

Improving Deaf Students' Interest in Learning English through 3D Animation Media

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ABSTRACT

This study investigates whether 3D animation media increase deaf students' interest in learning English at SLB Negeri 1 Makassar. The study was motivated by the persistent difficulty of delivering English input to deaf learners through conventional verbal explanation and static print materials. Because deaf students depend strongly on visual access, learning media that combine movement, imagery, contextualized vocabulary, and sign-supported explanation are expected to attract attention and sustain engagement more effectively. The study employed a pre-experimental group design. Ten eleventh-grade deaf students participated in the study. Data were collected through a Likert-scale questionnaire administered before and after the treatment. The treatment consisted of English lessons supported by 3D animated videos and animated films, accompanied by guided questioning and sign language practice. Data were analyzed using descriptive statistics. The findings indicate a meaningful increase in students' interest in learning after the intervention. The mean score rose from 87.40 before the treatment to 103.30 after the treatment, while the significance value of 0.018 showed a statistically significant difference between the two measurements. The score distribution also shifted from neutral responses toward interested and strongly interested categories. These findings suggest that 3D animation media can make English instruction more visually accessible, engaging, and motivating for deaf learners. The study contributes practical evidence that visually rich media can support inclusive English pedagogy in special-school contexts and

may serve as an alternative instructional resource for teachers working with deaf students.

Keywords: 3D Animation Media; Deaf Students; English Learning Interest; Inclusive Pedagogy; Visual Learning

INTRODUCTION

English has become increasingly important in contemporary education because it provides access to knowledge, technology, mobility, and wider communication. In Indonesia, English is formally taught as a foreign language, yet access to English learning is not equally available to all learners. Deaf students often encounter greater barriers because English instruction is still commonly organized around oral explanation, listening-based interaction, teacher talk, repetition drills, and text-heavy materials. In special-school contexts, this conventional pattern can unintentionally reduce students' learning interest because the lesson is delivered through modes that do not fully match deaf learners' primary channels of access. When English is explained mainly through speech or abstract written words without sufficient visual support, students may struggle to connect vocabulary with meaning, follow classroom interaction, and respond confidently. As a result, English may be perceived not as a meaningful communication tool but as a difficult, distant, and inaccessible subject.

This problem is not caused by deaf students' lack of ability to learn English; rather, it reflects a mismatch between instructional delivery and learners' linguistic and sensory needs. Deaf students depend strongly on visual communication, including sign language, facial expression, gesture, written words, pictures, and contextual demonstration. However, conventional English teaching frequently prioritizes spoken explanation and printed vocabulary lists, which may limit students' opportunities to experience English through visible, concrete, and interactive forms. In special-school classrooms, repeated exposure to inaccessible instruction can weaken attention, reduce curiosity, and lower willingness to participate. Students may become passive not because they are uninterested in learning itself, but because the learning environment does not provide enough accessible entry points for understanding. This condition is pedagogically critical because inclusive education requires teachers to adjust content delivery to learners' perceptual, linguistic, and affective needs (Cannon & Guardino, 2012; Knoors & Marschark, 2014).

The challenge becomes more visible in English vocabulary learning. Vocabulary is the foundation of language comprehension and production; without adequate vocabulary, learners find it difficult to understand classroom instructions, read simple texts, and express meanings in written or signed forms (Alqahtani, 2015). For deaf students, vocabulary learning can be particularly challenging when English words are introduced as isolated written forms or pronounced orally without clear visual representation. Such instruction may make vocabulary appear abstract and disconnected from students' everyday experiences. Deaf students may also have fewer opportunities for incidental language exposure through surrounding speech,

which means that classroom instruction must provide more deliberate, repeated, and visually meaningful access to new words. Research on deaf and hard-of-hearing learners consistently shows that vocabulary instruction must be explicit, repeated, contextual, and visually supported because vocabulary knowledge is central to reading, thinking, and communication (Luckner & Cooke, 2010). In this sense, English teachers in special-school contexts need media that can transform words into concrete and observable meanings.

