

Analysis of Learning Behavior, Persistence, and Conceptual Understanding of Students with Hearing Impairments in Visual Learning at Manunggal Special School, Slawi

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Article Info	Abstract
<p>Article history: Submitted: 07-01-2026 Accepted: 21-02-2026 Published: 30-03-2026</p> <p>Keywords: hearing impairment; visual learning; learning behavior; persistence; conceptual understanding</p>	<p><i>This study aimed to analyze the learning behavior, persistence, and conceptual understanding of Grade VI students with hearing impairments in visual learning at Manunggal Special School, Slawi. A descriptive qualitative design with a case study orientation was employed. Participants consisted of one classroom teacher and six students with hearing impairments selected purposively. Data were collected through classroom observation, visual worksheet analysis, field notes, and teacher confirmation. The observation focused on learning focus, visual response, conceptual understanding, independence, and persistence, using a four-point scoring scale. The findings showed that students obtained high scores ranging from 3 to 4 across most observed indicators, indicating good to very good engagement. Visual learning supported students' ability to follow instructions, recognize images, match pictures with concepts, complete simple arithmetic tasks, and persist in completing worksheets despite communication barriers. The teacher's use of pictures, demonstrations, sign language, facial expressions, and concrete examples helped transform verbal concepts into accessible visual information. The study concludes that visual learning functions as pedagogical accessibility for students with hearing impairments. It supports not only conceptual understanding but also learning persistence and independence. These findings highlight the importance of structured visual media and empathetic teacher communication in special education classrooms more meaningfully.</i></p>
<p>Kata kunci: tunarungu; pembelajaran visual; perilaku belajar; ketekunan; pemahaman konsep.</p>	<p>Abstrak Penelitian ini bertujuan menganalisis perilaku belajar, ketekunan, dan pemahaman konsep siswa tunarungu kelas VI dalam pembelajaran visual di SLB Manunggal Slawi. Penelitian menggunakan desain kualitatif deskriptif dengan orientasi studi kasus. Partisipan terdiri atas satu guru kelas dan enam siswa tunarungu yang dipilih secara purposive. Data dikumpulkan melalui observasi kelas, analisis lembar kerja visual, catatan lapangan, dan konfirmasi dengan guru. Observasi difokuskan pada aspek fokus belajar, respons visual, pemahaman konsep, kemandirian, dan ketekunan menggunakan skala penilaian empat poin. Hasil penelitian menunjukkan bahwa siswa memperoleh skor tinggi, yaitu 3–4, pada sebagian besar indikator yang diamati, sehingga berada pada kategori baik hingga sangat baik. Pembelajaran visual membantu siswa mengikuti instruksi, mengenali gambar, mencocokkan gambar dengan konsep, menyelesaikan operasi hitung sederhana, serta tetap tekun mengerjakan tugas meskipun memiliki hambatan komunikasi. Penggunaan gambar, demonstrasi, bahasa isyarat, ekspresi wajah, dan contoh konkret oleh guru membantu mengubah konsep verbal menjadi informasi visual yang mudah diakses. Penelitian ini menyimpulkan bahwa pembelajaran visual berfungsi sebagai bentuk aksesibilitas pedagogis bagi siswa tunarungu. Pembelajaran visual tidak hanya mendukung pemahaman konsep, tetapi juga memperkuat ketekunan dan kemandirian belajar siswa.</p>
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Introduction

Education for students with hearing impairments requires instructional practices that provide meaningful access to language, communication, and academic content. Students with hearing impairments do not necessarily experience intellectual limitations; rather, their learning challenges often emerge from restricted access to auditory-verbal information and classroom communication. Therefore, effective instruction for these students should not merely simplify learning materials, but should transform them into accessible forms through visual representation, sign language, gestures, facial expressions, demonstrations, and written cues. Recent scholarship in deaf education emphasizes that curriculum and instruction for deaf and hard-of-hearing students must be designed around language access, literacy development, and communicative accessibility rather than deficit-based assumptions about learners' capacities (Hartman, Smolen, and Powell 2023).

