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# A New Approach in Science Education: Project-based Visual Stimulus Media to Practice Life Skills and Understanding of Biological Concepts in Deaf Students

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**ABSTRACT:** This research aims to develop visual stimulus media using the instructional development model developed by Thiagarajan, known as the Four Component Instructional Design Model. The purpose of this research is to produce valid, practical, and effective visual stimulus media to support Project-Based Learning (PjBL) in training life skills and mastery of biology concepts for deaf students. Visual stimulus media supporting Project-Based Learning (PjBL) has been declared suitable for use in biology learning for deaf students. Its validity is based on assessments conducted by experts, including material experts, media experts, and practitioners in the field of biology education. The designed media meets the criteria for content and visual appearance and is appropriate to the needs and characteristics of deaf students. This media is effective in improving life skills and understanding of biology concepts in deaf students. The developed stimulus media has proven effective as a support for Project-Based Learning (PjBL). This is evident in its ease of use by teachers and students in the SMALB (Special School for the Deaf) environment. This media facilitates the biology learning process and can bridge the gap in information and understanding abstract concepts for deaf students. Visual stimulus media is effective, as evidenced by improvements in students' life skills and biology concept comprehension test scores. This media is highly effective in supporting Project-Based Learning (PjBL) because it can increase student active engagement, support collaborative project activities, and present biology material in a visual and contextual manner, which is appropriate to the characteristics of students with hearing impairments.

## INTRODUCTION

Every child has the right to receive a quality education, including children with special needs who have hearing impairments. The learning process for deaf students needs to be provided specifically (Bowen & Probst, 2023). Deaf children have unique characteristics, both physically, emotionally, and intellectually. Their physical condition makes it difficult for them to obtain information, which makes it difficult to communicate and interact with other students. Abstract concepts that are often encountered in science learning, such as biology, are not easy for deaf students to understand because, in general, deaf students rely heavily on verbal explanations (Jones, 2014). Deaf students require a learning approach that is contextual, concrete, and visual (Ramadhani et al., 2018). Contextual learning can substantially support the development of life skills in deaf individuals. By connecting material to real-life situations, contextual learning helps deaf individuals better understand concepts and apply them to everyday activities. This supports them in developing critical thinking, problem-solving, and collaboration skills, which are essential elements of life skills (Rakadia, 2022).

Life skills are important abilities that students with hearing impairments should develop. These skills are closely linked to students' academic performance. (Sánchez-Hernando et al., 2021) and also help prepare them for real-life challenges (Prajapati et al., 2017). Having strong life skills is expected to help graduates easily meet the demands of working in the job market. (Kivunja, 2014). Because of their importance, several countries have studied the implementation of life skills programs for school-age students. (Kirchhoff & Keller, 2021). These programs can produce graduates who have good personal and social skills. (Nair & Fahimirad, 2019) as well as work readiness (Amirullah, 2017). Students with hearing impairments often experience unstable mental health, and life skills can reduce emotional stress. (Cassidy et al., 2018) and negative behaviors (Huang et al., 2020).

Training in life skills plays an important role in improving social skills for students with hearing impairments. Social skills help children interact well with others(Izzati et al., 2019). Low social skills can lead to behavior problems, academic failure, isolation, and rejection of students with hearing impairments. (Kauffman et al., 2018). Life skills training can also improve the mental health. (Rahmati & Niktab, 2016) and self-esteem of students with hearing impairments (Vernosfaderani, 2014). Good life skills for students with hearing impairments can help them become independent individuals with a bright future once they graduate from school. (Siambombe & Isaac, 2019), (Musyoka et al., 2015). Life skills are needed for students who graduate from special education schools. (Chiang et al., 2017).

Students with hearing impairments are reported to have several limitations in their intellectual aspects. Many of them struggle with all areas of academic achievement. (Mpofu, 2013). Over the past few decades, there have been several educational reforms, but academic performance of students with hearing impairments is still reported to be behind. (Hendar & O'Neill, 2016). A study conducted on students with hearing impairments in Kenya found that most students scored below average in all subjects required for the KCSE exam. (Namukoa, 2014). Their performance in science subjects is clearly lower compared to other subjects. (George & Nyakwara, 2013). A project-focused learning approach can strengthen student participation as well as academic outcomes, better preparing them to face complex problem-solving challenges in their future academic pursuits and careers. (Atmojo et al., 2025).