Learning interest is also a decisive affective factor. Interest is not merely a temporary feeling of liking a subject; it reflects attention, curiosity, enjoyment, and willingness to engage with learning tasks. Students who are interested tend to persist longer, respond more actively, and invest more effort in classroom activities (Achru, 2019; Hidi & Renninger, 2006). Conversely, when students repeatedly experience English lessons as inaccessible, overly verbal, or visually limited, their situational interest may decline. Conventional instruction may reduce interest because it places students in a position where they must receive information without adequate visual scaffolding, wait for meaning to be clarified, or rely heavily on teacher explanation that may not be fully accessible. This can create frustration and low confidence, especially when students are expected to memorize vocabulary without seeing how words function in context. Factors such as teaching strategies, media, classroom atmosphere, and student confidence can influence interest in learning (Al Fuad & Zuraini, 2016). Therefore, for deaf students, the development of interest in learning English is closely connected to the availability of accessible, visually meaningful teaching materials.

3D animation media are relevant to this need because they combine image, movement, sequence, character, color, and context. Unlike static pictures, animation can represent actions, relationships, and situations dynamically. This advantage is important in English instruction because many vocabulary items and expressions become meaningful when learners can see how they are used in context. For deaf learners, 3D animation can reduce the limitations of conventional instruction by turning abstract vocabulary into observable scenes and by supporting teacher explanation through sign language, written labels, guided questioning, and repeated viewing. Multimedia learning theory explains that learners can understand material more deeply when words and visual representations are coherently organized, as the visual and verbal channels support each other in meaning construction (Mayer, 2021; Mayer & Moreno, 2002). Dual-coding theory similarly suggests that information represented both visually and verbally can strengthen memory and comprehension (Paivio, 1990). For deaf students, the visual channel is not an optional aid but a primary route for accessing information.

Previous studies have supported the use of visual and digital media in English learning. Kurniawati (2017) found that visual media supported deaf students' English vocabulary mastery, while Rizki (2016) developed a pictorial English dictionary to make vocabulary learning more accessible for deaf learners. In broader EFL contexts, interactive multimedia has been associated with improved

participation and learning outcomes when integrated into meaningful classroom procedures (Nabung et al., 2023; Rojabi et al., 2022). Studies on Toontastic 3D also show that animation-based digital storytelling can support speaking practice, vocabulary development, and positive learner responses (Sam & Hashim, 2022). Nappu et al. (2023) found that the Toontastic application improved students' English vocabulary mastery and generated strong student interest, confirming that animation-based applications can support vocabulary learning through visual and creative engagement. These findings imply that animation is pedagogically useful when it helps learners connect words to visible experience, rather than serving only as entertainment.

The present study is relevant to technology-supported English instruction, as Nappu (2014) showed that computer-assisted language learning could increase students' English vocabulary mastery and make language learning more attractive. Nappu et al. (2022) also demonstrated that technology-mediated learning influenced students' academic writing learning during the COVID-19 period, suggesting that technology can reshape English learning practices when teachers design activities purposefully. In addition, Kibar et al. (2023) documented EFL teachers' strategies in utilizing ICT in Indonesian public high schools, while Nurmaharaeni et al. (2022) emphasized the importance of cognitively engaging learning tasks in EFL reading. These studies strengthen the rationale that English learning media should be accessible, interactive, and pedagogically structured.

The classroom problem observed at SLB Negeri 1 Makassar reflected these theoretical and empirical concerns. Based on preliminary information from the English teacher, students tended to show limited interest when English was presented through conventional explanation and restricted media. This condition suggests that students' low interest was not simply an affective problem, but a response to instructional practices that did not sufficiently support their visual access to English. Students needed learning resources that could sustain attention, clearly convey the meanings of vocabulary items, and support explanations in sign language. Although visual media have been used in many classrooms, the specific use of 3D animation to improve deaf students' interest in learning English remains under explored in local special-school settings. Most previous studies have focused on vocabulary mastery, media development, or general student populations, while fewer studies have examined affective engagement among deaf learners.

Therefore, this study investigated whether 3D animation media could improve the interest in learning English among eleventh-grade deaf students at SLB Negeri 1 Makassar. The study focused on learning interest because affective engagement is a necessary condition for sustained participation in English lessons. The research question was: Does the use of 3D animation media significantly improve deaf students' interest in learning English? The objective was to measure students' learning interest before and after the use of 3D animation media and to interpret the pedagogical meaning of the change. The findings are expected to contribute to inclusive English pedagogy by providing practical evidence that visually rich and

sign-supported media can increase interest in learning in special-school English classrooms.