Visual learning is particularly relevant in the education of students with hearing impairments because it allows academic information to be presented in forms that can be directly observed, interpreted, and connected to prior experience. In science learning, abstract concepts often require concrete representation so that students can identify, compare, classify, and explain phenomena through visible evidence. Atika et al. (2023) found that science education practices for deaf and hard-of-hearing students in Indonesia rely strongly on visual strategies and hands-on activities to make conceptual content more accessible. Similarly, Ediyanto et al. (2023) emphasized that learning instruments for students with hearing impairments need to support conceptual understanding through concrete and visual forms. These findings are directly relevant to the present study, which examines how visual worksheets, pictures, symbols, and demonstrations support students' understanding of changes in the states of matter and simple arithmetic operations.

However, visual learning should not be understood merely as the use of attractive pictures or supporting media. In the context of students with hearing impairments, visual learning functions as pedagogical accessibility. It helps students receive instructions, follow learning sequences, respond to tasks, and construct meaning from academic content. Gehret and Elliot (2025) argue that multimedia learning for deaf and hard-of-hearing students should promote active processing, not passive reception of visual information. This means that visual media become educationally meaningful when students are required to observe, match, interpret, organize, and apply the information. In the present study, this principle is reflected in the use of visual worksheets that require students to connect images with scientific concepts and numerical symbols.

Language access is also central to conceptual learning among students with hearing impairments. Santos and Cordes (2022) showed that mathematical abilities in deaf and hard-of-hearing children are closely related to language development in building number concepts. This indicates that difficulty in mathematics or science should not automatically be interpreted as cognitive weakness, because limited access to language and representation may interfere with the formation of academic concepts. Finton et al. (2025) further reported that sign language exposure and language development are associated with academic outcomes among deaf children. Therefore, visual learning should not be treated as a replacement for language, but as part of a broader accessible communication system involving sign language, written instructions, visual symbols, teacher demonstration, and nonverbal expression.

In addition to conceptual understanding, learning behavior and persistence are important dimensions in understanding the academic process of students with hearing impairments. Learning success is not only reflected in correct answers, but also in students' ability to maintain attention, respond to visual instructions, continue working despite difficulty, ask for help, and complete assigned tasks. Herring and Woolsey (2020) emphasize that instructional strategies for deaf and hard-of-hearing students should increase active student responding, classroom participation, and engagement. This supports the need to observe students' learning behavior directly rather than relying solely on final test scores.

The present study was conducted at Manunggal Special School, Slawi, where Grade VI students with hearing impairments participated in visual-based learning activities. Preliminary classroom observations indicated that students responded positively when the teacher used pictures, visual worksheets, sign language, demonstrations, and concrete examples. The students also showed emotional sensitivity, positive responses to teacher support, and willingness to continue completing tasks when guidance was delivered patiently and visually. These classroom characteristics suggest that the effectiveness of visual learning is shaped not only by the media itself, but also by the teacher's role as a mediator who translates verbal concepts into accessible visual and communicative forms.

Although previous studies have discussed visual learning, science education, language access, and instructional strategies for deaf and hard-of-hearing students, there remains limited research that examines learning behavior, persistence, and conceptual understanding together in a natural classroom context. Many studies tend to focus on media effectiveness or academic outcomes separately. This creates a gap in understanding how students with hearing impairments actually engage with visual instruction during the learning process: how they focus, respond, persist, seek help, and demonstrate conceptual understanding through worksheets and classroom interaction.

To address this gap, this study analyzes the learning behavior, persistence, and conceptual understanding of Grade VI students with hearing impairments in visual learning at Manunggal Special School, Slawi. The study uses a descriptive qualitative design because it seeks to capture students' learning processes in a natural setting through classroom observation, analysis of visual worksheets, and confirmation with the classroom teacher. This methodological approach allows the study to examine not only what students produce in their worksheets, but also how they engage with visual learning, how they sustain effort, and how they construct meaning from visual representations.

The novelty of this study lies in its integrated analysis of three interrelated dimensions: learning behavior, persistence, and conceptual understanding. Unlike previous studies that mainly discuss visual media or learning outcomes separately, this study provides a more complete picture of how visual learning supports the academic process of students with hearing impairments. The findings are expected to contribute theoretically to deaf education studies and practically to the development of visual, communicative, and accessible instructional strategies in special education classrooms.