One learning model that has the potential to improve the biology learning process is Project-Based Learning (PjBL). Through PjBL, students can learn and apply biology concepts by working on specific projects. (Krajcik & Czerniak, 2018); (Rahardjanto et al., 2019). This approach gives students real-life learning experiences where they take part in projects that involve biology topics. Students can learn biology concepts and develop important skills such as problem-solving, teamwork, and critical thinking. They can carry out experiments, field observations, or research projects that allow them to experience biological concepts firsthand. Students find it easier to understand and make sense of the concepts they learn through this contextual learning approach. (Goodman & Goodman, 2013). In line with this explanation, various studies have reported that implementing PjBL significantly affects student performance. (Iwamoto et al., 2016)and academic achievement (Karaçalli & Korur, 2014).

Project-Based Learning (PjBL) has the potential to help teachers empower the life skills of deaf students throughout the learning process. A recent study shows that Project-based learning is an approach that can facilitate meaningful learning and train the life skills of deaf students (Elliott, 2020). This model is expected to support students in developing practical abilities that can improve their work readiness (Yanqiu & Tian, 2019). It has also been reported to enhance students' cooperative and communicative skills (Wahbeh et al., 2021). This learning model is also capable of improving students' personal and vocational skills (Setiawan & Nurhajati, 2021). Research in Vietnam has shown that PjBL can help students improve problem-solving, time management, and interpersonal skills (Nguyen, 2017). These studies involved students without hearing difficulties. In learning environments involving deaf students, PjBL also has a positive impact. Implementing PjBL can help deaf students improve their product-making skills (Dina & Efendi, 2020), and their critical thinking abilities can also be enhanced (Eldiva & Azizah, 2019). For deaf students, learning should be meaningful, real, and lasting. To support academic instruction, visual aids and communication approaches that complement the use of sign language in classroom instruction are necessary (Mwanyuma, 2016). An analysis of the needs for PjBL models for deaf students revealed that there are challenges in carrying out one of the steps in the model, specifically in the product design phase. Therefore, efforts are needed to support the implementation of the PjBL model for deaf students, one of which is through learning media.

Using media can help present learning materials, and it's recommended that teachers use it to make learning more effective for students who are deaf. (Adigun, 2020). Considering the limitations that deaf students have in understanding learning content,

as well as the recommendations from previous researchers, it's important to provide media that can help improve the use of Project-Based Learning (PjBL) for these students. Deaf students can still get information through other senses, so teachers should use media in their teaching. (Hidayat et al., 2017). The presence of learning media can help deaf students understand lessons better and improve their vocational skills. (Jaya et al., 2018). Deaf students have difficulties in speaking and listening, so the right learning media should be visual (visual stimulus media). One way to explain this type of media to deaf students is by using lip-reading language. (Cahyono, 2019). Visual stimulus media is expected to be an effective communication tool for deaf students, helping them share ideas, present projects, and work with classmates. (Zakia et al., 2017). The use of visual stimulus media is also one of the recommendations for modifying the classroom environment to increase involvement and reduce obstacles for deaf students. (Guardino & Antia, 2012). Previous researchers' content analysis concluded that visual stimulus media can be used to optimize learning for deaf students. (Sari & Putro, 2021).

The purpose of this research is to create visual stimulus media that supports PjBL, which is valid, practical, and effective in improving life skills and students' understanding of biology concepts. The research hypothesis is: The use of visual support media in Project-Based Learning (PjBL) can improve the life skills of students with hearing impairments, and the use of visual support media in Project-Based Learning (PjBL) can enhance the understanding of biology concepts among students with hearing impairments.

## METHODS

This research is a development study using the 4D model. (Thiagarajan et al., 1974). The 4D model is an instructional design model created by Thiagarajan, known as the Four-Component Instructional Design Model. The 4D development model consists of four stages: Define, Design, Develop, and Disseminate. The procedure for developing visual stimulus media to support Project-Based Learning (PjBL) uses the 4D model (Thiagarajan et al., 1974) which involves the following steps:

### *1.1.Define*

The Define phase is carried out with the purpose of setting and defining the requirements for developing certain activities. The first step in the 4D model is the definition of development requirements. During this phase, which is the needs analysis stage, developers need to refer to the development requirements, analyze, and collect information to determine how far the development should go. The definition or needs analysis phase can be carried out through analysis of previous research and literature studies. There are five activities that can be done during the Define phase, which include: a. Front-end Analysis, b. Learner Analysis, c. Task Analysis, d. Concept Analysis, and e. Specifying Instructional Objectives.