LITERATURE REVIEW

English Learning for Deaf Students

English learning for deaf students requires more than the adjustment of teaching materials; it requires an instructional design that recognizes how deaf learners access language, meaning, and classroom interaction. In conventional English classrooms, vocabulary and sentence patterns are often introduced through spoken explanation, oral repetition, and written lists. These procedures may be suitable for hearing learners who can access both spoken and written input, but they can become less effective for deaf students when visual scaffolding is limited. Deaf learners need instruction that connects written English with visible meaning through sign language, pictures, gestures, facial expression, contextual demonstration, and repeated visual exposure. Therefore, the central issue in deaf English education is not whether deaf students can learn English, but whether classroom instruction provides accessible routes for understanding and participation (Cannon & Guardino, 2012; Knoors & Marschark, 2014).

Vocabulary Learning and Visual Communication

Vocabulary learning illustrates this need clearly. Vocabulary is a basic component of English proficiency because it supports reading comprehension, classroom communication, and written expression (Alqahtani, 2015). For deaf students, vocabulary development may be constrained when English words are presented as abstract written symbols or through oral explanation that is not fully accessible. Luckner and Cooke (2010) emphasize that vocabulary instruction for deaf and hard-of-hearing students should be explicit, repeated, meaningful, and visually supported. This means that teachers need to help students connect English words to objects, actions, situations, and experiences. In special-school contexts, vocabulary learning should therefore be designed as a visual and interactive process rather than as memorization of isolated words.

This perspective is closely related to the role of visual communication and sign-supported instruction in deaf education. Deaf students may use different combinations of communication modes, including sign language, written language, lip-reading, gesture, and visual attention. Hall (2017) warns that limited language access can create long-term educational consequences for deaf children, while Humphries et al. (2012) argue that deaf learners benefit when educational environments allow flexible and accessible communication approaches. Although this study focuses on learning interest rather than language acquisition alone, these arguments are important because interest can decline when students repeatedly face lessons that are difficult to access. When English input is supported by signs,

images, animation, and teacher guidance, students are more likely to understand the lesson and participate actively.

Sign-Supported Instruction and Learning Interest

Learning interest is a key affective dimension in this study because accessibility and motivation are closely connected. Hidi and Renninger (2006) explain that interest may begin as situational interest triggered by attractive classroom conditions and may develop into more stable engagement when learners experience meaningful participation. For deaf students, situational interest may be triggered by visually rich media, but it is more likely to be sustained when the media also make English understandable. Achru (2019) views learning interest as an internal tendency that encourages students to participate in learning activities, while Al Fuad and Zuraini (2016) note that teaching strategies, classroom atmosphere, and learning media influence students' interest. Thus, the value of 3D animation in this study lies not only in its attractiveness but also in its potential to make English lessons more accessible, concrete, and participatory.

Multimedia Learning Theory

Multimedia learning provides a useful framework for understanding why animation may support deaf students' interest in learning English. Mayer (2021) argues that students learn more effectively when verbal and visual information are integrated coherently. Mayer and Moreno (2002) further explain that animation can support learning when it helps students understand movement, sequence, and relationships that are difficult to communicate through words alone. Paivio's (1990) dual-coding theory also suggests that information represented through both verbal and visual systems can strengthen comprehension and memory. These theories become particularly relevant in deaf education because visual input is not merely supplementary. For deaf students, visual information is often the main channel through which classroom meaning is accessed.

The connection between deaf education, multimedia learning, and learning interest can be synthesized as follows. First, deaf education emphasizes the need for accessible visual and sign-supported input. Second, multimedia learning explains how visual and verbal materials can be combined to support meaning-making. Third, learning-interest theory explains how accessible, meaningful, and engaging materials can increase students' attention, response, motivation, and persistence. In this study, 3D animation is positioned at the intersection of these three areas. It can visually represent English vocabulary, support sign-language explanation, provide repeated exposure through replayed scenes, and create an enjoyable classroom atmosphere. Therefore, animation is expected to increase interest because it reduces access barriers while also stimulating attention.

Pedagogical Advantages of 3D Animation

3D animation has several pedagogical advantages for English instruction with deaf learners. It can present objects, actions, emotions, and situations dynamically through character movement, color, spatial relation, and story sequence. For example, vocabulary related to animals, fruits, actions, or emotions can be shown through animated scenes rather than explained only through speech or static pictures. This dynamic representation may help students understand the relationship between English words and real-world meaning. Animation can also support repetition because teachers can pause, replay, and highlight important scenes. When combined with written labels, signs, guided questions, and teacher feedback, animation can become an instructional bridge between visual experience and English vocabulary.