Therefore, this study aims to analyze the learning behavior, persistence, and conceptual understanding of Grade VI students with hearing impairments in visual learning at Manunggal Special School, Slawi. Specifically, the study investigates how students maintain learning focus, respond to visual instructions, persist in completing tasks, and demonstrate conceptual

understanding when learning materials are presented through pictures, symbols, demonstrations, sign language, and structured visual worksheets.

Methods

Research Design

This study employed a descriptive qualitative design with a case study orientation. This design was selected because the study aimed to describe, interpret, and understand the learning behavior, persistence, and conceptual understanding of students with hearing impairments in a natural classroom setting. A descriptive qualitative approach is appropriate when the researcher seeks to explore participants' learning experiences, behavioral patterns, and responses to instructional activities through rich, contextual data rather than statistical testing (Nassaji 2015). In addition, a case study orientation was used because the research focused on a bounded educational context, namely visual learning practices involving Grade VI students with hearing impairments at Manunggal Special School, Slawi. Case study research allows an in-depth and multifaceted examination of complex phenomena in real-life settings (Crowe et al. 2011).

The focus of the study was not to measure the causal effect of visual learning, but to examine how students responded to visual-based instruction, how they persisted in completing tasks, and how they demonstrated conceptual understanding through visual worksheets and classroom interaction. Therefore, the design was considered suitable for capturing the interaction between visual instructional support, teacher mediation, and students' learning responses.

Research Setting and Participants

The study was conducted at Manunggal Special School, Slawi, Tegal Regency, Central Java, Indonesia. The research setting was selected because the school provides educational services for students with special needs, including students with hearing impairments. The classroom observed in this study was Grade VI, where visual learning was used to support students' understanding of science and basic arithmetic concepts.

The participants consisted of one classroom teacher, identified as Bu Nur, and six Grade VI students with hearing impairments. The students were selected purposively because they met the criteria relevant to the study focus: they were students with hearing impairments, participated in classroom learning supported by visual media, and were able to respond to learning activities through sign language, gestures, written responses, or visual worksheets. Purposeful sampling is appropriate in qualitative research because it enables researchers to select information-rich participants who can provide relevant data related to the phenomenon being studied (Palinkas et al. 2015).

The teacher was involved as a key informant because she directly facilitated the learning process, provided visual instructions, assisted students during task completion, and understood the students' communication characteristics. The inclusion of the teacher's perspective strengthened the interpretation of observational and document-based data.

Learning Context and Visual-Based Activities

The visual learning activities focused on two learning materials: changes in the states of matter and simple arithmetic operations. These topics were selected because they required students to connect visual objects, symbols, and conceptual meaning. In the science lesson,

students worked on visual worksheets related to melting, freezing, evaporation, and condensation. In the mathematics lesson, students completed simple addition tasks supported by pictures and concrete visual representations.

The instructional process used several forms of visual support, including pictures, visual worksheets, concrete examples, demonstrations, sign language, facial expressions, and hand movements. These supports were used to help students access information, understand instructions, identify concepts, and complete learning tasks. The use of visual support was central to the research because the study examined how students with hearing impairments responded to learning when verbal-auditory access was limited.

Data Collection Procedures

Data were collected through three main stages: pre-observation, classroom observation, and document analysis. First, the pre-observation stage was conducted to understand the classroom context, students' communication characteristics, learning routines, and the teacher's instructional strategies. This stage helped the researcher identify how visual communication was commonly used in the classroom. Second, the classroom observation stage was conducted during visual-based learning activities. The researcher observed teacher-student interaction, students' attention to visual instructions, responses to worksheets, persistence in completing tasks, and the ways students asked for help when they encountered difficulty. Observation was conducted without disrupting the normal learning process. Third, the document analysis stage involved reviewing students' visual worksheets and observation sheets. The analysis focused on the accuracy of students' answers, their ability to match pictures with concepts, their ability to follow visual instructions, and their completion patterns. Document analysis was used to complement classroom observation and provide concrete evidence of students' conceptual understanding. In addition, a brief interview or confirmation discussion was conducted with the classroom teacher to clarify students' responses, learning difficulties, and the teacher's interpretation of classroom behavior. This procedure was aligned with qualitative reporting standards that emphasize transparency in describing the research context, participants, data collection, and analysis procedures (Tong, Sainsbury, and Craig 2007).