### *2.2. Design*

The second stage in the 4D model is the design phase. This stage aims to create a prototype for the instructional material. This phase can begin after the behavioral objectives for the instructional content have been established. Choosing the media and format for the material, as well as producing an initial version, are key parts of this design stage. There are four steps that must be followed during this phase: developing a criterion-referenced test, selecting the media, selecting the format, and creating the initial design.

### *2.3. Develop*

The third phase in the development of learning devices using the 4D model is development(Indriani, 2017). This phase is where a development product is created. During the development phase, feedback is obtained through formative evaluation, and the material is refined accordingly. This stage includes two steps: expert appraisal followed by revisions and developmental testing. a. Expert Appraisal: At this stage, experts (validators) assess the developed media and learning materials. Next, revisions or improvements are made as necessary after receiving input and suggestions from the expert validation results. The validators involved in this study are as follows: 1) Media Expert. The appointed media expert is a lecturer in the Biology Education study program, teaches instructional media courses, holds a minimum of a doctorate, and has been a lecturer for 5 years. 2) Material Expert. The appointed material expert is a lecturer in the Biology Education study program, holds a minimum of a doctorate, and has been a lecturer for 5 years. 3) Biology Education Practitioner. The appointed Biology Education Practitioner is a Biology teacher with experience teaching deaf students and has been a teacher for 5 years.

Validity data are obtained from the analysis of validity questionnaires completed by validators, material experts, media experts, and biology subject practitioners, as well as teacher and student questionnaire responses. These questionnaires will be analyzed using the following steps. a) Score the answers using indicators based on a Likert scale. b) Determine the highest score. Highest score = number of validators x number of indicators x maximum score. c) Determine the total score for each validator by adding up all the scores obtained from each indicator. d) Determine the score obtained by adding up the scores from each validator. e) Determine the validity value using the following method.

$$V = \frac{Tse}{Tsh} x\ 100\%$$

Description:

V = Validity

Tse = Total score obtained

Tsh = Total Maximum Score

The percentages of assessments obtained from media experts, material experts, and biology subject practitioners were converted into learning device quality categories, so it can be concluded that the validity-level criteria for the learning device are presented in Table 2.1.

**Table 2.1** Validity Level Criteria

| Value Achievement (score) | Validity Category | Description |
|---|---|---|
| V=100 | Very valid | Very good for use |
| 80≤ V <100 | Valid | May be used with minor revisions |
| 60≤ V <80 | Less valid | May be used after major revisions |
| 40≤ V <60 | Invalid | May not be used |
| 20≤ V <40 | Very invalid | May not be used |

Source: Adapted from Azwar (2022:78)

b. Developmental testing.

The development trial was conducted to obtain direct feedback in the form of responses, reactions, and comments from students and observers regarding the developed learning tools. The trial and revisions were conducted repeatedly to achieve effective and consistent learning tools. The subjects of this trial were deaf students at Karya Mulya Special Needs High School. The trial was conducted in one class, grade 11. The following activities were carried out during this trial phase: 1) Observing the life skills of deaf students in grade 11. 2) Conducting pre- and post-tests on the conceptual understanding of deaf students in grade 11.

*2.4. Disseminate*

The dissemination phase is carried out to promote the developed product and ensure its acceptance by individuals, groups, or systems. Material packaging must be selective to achieve the appropriate format. According to Thiagarajan (1974), there are three main stages in the dissemination phase: validation testing, packaging, and diffusion and adoption. a. Validation testing. Before disseminating materials, a summative evaluation is conducted. In the validation testing phase, the materials are used under replicable conditions to demonstrate who will learn them, under what conditions, and for how long. The materials must also undergo professional review to obtain an objective opinion regarding their adequacy and relevance. Before dissemination, the practicality of the developed media must be assessed. Teacher and student responses to visual stimulus media are used to assess the practicality of visual stimulus media as a support for Project-Based Learning (PjBL). The instrument used to assess teacher and student responses to visual stimulus media is a questionnaire. Data on the practicality of visual stimulus media as a

support for project-based learning and student responses to the implementation of visual stimulus media as a support for PjBL are analyzed using the following procedures:

$$P = \frac{Tse}{Tsh} x\ 100\%$$

Description:

