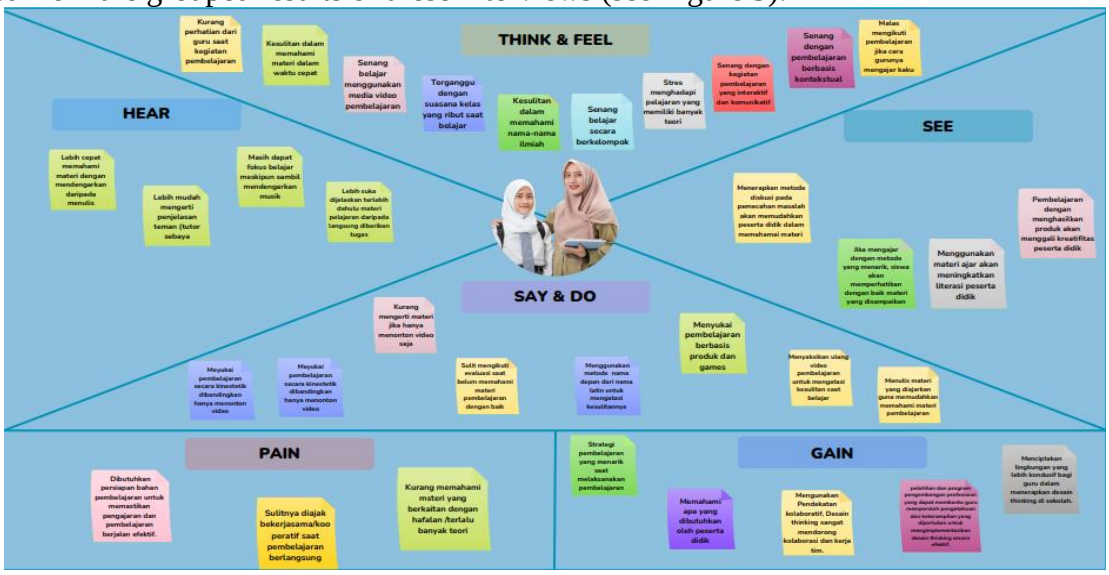

Figure 5. Sample Empathy Map

All points on the sticky notes in the empathy map were essential for the convergent stage. During this stage, it was necessary to narrow down the findings in order to develop a deeper understanding and inspire the emergence of ideas (refer to Figure 6).

Figure 6. Convergent Stages-Table of Understanding

Moreover, the researcher recorded the interview findings on sticky notes, which served as the basis for formulating insights in Figure 7.

Figure 7. Understanding Insight Phase Empathise

Based on the insights in Figure 7, five design challenges were identified:

1) How can interesting Biology learning media be designed for class X-4 to prevent student boredom during lessons?
2) How can a classroom environment be designed that is safe, comfortable, and conducive to the ecosystem, enabling optimal absorption of the subject matter by students?
3) How can collaborative and interactive learning be implemented in class X-4 to increase student interest in learning?
4) How can effective biology learning strategies be developed for class X-4 to promote active student participation in the classroom?
5) How can positive relationships be established with class X-4 students to better understand their personalities and make learning more relaxed and enjoyable?

Based on these five design challenges, a unified challenge was formulated: "How to design collaborative and interactive learning, as well as interesting Biology learning media in class XII-4, to make learning enjoyable and enhance student interest?".

Define

In the define phase, also known as formulating design objectives or design challenges, the problem is defined, making it the most challenging part of the Design Thinking cycle. This phase requires the researcher to creatively connect pieces of information to produce a clear understanding of the problem (Dam & Siang, 2020). According to Dam & Siang (2020), an appropriate design challenge formulation involves combining an understanding of the user, their needs, and insights or findings from the Empathize phase into one actionable sentence using the Point of View technique. In this study, the design challenge formulation is "How to design collaborative and interactive learning, as well as interesting Biology learning media, in class X-4 so that learning becomes fun and can increase students' interest in learning?"

During this stage, the researchers encountered difficulties in aligning their perceptions with the observations made in the Empathize phase. After conducting a collaborative analysis and synthesis, student-centered problems were identified.

Ideate

The Ideate phase in Design thinking involves exploring a range of radical alternative ideas that can serve as solutions to a problem or need (Doorley et al., 2018). During this stage, seven ideas were generated by the researchers:

1) Utilizing tools and materials to create engaging learning media.
2) Using educational games, such as the Engklek (Kadende) game, as learning media.
3) Incorporating stories or fairy tales to evoke emotion and foster relationships with students.
4) Transforming used materials into visual media or teaching aids.

5) Utilizing whiteboards and markers for delivering material.
6) Providing contextual examples using surrounding objects to reinforce subject matter concepts.
7) Using nature as learning material to convey contextual information.