Previous Studies on Visual and Digital Media

Previous studies support the importance of visual and digital media for language learning. Rizki (2016) developed an English pictorial dictionary for deaf students and showed that picture-based vocabulary resources can support vocabulary learning. Kurniawati (2017) found that Fun Thinkers media improved deaf students' English vocabulary mastery by providing visual stimulation and engaging tasks. In broader EFL contexts, Nabung et al. (2023) reported that interactive multimedia could improve learning outcomes, while Rojabi et al. (2022) showed that gamified vocabulary learning increased engagement and motivation. Sam and Hashim (2022) found that pupils responded positively to Toontastic 3D as a digital storytelling tool, and Nappu et al. (2023) reported that Toontastic supported vocabulary mastery and student interest. Together, these studies suggest that visual and animated media can support both cognitive and affective aspects of English learning when used purposefully.

Challenges in Using Animation for Deaf Learners

However, the use of animation media for deaf learners also presents several classroom challenges. First, animation may contain too much movement, color, sound, or rapid scene transition, which can distract students or create cognitive overload if not carefully selected. Mayer (2021) emphasizes that multimedia materials should be coherent and should avoid unnecessary details. For deaf students, visual overload can be especially problematic because they must divide attention among the animation, written words, teacher explanation, and sign language. If the teacher signs while the animation continues to move quickly, students may miss either the sign explanation or the visual content. Therefore, teachers need to pause the animation, control the pace, and ensure that visual attention is directed to one main source of information at a time.

Second, not all animation materials are automatically accessible for deaf learners. Many animated videos rely heavily on spoken narration, background music, or sound effects to carry meaning. If these elements are not replaced or supported by captions, written labels, signs, or teacher explanation, deaf students may only receive partial information. In addition, some animations may present culturally unfamiliar settings or vocabulary beyond students' language level, making them visually attractive but pedagogically unsuitable. Teachers must therefore select or adapt animations based on students' vocabulary needs, visual clarity, cultural familiarity, and compatibility with sign-supported instruction.

Third, the effectiveness of animation depends strongly on teacher mediation. Technology alone does not guarantee learning interest. Kibar et al. (2023) show that teachers' use of ICT depends on strategy, classroom condition, and teacher readiness. Nappu et al. (2022) similarly demonstrate that technology-mediated learning is effective only when it is connected to purposeful teaching procedures. In deaf classrooms, teacher mediation is even more important because students may need signs, gestures, written reinforcement, and repeated visual explanation to interpret animated content. Without guided questioning, vocabulary labeling, and interaction, animation may become entertainment rather than a learning medium.

Fourth, practical limitations may affect the use of 3D animation in special-school contexts. Teachers may face limited access to projectors, computers, stable electricity, internet connection, or suitable animation software. Preparing animation-based lessons also requires time because teachers need to preview materials, select appropriate scenes, prepare vocabulary lists, design sign-supported explanations, and plan student responses. Some teachers may also need training to integrate animation with deaf-friendly pedagogy. These challenges do not reduce the value of animation, but they show that animation must be used selectively and pedagogically rather than assumed to be effective in all conditions.

Conceptual Synthesis

Based on the synthesis above, 3D animation media may enhance deaf students' interest in learning English through three main mechanisms. First, it increases visual accessibility by presenting vocabulary and actions in observable form. Second, it triggers and maintains attention through movement, color, character, and storyline. Third, it supports guided interaction when the teacher connects animated scenes with written English, sign language, and questions. At the same time, its effectiveness depends on appropriate material selection, controlled pacing, visual clarity, teacher mediation, and classroom resources. The present study contributes to this area by examining whether the use of 3D animation media is associated with measurable improvement in deaf students' interest in learning English in a special-school classroom.

METHOD

Design and Sample

This study employed a quantitative pre-experimental design with a one-group pre-questionnaire-post-questionnaire procedure. The design was selected because the study aimed to examine changes in students' learning interest before and after the implementation of 3D animation media in one naturally formed classroom. In school-based educational research, a one-group pretest-posttest design is often used when the researcher intends to obtain preliminary evidence of instructional effectiveness in an authentic classroom setting and when the number of available participants is limited (Creswell & Creswell, 2023; Harefa, 2020). This design can be represented as O_1-X-O_2 , where O_1 refers to the pre-questionnaire, X refers to the treatment using 3D animation media, and O_2 refers to the post-questionnaire. Because the design did not include a control group, the findings are interpreted as evidence of classroom-level improvement rather than as a broad causal generalization.