P = Practicality

Tse = Total score obtained

Tsh = Total Maximum Score

The obtained score is confirmed by the practicality criteria as presented in. In the validation testing stage, the revised product completed during the development stage is implemented on the actual target or target audience. At this stage, the achievement of objectives is also measured to determine the effectiveness of the developed product. Furthermore, after implementation, researchers/developers need to observe the results of goal achievement. Any goals that have not been achieved must be resolved to prevent recurrence after the product is disseminated.

b. Packaging.

In the packaging, diffusion, and adoption stages, the product is packaged by printing an implementation guidebook, which is then distributed so that it can be absorbed (diffused) or understood by others and used (adopted) in their classes. Important considerations in dissemination include user analysis, strategy and theme, timing of dissemination, and selection of distribution media. The final stage of development is Dissemination. A product can be said to have reached the final stage of production (development) when testing at the development stage produces a product that receives positive assessments from experts, is proven consistent, and is declared suitable for use; then the product is ready for widespread use. This implementation phase will be conducted at a special needs high school (SMALB) in the Greater Surabaya area. Implementation will be conducted in one class (one treatment class). The chosen design is a one-group pretest-posttest design. At this stage, the media and learning materials are packaged and ready to print.

c. Diffusion and Adoption

The final stage of packaging, diffusion, and adoption, is the most crucial, yet often overlooked. A producer and distributor must be selected and work cooperatively to package the materials in an acceptable format. Efforts are needed to distribute the materials widely among trainers and trainees, and to encourage their acceptance and use.

Two activities are used to facilitate diffusion: conducting training on the use of media and learning tools for teachers and presenting research and development results at national seminars, articles in international journals, and articles in national journals. In the adoption phase, the developed media can be used by teachers at special needs high schools (SMALLB).

## RESULTS

### *3.1 Validity of Learning Tools*

The results obtained from this stage include input or suggestions from validators and validation scores for learning tools using visual stimulus media to support Project-Based Learning. This is conducted by media expert validators, material expert validators, and biology education practitioner validators. The practical data collected comes from the responses of students with hearing impairments and their teachers. They filled out questionnaires provided by the researcher. The questionnaires were completed after the visual stimulus media supporting project-based learning (PjBL) was implemented for students in class X at SMALB Karya Mulia and SMALB Samudra Lavender. The practicality scores of the visual stimulus media supporting project-based learning (PjBL) are presented in Table 3.1: Average Practicality Scores.

The improvements made by the researcher based on the suggestions provided by the material expert validator were then presented back to the material expert validator until all input and suggestions had been incorporated and assessed by the validator. The results of the analysis of the average material validation scores are presented in Table 3.1.

**Table 3.1** Average Material Validation Score

| Assessment Aspect | Score Obtained | Maximum Score | Average | Percentage | Appropriateness |
|---|---|---|---|---|---|
| Title | 15 | 15 | 5 | 100 | Very valid |
| Examples and Illustrations | 15 | 15 | 5 | 100 | Very valid |
| Images/Photos/Videos | 15 | 15 | 5 | 100 | Very valid |
| Language | 15 | 15 | 5 | 100 | Very valid |
| Conceptual Authenticity of the Material | 40 | 40 | 5 | 100 | Very valid |
| The Truth of the Concept of Matter | 45 | 45 | 5 | 100 | Very valid |
| Material Up-to-Date | 15 | 15 | 5 | 100 | Very valid |
| Material Contextuality | 15 | 15 | 5 | 100 | Very valid |

The results of the validator's assessment after a series of improvements were made by the researcher are presented in the form of the Average Media Validation Score in Table 3.2.