To finalize the idea, the researchers conducted a team vote, selecting ideas based on ease of implementation and impact. This process is illustrated in Figure 8. In this phase, ideas that could serve as solutions, specifically poster media, were documented. The learning media that will be developed consist of poster media and teaching aids, utilizing the problem-based learning (PBL) model with a hands-on approach. The decision to utilize this media was based on its cost-effectiveness in production and its applicability to almost all Biology materials. Furthermore, this media has the potential to enhance students' creativity and foster their interest in learning by involving them in group-based roles and tasks. The use of poster and props media enables open communication, as students engage in the process of creating posters and props using recycled materials.

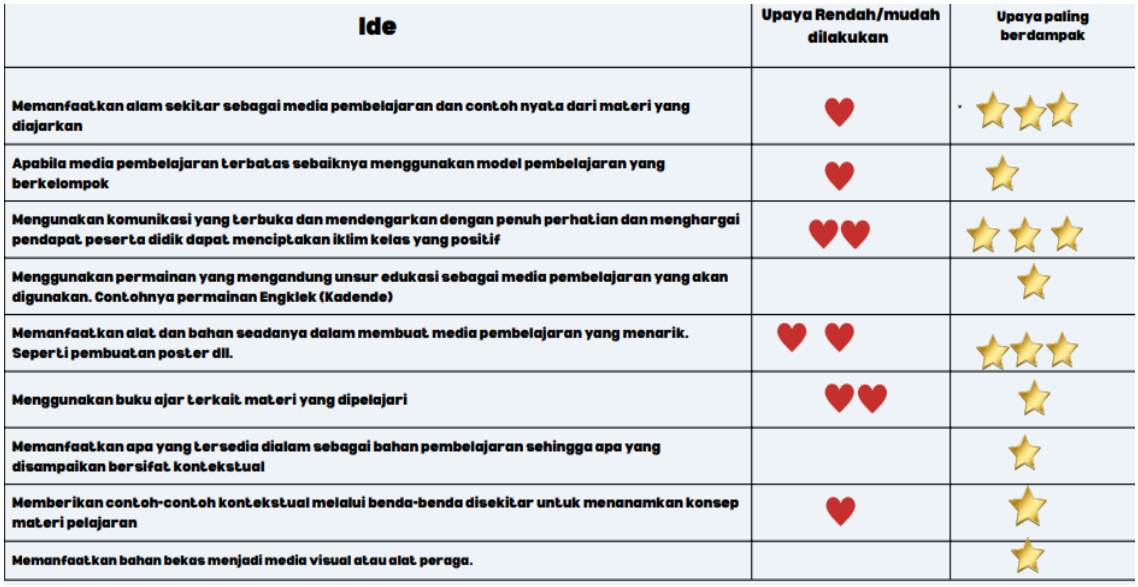

Figure 8. Enhancing Learning through Voting

During this phase, the researchers decided to use poster media as a solution. The chosen learning media is poster media and teaching aids through the problem-based learning (PBL) model with a hands-on approach. This media was selected because it is cost-effective and suitable for almost all Biology topics. It also promotes student creativity and interest in learning through group roles and tasks. The use of poster and props media allows for open communication and the utilization of used materials in the process of creating posters and props.

The idea of using poster media as a solution in problem-based learning models is based on its ease of implementation and its high impact on students. Poster media and teaching aids are suitable for a wide range of Biology topics, as they require minimal funds for production. Moreover, these media can foster student creativity and increase engagement in learning.

To implement this idea, a specific interaction scenario is employed, following the learning syntax embedded in the PBL model. The scenario unfolds as follows:

1) The teacher presents a relevant video related to the topic, followed by a brief introduction of the material.
2) The students are divided into heterogeneous groups according to the class size.
3) Each group is given instructions on the tasks they need to complete.
4) The provided instructions include guidelines for creating posters and props that are tailored to the specific material.

5) Students are encouraged to express their ideas and showcase their creativity through collaboration and interaction, both within their group and with the teacher.
6) The work continues at home, allowing students flexibility in designing posters in terms of both content and aesthetics.
7) Each group is required to present their work, including the posters and props. Other groups have the opportunity to provide feedback, suggestions, and critical analysis.
8) The teacher acknowledges and appreciates the well-executed work of each group.

Figure 9. Interconnections between Media, Posters, and Simple Teaching Aids

The relationship between the media, posters, and simple teaching aids can be seen in Figure 9. Poster media and simple teaching aids lack the advanced features found in modern technology-based learning media. However, they possess unique characteristics in terms of the materials used for their creation. Cardboard paper, either in a conventional method or through the use of poster-making applications like Canva, is commonly used for making posters. Simple teaching aids, on the other hand, make use of readily available materials such as cardboard, plastic bottles, and earplugs.