Research Instruments

The instruments used in this study consisted of an observation sheet, visual worksheets, and an interview guide. The observation sheet was used to record students' learning behavior during visual-based instruction. The observed indicators included learning focus, visual response, conceptual understanding, independence, and persistence. Each indicator was scored using a four-point scale, ranging from 1 to 4.

Table 1. Scoring Criteria for Learning Behavior, Persistence, and Conceptual Understanding Observation

Score	Category	Description
1	Poor	The behavior rarely appeared, and the student required full assistance.
2	Fair	The behavior appeared occasionally, but the student still required frequent guidance.
3	Good	The behavior appeared clearly, and the student could complete tasks with limited assistance.

Score	Category	Description
4	Very Good	The behavior appeared consistently, and the student could complete tasks independently or with minimal guidance.

The visual worksheets were used to examine students' conceptual understanding. The worksheets covered changes in the states of matter and simple arithmetic operations. Students' answers were analyzed based on accuracy, ability to connect images with concepts, and ability to follow visual instructions. The interview guide was used to support triangulation with the classroom teacher. The interview focused on students' learning characteristics, communication needs, responses to visual learning, and the teacher's assessment of students' persistence and conceptual understanding.

Data Analysis

The data were analyzed using a qualitative interactive model consisting of data condensation, data display, and conclusion drawing. In the data condensation stage, observation results, worksheet data, and teacher confirmation were selected, simplified, and grouped according to the research focus: learning behavior, persistence, and conceptual understanding. In the data display stage, the findings were organized into descriptive narratives supported by observation scores and worksheet evidence. In the conclusion-drawing stage, patterns were interpreted inductively to explain how visual learning supported students' focus, task persistence, and conceptual understanding.

The analysis also followed the logic of thematic interpretation. Recurring patterns from observation, worksheets, and teacher confirmation were compared to identify dominant themes. Thematic analysis is useful for identifying, organizing, and interpreting patterns of meaning in qualitative data, particularly when the researcher needs to connect multiple sources of evidence into coherent findings (Nowell et al. 2017). The main themes developed from the analysis were: visual access and learning focus, visual response and conceptual understanding, persistence in completing tasks, and teacher mediation in visual learning.

Trustworthiness of the Data

The trustworthiness of the study was strengthened through triangulation, member checking, and documentation of the research process. Triangulation was conducted by comparing data from classroom observation, student worksheets, and teacher confirmation. This was done to ensure that the findings did not depend on a single source of evidence.

Member checking was conducted with the classroom teacher to confirm whether the researcher's interpretation of students' behavior was consistent with the actual classroom context. The dependability of the study was supported by maintaining documentation of the observation process, instruments, worksheet results, and analytic notes.

Trustworthiness in qualitative research includes credibility, transferability, dependability, and confirmability. These criteria are important for ensuring that qualitative findings are grounded in the data and can be evaluated transparently by readers (Korstjens and Moser 2018). In addition, an auditable decision trail was used to support analytic transparency, as recommended in rigorous thematic analysis (Nowell et al. 2017).

Ethical Considerations

This study was conducted by considering ethical principles in educational research involving students with special needs. Permission was obtained from the school before data collection. The teacher and students' parents were informed about the purpose of the study, and verbal consent was obtained. Students' identities were kept confidential by not using personal names in the research report. The observation process was conducted carefully to avoid disrupting classroom activities or creating discomfort for students. All data were used only for academic purposes. Because the participants were students with hearing impairments, the researcher ensured that the data collection process respected their communication needs and classroom routines.

Methodological Limitations

This study involved a small number of participants and was conducted in one special school. Therefore, the findings cannot be generalized to all students with hearing impairments. However, the study provides a contextual and in-depth description of how visual learning supports learning behavior, persistence, and conceptual understanding in a special education classroom. Future studies may use a mixed-methods design, involve more participants from different special schools, and compare visual learning with other instructional approaches such as sign-language-based instruction, interactive multimedia, or tactile-kinesthetic learning.