**Table 3.2** Average Media Validation Score

| Assessment Aspects | Score Obtained | Obtained Maximum | Average | Percentage | Information |
|---|---|---|---|---|---|
| Supporting Media for PjBL | 40 | 50 | 4 | 80 | Valid |
| Media Support for Life Skills Training | 139 | 165 | 4,2 | 84 | Valid |
| Media Design | 35 | 35 | 5 | 100 | Very valid |
| Layout | 18 | 20 | 4,5 | 90 | Valid |
| Handouts | | | | | |
| Content Appropriateness | 20 | 20 | 5 | 100 | Very valid |
| Material Presentation | 19 | 20 | 4,75 | 95 | Valid |
| Consistency | 15 | 15 | 5 | 100 | Very valid |
| Language | 4 | 5 | 4 | 80 | Valid |

Improvements or revisions made by the researcher based on suggestions from the practitioner validator are then presented back to the practitioner validator for assessment of the revised results. The average Practitioner Validation Score data are presented in Table 3.3

**Table 3.3** Mean Practitioner Validation Score

| Assessment Aspects | Score obtained | Maximum score | Average | Percentage | Description |
|---|---|---|---|---|---|
| Curriculum | 15 | 15 | 5 | 100 | Very valid |
| Material | 35 | 35 | 5 | 100 | Very valid |
| Grammar | 10 | 10 | 5 | 100 | Very valid |
| Display Design | 55 | 55 | 5 | 100 | Very valid |

### *3.2 Practicality of Visual Stimulus Media*

The practicality data collected were in the form of responses from deaf students and teachers by filling out a questionnaire provided by the researcher. The questionnaire was filled out after the visual stimulus media supporting the PjBL was implemented in SMALB Karya Mulia and SMALB Samudra Lavender students in class X. The practicality data of the visual stimulus media supporting project based learning (PjBL) is presented in Table 3.3 Average Practicality Score

**Table 3.3** Average Practicality Score

| No | Respondents | School | Average | Percentage | Criteria |
|---|---|---|---|---|---|
| 1 | Teachers | SMALB Karya Mulia | 5,00 | 100 | Very Practical |
| 2 | Teachers | SMALB Samudra | 4,50 | 90,00 | Practical |
| 3 | Students | SMALB Karya Mulia | 4,74 | 94,79 | Practical |
| 4 | Students | SMALB Samudra | 4,41 | 88,24 | Practical |

### *3.3 Effectiveness of Visual Stimulus Media on Life Skills*

Effectiveness data was obtained from observations of students' life skills during the implementation of learning activities. Data from observations of the life skills of deaf students in grade X at SMALB Karya Mulia Surabaya are presented in Figure 3.1.

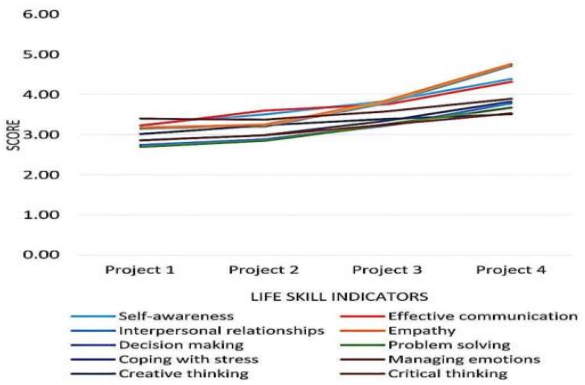


**Figure 3.1** Life skills of SMALB Karya Mulia students

The effectiveness of visual stimulus media in supporting Project-Based Learning (PjBL) was assessed by observing the development of life skills among 10th-grade hearing-impaired students at SMALB Karya Mulia Surabaya. Data on life skills were gathered through student observations conducted across four learning projects. Based on these observations, ten life skills indicators were analyzed: self-awareness, effective communication, interpersonal relationships, empathy, decision-making,

problem-solving, coping with stress, emotional management, creative thinking, and critical thinking. The observation results revealed an increase in average scores across all indicators from the first project to the fourth. These findings indicate that visual stimulus media supporting PjBL can foster the life skills of hearing-impaired students gradually and comprehensively leading to improvement and growth compared to their initial levels.