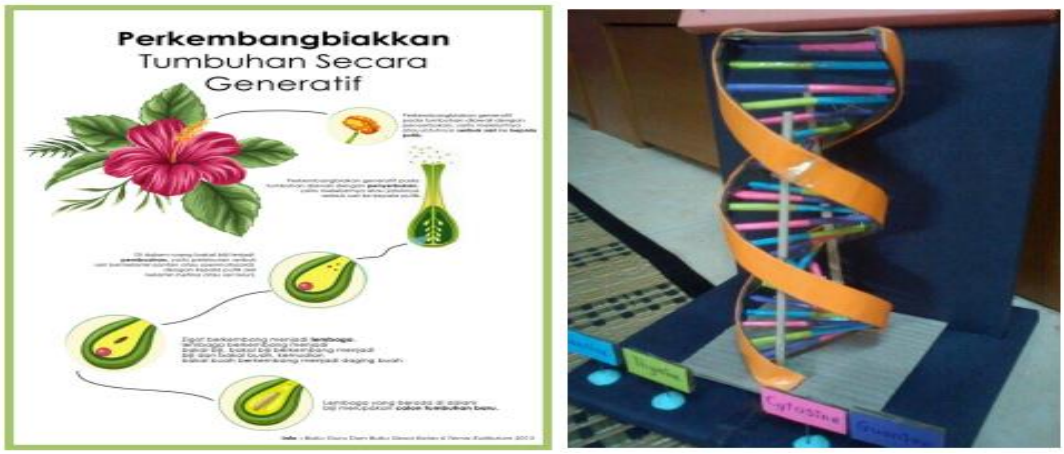

Figure 10. Ideas for Posters and Props

Based on the design challenge, visual learning media in the form of posters and simple props were designed using the PBL (Problem Based Learning) learning model. The main concepts are as follows:

1) Visual media can enhance the comprehension of the presented material.
2) The tools and materials needed for creating posters and teaching aids are easily accessible and cost-effective.
3) Poster media can be utilized for various Biology topics.
4) Poster media and simple teaching aids can be applied in diverse educational settings.

5) The creation of posters and teaching aids can foster students' interest, motivation, and wisdom, thereby enhancing the learning process.
6) Active student involvement in the production of learning media can promote an interactive and collaborative learning environment.

Prototype Phase

Prototype development constitutes an essential component of design thinking and user-centered design, as it allows for idea testing and improvement within a short timeframe (Dam & Siang, 2021). The selection of prototype type takes into consideration factors such as time, energy, funds, and availability of tools and materials. In accordance with the predetermined design challenge of creating learning media in the form of growth and development posters, a prototype was developed.

Figure 11. Poster Media Prototype

The teaching media employed for growth and development materials is relatively simple. This is because the primary objective is for teachers to effectively convey accurate information about growth and development in living organisms. Hence, poster media can serve as an interactive and precise learning tool for this subject matter. The content within the poster can encompass a general understanding of growth and development, factors influencing growth and development, and the analysis of relationships between these factors through experiments designed by students.

Testing

The testing of the prototype was conducted using poster media created by students themselves during classroom learning, and the effectiveness of the poster in aiding understanding of the presented material was assessed through observation. This prototype test was performed once and then evaluated, considering the advantages and disadvantages of the prototype used. The outcome revealed that the addition of animated image elements to the poster attracted students' interest in reading the content being conveyed. The trial involved testing with 20 students, divided into 5 groups. Figure 12 depicts one of the groups during the prototype testing.

Figure 12. Prototype Trial Results

As a result, students displayed great interest and enthusiasm towards the prototypes. This was evident through their active engagement, inquiring with many questions and eagerly awaiting their turn to try it. Moreover, the prototype testing was attended by peers acting as validators. The validators provided input: (1) Some students struggled to understand the poster's content, which hindered their ability to visualize the taught concepts. (2) However, many students exhibited enthusiasm and actively participated when using the poster media, ultimately making the learning process easier. In conclusion, the validators deemed the posters to be highly effective.

CONCLUSION

The intensity and dynamics of the empathy phase in the design thinking process are immensely impactful in motivating us as design thinkers to create and implement effective learning activities. These activities aim to unlock the potential of students and foster their continuous growth. An important outcome of employing empathy techniques in design thinking is the creation of an empathy map, which proves highly valuable in gaining diverse perspectives on students and understanding the various challenges they face. Additionally, this phase involves searching and gathering ideas for learning media that are not only suitable and affordable, but also offer solutions to the design challenges at hand.

The Design Thinking method aids in the creation of appropriate learning media that address the content and learning needs of students. By incorporating engaging imagery and features, the learning media can cater to different learning styles and accommodate variations in students' understanding and learning speed. Enhancing the clarity of teaching materials within the learning media is crucial, as is designing the media to harness students' potential. When formulating the design challenge, it is essential to specify whether the focus lies on content, methods, or the media to be used. Furthermore, when designing lessons, the selection of models, approaches, or media should align with the subject matter being taught.

One challenge encountered is aligning perceptions regarding the observations made in phase 1 (empathize) in order to analyze and synthesize data, thereby determining the core problem that needs to be addressed. Working collaboratively and maintaining effective communication are vital in identifying the problem and formulating it as a student-centered problem statement.

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