The study was conducted at SLB Negeri 1 Makassar, a special school serving students with disabilities, including those with hearing impairments. The participants were ten eleventh-grade deaf students. Total sampling was applied because all students in the target class were included as participants. Total sampling was considered appropriate because the accessible population was small and the study was intended to describe changes in learning interest in that specific classroom context. The students had previously received English instruction, but teacher reports indicated that their interest tended to decline when lessons relied on conventional explanations and limited media support. Therefore, the treatment was designed to provide concrete, visual, and interactive English-learning support.

The independent variable was the use of 3D animation media in English instruction, while the dependent variable was students' interest in learning English. The media consisted of selected 3D animated videos and animated films related to familiar vocabulary topics, especially animals and fruits. These topics were selected because they were concrete, visually representative, and appropriate for introducing basic English vocabulary through visible scenes. The selection of the animation materials followed several criteria. First, the content had to match the students' English level and the vocabulary focus of the lesson. Second, the animated scenes had to contain clear visual representations of objects, actions, or situations so that students could infer meaning without relying on sound. Third, the videos had to use simple story lines, slow or moderate movement, bright but not excessive colors, and limited distracting background details. Fourth, the duration of each clip had to be short enough to maintain attention and allow repeated viewing. Fifth, the content had to be culturally and contextually familiar to students so that the vocabulary could be connected to their everyday experiences.

The selected 3D animation materials were adapted to meet deaf students' learning needs before being used in the classroom. The researchers and teacher previewed each video and identified the scenes that were most relevant to the target vocabulary. Unnecessary parts, overly fast scenes, or segments that depended heavily on spoken narration or sound effects were minimized or omitted during classroom use. Important scenes were paused and replayed so that students had sufficient time to observe the visual information and connect it with the English words. Written English labels were prepared for the target vocabulary and shown together with the animated scenes. The teacher also provided sign-language-supported explanations, gestures, facial expressions, and pointing to help students understand the meaning of each word. In this way, the animation was not used as a stand-alone entertainment tool but as a visual scaffold integrated with written vocabulary, sign language, guided questioning, and teacher feedback.

The classroom implementation of the animation media was also adapted to reduce possible visual overload. Because deaf students need to divide visual attention between the screen, written vocabulary, and teacher signing, the teacher controlled the pace of the lesson carefully. The teacher first introduced the vocabulary in written form, then showed the animation, paused the video at key moments, and provided sign-supported explanation after students had focused on the visual scene. Students were invited to identify objects or actions, imitate or produce signs, respond to simple questions, and review the vocabulary after watching. This procedure was designed to ensure that the animation supported comprehension and interest rather than distracting students from the learning objective.

Instruments and Procedures

Data were collected using a Likert-scale questionnaire consisting of 26 items. The questionnaire measured five indicators of learning interest: attention, response, memory, motivation, and environmental support. The attention indicator referred to students' focus during animation-supported English lessons. The response indicator measured students' willingness to participate and answer questions. The memory indicator referred to students' perceptions of their ability to remember English words after watching the animation. The motivation indicator measured students' desire to learn English through the media. The environmental-support indicator examined whether the classroom situation, teacher support, and media use made students feel comfortable during learning. Likert-type instruments are commonly used to measure attitudes, perceptions, and affective responses in educational research because they allow participants' responses to be quantified systematically (Boone & Boone, 2012; Taherdoost, 2019).

To strengthen the credibility of the instrument, the questionnaire was developed through several validation steps. First, the researchers formulated the questionnaire items based on the five indicators of learning interest and reviewed relevant literature on learning interest, media-supported learning, and English instruction for deaf students. Second, the initial items were examined by experts in English

education and special-needs education to evaluate content relevance, clarity, and appropriateness for deaf learners. The experts checked whether each item represented the intended indicator and whether the wording was understandable for eleventh-grade students in a special-school context. Third, items that were considered unclear, repetitive, or too abstract were revised. The language of the questionnaire was simplified, and the teacher provided sign-language explanation when needed to ensure that students understood the meaning of each item.