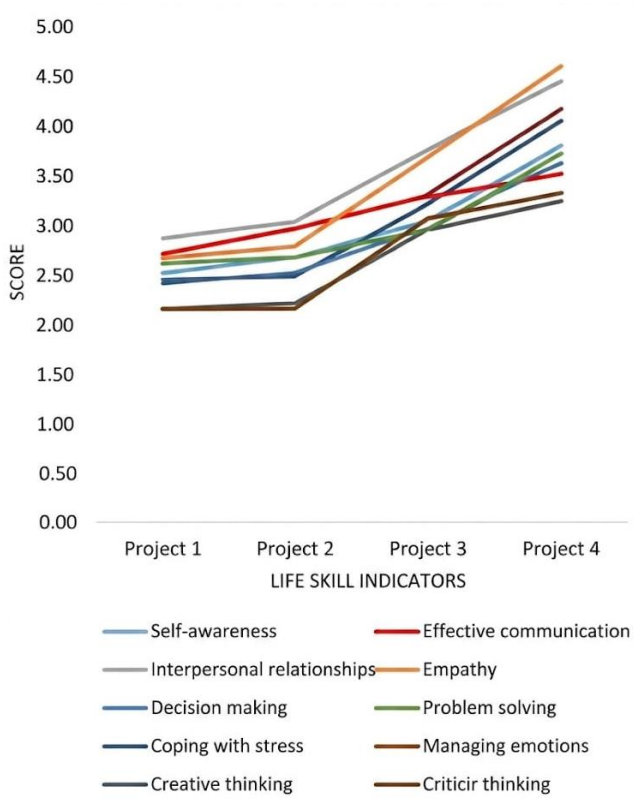


**Figure 3.2** Life skills of SMALB Samudra Lavender students

Among the ten life skills indicators, empathy achieved the highest score in the studies conducted at both SMALB Karya Mulia and SMALB Samudra Lavender. Deaf students demonstrated a profound sense of empathy toward their peers. Their strong sense of care was evident during the implementation of visual stimulus media; for instance, after completing a post-lesson quiz, students who had answered correctly would give those who had not yet found the answer a chance to respond. When working on projects, these students showed great concern for classmates who did not yet understand their assigned tasks. Deaf students possess excellent social awareness; they tend to be close to their peers and strive to assist them whenever they face difficulties. Deaf individuals share a very close bond with their community and possess a strong sense of solidarity with fellow Deaf people, offering mutual support to one another (Hauser et al., 2010).

### *3.4 Effectiveness of Visual Simulus Media on Understanding Biological Concepts*

The average value of understanding biology concepts of deaf students of SMALB Karya Mulia class X is presented in Figure 3.3. Average Test Score of SMALB Karya Mulia Students The average test score of SMALB Samudra Lavender students is presented in Figure 3.4.

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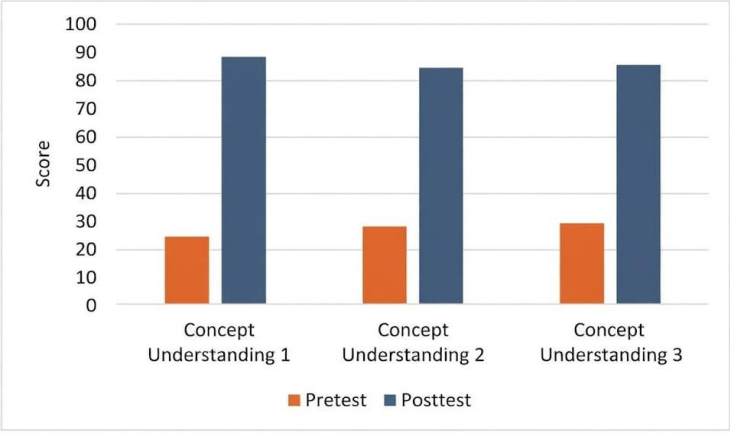