Research Results and Discussion

Results

This study analyzed the learning behavior, persistence, and conceptual understanding of Grade VI students with hearing impairments in visual learning at Manunggal Special School, Slawi. Data were obtained through classroom observation, student worksheets, and notes on students' engagement during visual-based learning activities. In general, the observation results showed that most indicators obtained scores ranging from 3 to 4, indicating good to very good performance. These findings suggest that students with hearing impairments were able to participate actively in learning when the material was presented through pictures, symbols, demonstrations, sign language, and clear visual instructions.

In terms of learning behavior, students demonstrated relatively strong focus during the learning process. They were able to pay attention to the teacher's directions, follow instructions, and respond to the assigned tasks, even though classroom communication mainly relied on sign language and visual support. Students' interest appeared to increase when the teacher used pictures, visual worksheets, and concrete examples. This was particularly evident during the lesson on changes in the states of matter. Students found it easier to understand the instructions when concepts such as melting, freezing, evaporation, and condensation were presented through visual representations.

Regarding visual response, students showed good ability to recognize pictures, match symbols with concepts, and complete visual-based tasks. The worksheet on changes in the states of matter showed that most students were able to connect pictures with the correct type of change. This finding indicates that visualization helped students understand scientific concepts that are often abstract in nature. Through pictures, concepts that were difficult to explain verbally became more concrete and observable.

In terms of conceptual understanding, students showed positive development. In the simple arithmetic worksheet, students were able to solve addition problems when the questions were supported by pictures or visual objects. This shows that visual representation helped students connect concrete objects with numerical symbols. Therefore, students' conceptual understanding was reflected not only in their ability to answer questions correctly, but also in their ability to connect pictures, symbols, and academic meaning appropriately.

In terms of persistence, students showed good effort in completing the assigned tasks. Although some students experienced difficulty understanding the instructions, they continued trying to complete their work. Some students asked questions through sign language, looked again at the visual examples, or waited for repeated guidance from the teacher. Observation scores in the range of 3–4 indicate that students demonstrated positive learning endurance. This persistence was especially visible when the teacher provided patient guidance, visual instructions, and direct assistance during worksheet completion.

The teacher's role also emerged as an important finding in this study. The teacher did not merely deliver the lesson material, but also transformed verbal information into visual forms that students could understand. The teacher used a combination of sign language, facial expressions, hand movements, concrete examples, and pictures. This approach helped students understand tasks more easily, remain focused, and become more confident in completing learning activities.

Discussion

The findings show that visual learning plays an important role in supporting the learning behavior of students with hearing impairments. Observation scores categorized as good to very good indicate that students were able to maintain focus and follow the learning process when information was delivered through visual channels. This finding is in line with Atika et al. (2023), who explained that science learning practices for deaf and hard-of-hearing students in Indonesia require visual strategies, direct activities, and communication access that suit students' needs. Therefore, the students' success in this study cannot be separated from the availability of visually accessible media and instructions.

The findings from the worksheet on changes in the states of matter show that students with hearing impairments more easily understood scientific concepts when the material was presented through pictures and concrete examples. This supports the work of Ediyanto et al. (2023), who stated that students with hearing impairments can better understand science concepts when learning is connected to real-life contexts and supported by appropriate learning instruments. In this study, pictures did not function merely as supporting tools, but as conceptual bridges that connected students' visual experiences with scientific concepts.

In simple mathematics learning, students were able to complete addition problems when the tasks were supported by visual objects. This finding indicates that hearing impairment does not directly imply cognitive limitation. Learning difficulties among students with hearing impairments are often more closely related to limited access to language and concept representation. Santos and Cordes (2022) emphasized that mathematical ability in deaf and hard-of-hearing children is strongly related to language access in the development of number concepts. Therefore, the use of pictures, symbols, and concrete examples in this study became an important strategy to help students understand the relationship between objects, quantities, and numerical symbols.

Students' persistence in completing tasks also shows that visual learning can support learning endurance. Students did not immediately stop when they encountered difficulties. Instead, they continued working by looking again at the visual examples or asking the teacher for further guidance. Herring and Woolsey (2020) explained that deaf and hard-of-hearing students need teaching strategies that can increase active responses, participation, and classroom engagement. In the context of this study, students' persistence emerged because the teacher provided clear instructions, accessible media, and appropriate communication support.