**Figure 3.3** Average Biology Concept Understanding Score of SMALB Karya Mulia Students

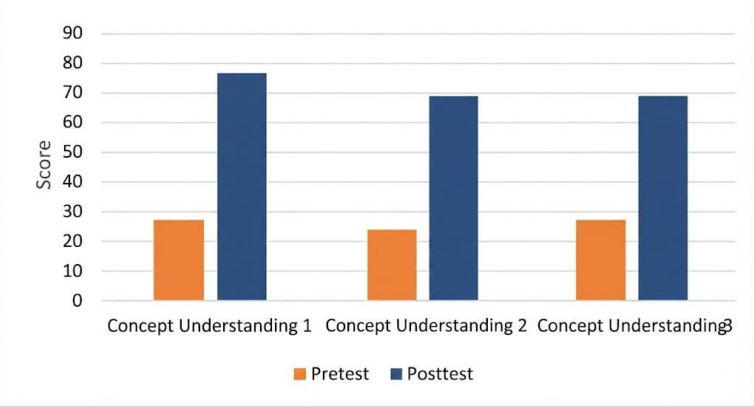


**Figure 3.4** Average Biology Concept Understanding Score of SMALB Samudra Lavender Students

## 4. DISCUSSION

*4.1 Validity*

The data obtained from the research were then analyzed, after obtaining the results of the data analysis from the research on developing visual stimulus media to support PjBL to improve life skills and understanding of biology concepts for deaf students are then presented in the following discussion.

Validation by content experts plays a crucial role in assessing the feasibility and accuracy of the content of the developed visual stimulus media. The purpose of this validation is to ensure that the material presented aligns with the national curriculum, is scientifically accurate, and is comprehensible to students with hearing impairments. Media presented in a concrete and visual manner is crucial for deaf students, who tend to experience difficulties understanding verbal information. Learning materials for deaf students must be structured systematically, concisely, and presented in a visual format that can help reduce students' cognitive load (Wardhani et al., 2024). Content experts must be able to identify whether the media presents concepts correctly and adapt the learning content to the language abilities and experiences of deaf students. Suggestions from material experts to visualize the consequences of not eating will result in weakness, illness, and death. This can facilitate the understanding of deaf students through learning with the help of visual-based media. Appropriate visualization can make it easier for students to remember for a longer period of time (Mayer, 2024).

Input from media experts indicates that, when designing handouts for deaf children, it is necessary to pay attention to the structure of the text and language, because deaf children generally have limitations in vocabulary compared to hearing children (Wahyudi et al., 2024). Deaf children have difficulty understanding complex sentences, because they have limitations in hearing,

which impacts their understanding of the meaning of a long sentence. The lack of experience hearing the complete language structure so that it tends to be confusing for them (Imran, 2023). Suggestions from media experts for sentences delivered to deaf children include using short sentences, using visual aids, or simple steps to support student understanding (Tomazin et al., 2025).

Suggestions from biology education practitioner validators provide several constructive recommendations, covering content elements, question formulation, and media design applied in the learning process. Suggestions for improvement regarding changing the question to be more specific, namely: "Name two biotic components!" aims to clarify the expectations of students' answers and indicate the main goal of achieving measurable indicators. The formulation of questions in the cognitive domain at level C1 (remembering) requires providing clear instructions, especially in questions given at the beginning of learning (Krathwohl & Anderson, 2010). The word "try" in the formulation of questions is considered inappropriate because it can lead to multiple interpretations and the impression of indecisiveness, so it is recommended to be removed.

The validator suggested that the visual stimulus media developed be made simple and easy to understand for deaf students, because simple and clear visualizations are very helpful for students in conveying meaning (Zakia et al., 2017) In biology learning media, the use of images and colors that resemble real objects can improve students' memory and recognition. The use of contrasting and unrealistic colors can lead to misconceptions. Recommendations for the use of media with moving images, especially to display animals, such as animation or real images, can increase students' attention in describing the processes or behavior of organisms that cannot be directly observed in class. For deaf students, moving media can help students understand the behavior, physical characteristics, and habitats of animals in a more realistic way (Kaya & Kuzugudenli, 2016)

*4.2 Practicality*

Practicality refers to how effectively and efficiently a product is applied in real-world situations (Milala et al., 2022). Practicality aims to ensure that the developed media is easy to use and understand by teachers and students in the learning process (Plomp & Nieveen, 2010). Media is considered practical if it can be implemented easily and does not pose technical obstacles during use. Practical visual stimulus media can support the initial stages of PjBL in determining fundamental questions and project planning. Good visualization can help deaf students understand the messages conveyed through the media (Gulati, 2016).

*4.3 Effectiveness*

Deaf students experience difficulties in verbal communication due to limitations in understanding vocabulary groups. Understanding a sentence requires the ability to form logical and hierarchical relationships between words. Relationships within a sentence play a role in developing thinking to support the ability to understand self-awareness and problem-solving. Deaf students have a lower level of understanding the meaning of a sentence compared to hearing students. As a result of this limitation, it can hinder the ability to access information and reduce the effectiveness of communication skills (González-Cuenca et al., 2024). Communication barriers and lack of awareness of the surrounding environment make it difficult for deaf students to understand and make the right decisions to solve their problems independently (Terry et al., 2025). Deaf students experience difficulties in solving their own problems because the way they communicate in their community is often confusing, this is influenced by the rules of sign language, culture, and their daily habits (Noschese, 2025).

*4.4 Research Findings*

Visual stimulus media can help students in completing projects according to the steps in PjBL properly. Deaf students can provide positive responses when given basic questions in the initial stages of PjBL. Deaf students are very enthusiastic about participating in lessons, because visual stimulus media can attract students' attention to learn and stimulate students to be able to answer. Visual stimulus media makes it easier for students to understand the material about biology presented by the teacher, by presenting images, videos, and delivery on visual stimulus media equipped with SIBI sign language. At the end of each explanation of the material presented in the media, to determine students' understanding of the lesson material presented in the visual stimulus media is equipped with a quiz. Almost all students can answer the questions in the quiz correctly.

Visual stimulus media is equipped with tutorials on project work, so students more easily understand what needs to be done to complete the project in groups. Visual stimulus media can facilitate teachers in delivering lesson materials and in project planning activities until the end of the project creation, students are already able to follow the information presented in the visual stimulus media, with the help of this media can assist teachers in explaining the material and steps in making the project.

The role of visual stimulus media as a support for Project-Based Learning (PjBL) has great potential to improve the life skills of deaf students. Project-Based Learning provides students with hands-on practice opportunities that allow them to experience, observe, and create real-world products relevant to the subject matter. These hands-on activities are crucial for deaf students, as they rely more heavily on visual aids and concrete experiences to understand concepts.

Project-Based Learning can improve independence, critical thinking skills, and collaboration in students with special needs, including those with hearing impairments, because they play an active role in the learning process through the stages of design, implementation, exploration, and reflection (Mursita et al., 2025). Meanwhile, according to direct practice in PjBL, it has a significant influence on the understanding of biology concepts, because deaf students can observe and evaluate real objects related to the learning material (Olufemi, 2020).

The Project-Based Learning (PjBL) model, viewed from a life skills perspective, has been proven to develop skills such as problem-solving, decision-making, and responsibility for tasks. Project-Based Learning creates a learning environment that stimulates students' active involvement in meaningful tasks, which indirectly builds self-confidence and social skills (Tia & Wangid, 2024). Project-Based Learning (PjBL) is highly relevant for deaf students, especially in biology lessons that require an understanding of abstract concepts. Through the assistance of visual media, hands-on practice, and concrete experiences, deaf students can more easily develop conceptual understanding and life skills.

## 5. CONCLUSIONS

Referring to the data analysis and discussion presented, it can be concluded that:

1. The visual stimulus media supporting Project-Based Learning (PjBL) is declared valid for use in biology instruction for deaf students. This validity was obtained from the assessment of experts, namely material experts, media experts, and biology education practitioners. The developed media meets the requirements of content and visual design, and is appropriate to the needs and characteristics of deaf students. This media is valid in improving the life skills and understanding of biology concepts in deaf students.

2. The developed visual stimulus media has proven practical for use as a support for Project-Based Learning (PjBL). This is evident in its ease of use by teachers and students in the SMALB (Special School for the Deaf) environment. This media supports the biology learning process and is able to bridge the information barrier and understanding of abstract concepts in deaf students. This media is practical in improving the life skills and understanding of biology concepts in deaf students.

3. The effectiveness of visual stimulus media is demonstrated through improvements in students' life skills and test scores on understanding biology concepts. This media is effective as a support for Project-Based Learning (PjBL) because it can increase active student engagement, facilitate group project work, and present biology material visually and contextually, appropriate to the characteristics of deaf students.

4. The use of visual stimulus media to support Project-Based Learning can improve the life skills of deaf students. Of the ten life skills indicators observed, including self-awareness, effective communication, interpersonal relationships, empathy, problem-solving, decision-making, creative thinking, critical thinking, emotional management, and stress management, the empathy indicator demonstrated excellent criteria and the highest score among deaf students' life skills.

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**Ethical considerations**

” if the study does not require an ethical statement.

**Conflict of Interest**

"The authors declare no conflicts of interest".

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