The teacher's role was a determining factor in the success of visual learning. The teacher acted as a mediator who transformed verbal concepts into visual, concrete, and communicative forms. This is consistent with Hartman et al. (2023) who emphasized that curriculum and instruction for deaf and hard-of-hearing students must consider language needs, literacy development, and accessible learning design. Thus, visual media will not be effective if they are not supported by the teacher's ability to explain, model, and guide students appropriately.

The findings also indicate that learning for students with hearing impairments should not only place students in a learning environment, but should also ensure that they have meaningful access to academic information. Silvestri and Hartman (2022) argued that the inclusion of deaf and hard-of-hearing students must consider accessibility, socio-emotional aspects, and language policies so that students do not experience isolation in the learning process. At Manunggal Special School, Slawi, such access was reflected in the use of sign language, pictures, demonstrations, facial expressions, and personal guidance from the teacher.

Furthermore, the findings show that language access is closely related to the academic understanding of students with hearing impairments. Finton et al. (2025) showed that exposure to sign language and language development is associated with the academic outcomes of deaf children. This finding is relevant to the present study because students were better able to understand the material when visual instructions were combined with sign language and clear nonverbal communication. Therefore, visual learning should not be understood as a replacement for language, but as part of a broader learning communication system.

Visual learning also needs to be designed as an active learning process, not merely as the display of pictures. Gehret and Elliot (2025) showed that multimedia learning for deaf and hard-of-hearing students should enable students to process information actively rather than receive it passively. This aligns with the present findings, as students did not only look at pictures, but also matched, identified, interpreted, and completed tasks based on visual information. Therefore, effective visual media are those that stimulate students' thinking processes.

Theoretically, the results of this study strengthen the view that learning for students with hearing impairments should be directed toward an access-based and strength-based approach. The students in this study demonstrated focus, visual response, persistence, and conceptual understanding when the material was delivered through appropriate strategies. Thus, hearing impairment should not be viewed as a limit to learning capacity, but as a basis for designing instruction that is more adaptive, visual, communicative, and empathetic.

Conclusion

This study concludes that visual learning plays an important role in supporting the learning behavior, persistence, and conceptual understanding of Grade VI students with hearing impairments at Manunggal Special School, Slawi. Observation results showed high scores,

ranging from 3 to 4, in learning focus, visual response, conceptual understanding, independence, and persistence. These findings indicate that visual media can provide meaningful learning access for students with hearing impairments, especially when verbal-auditory communication is limited. Students' visual worksheets also showed improved conceptual understanding. They were able to match pictures with concepts, complete tasks more accurately, and work with greater independence. This suggests that pictures, symbols, demonstrations, and structured visual instructions help students connect concrete experiences with academic concepts.

The teacher's role was also essential. Patient, expressive, and empathetic communication helped students feel supported, motivated, and persistent during learning. Thus, effective instruction for students with hearing impairments requires not only appropriate visual media but also a supportive teacher-student relationship. This study contributes to special education research by integrating three dimensions: learning behavior, persistence, and conceptual understanding. It also supports the relevance of Paivio's Dual Coding Theory and Bruner's iconic representation in the context of deaf education in Indonesia. Based on the findings, teachers are encouraged to optimize visual media, use clear and simple instructions, and maintain expressive and empathetic communication. Schools should provide teacher training, expand the use of interactive visual media, and develop programs that strengthen students' visual and artistic potential. Future studies are recommended to use digital visual media, mixed-methods designs, larger samples, and longer observation periods.

CRedit Authorship Contribution Statement

All authors contributed to the conceptualization, methodology, data collection and analysis, manuscript writing, revision, and approval of the final version. All authors take responsibility for the content of this article.

Data Availability Statement

The data used in this study are available from the corresponding author upon reasonable request. The data are not publicly available due to respondent confidentiality and ethical considerations.

Declaration of AI-Assisted Writing

The authors declare that AI-assisted writing tools were used only to improve language, grammar, and readability. All scientific content, analysis, interpretation, conclusions, and academic responsibility remain entirely with the authors.

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