Before the main data collection, the questionnaire was also reviewed for readability and classroom practicality. The researchers checked whether the response options were easy for students to distinguish and whether the items could be administered within the available class time. During administration, students were given clear instructions, and the teacher assisted by explaining the items through sign language without directing students toward particular answers. This procedure was intended to reduce misunderstanding while maintaining the independence of students' responses. The same questionnaire was used in the pre-questionnaire and post-questionnaire to allow comparison of students' learning interest before and after the treatment.

The research procedure consisted of three main stages: preliminary observation, treatment, and post-treatment measurement. In the preliminary stage, the researchers collected information about students' learning conditions and administered the pre-questionnaire. During the treatment stage, English lessons were delivered using 3D animation media. Each meeting followed a structured sequence. First, the teacher introduced the topic and displayed the target vocabulary in written form. Second, students watched the selected animated material under the teacher's guidance. Third, the teacher paused or replayed important scenes to highlight objects, actions, or expressions. Fourth, students were asked to identify the meaning of words, connect them with signs, and respond to simple questions. Fifth, the teacher reviewed the vocabulary and gave feedback. This procedure was designed to ensure that animation functioned as an instructional medium rather than passive entertainment.

Data Analysis

The data were analyzed using descriptive and inferential statistics. Descriptive analysis included mean score, standard deviation, frequency, percentage, and learning-interest classification. The classification was based on five categories: strongly interested, interested, moderate, uninterested, and strongly uninterested. The inferential analysis used a paired-samples t-test to determine whether the difference between pre-questionnaire and post-questionnaire scores was statistically significant. The significance level was set at 0.05. If the significance value was less than 0.05, the alternative hypothesis would be accepted, indicating a significant improvement in students' interest in learning. Ethical consideration was maintained by reporting students' data collectively and avoiding the use of individual names in the manuscript.

RESULTS AND DISCUSSION

The findings indicate that the use of 3D animation media was followed by a meaningful increase in deaf students' interest in learning English. Before the treatment, the mean score of the learning-interest questionnaire was 87.40 with a standard deviation of 11.257. After the treatment, the mean score increased to 103.30 with a standard deviation of 10.371. The gain of 15.90 points suggests that students' affective response to English learning improved after they experienced animation-supported instruction. Because learning interest is associated with attention, willingness to participate, and persistence in learning tasks, this improvement is pedagogically important (Achru, 2019; Hidi & Renninger, 2006). The reduced standard deviation in the post-questionnaire also suggests that students' responses became more consistent after the treatment. Before the treatment, the classroom conditions showed a wider range of interest, with some students showing strong interest while others remained moderate. After the treatment, positive responses were more evenly distributed. In special-school contexts, this is important because successful media should support the whole class rather than only a few learners who already have high motivation. The finding supports the argument that visually accessible instruction can reduce barriers to participation for deaf students (Cannon & Guardino, 2012; Knoors & Marschark, 2014).

Table 1. Paired-Sample Statistics of the Experimental Class

Measurement	Mean	N	Std. Deviation
Pre-questionnaire	87.40	10	11.257
Post-questionnaire	103.30	10	10.371

The categorical distribution confirms the same pattern. In the pre-questionnaire, one student was categorized as strongly interested, three as interested, and six as moderate. After the treatment, three students were categorized as strongly interested and seven as interested. No student remained in the moderate, uninterested, or strongly uninterested categories. This shift is meaningful because it shows that the treatment not only raised the mean score numerically but also moved students away from neutral responses toward clearer positive engagement.

The finding can be interpreted through the concept of situational interest. Hidi and Renninger (2006) explain that interest can be triggered when classroom conditions capture learners' attention and can be maintained when learners feel supported and capable of engaging with the material. In this study, 3D animation appeared to trigger students' attention through movement, characters, color, and story sequence. The teacher's guided questioning and sign-language explanations then helped maintain interest by ensuring that students understood the meaning of the scenes. Thus, the increase in learning interest was not caused by animation alone; it resulted from the combination of visual accessibility and interactive pedagogy.

Table 2. Rating Score of Interest Classification

Interval Score	Category
109–130	Strongly Interested
87–108	Interested
65–86	Moderate
43–64	Uninterested
26–42	Strongly Uninterested

The inferential analysis strengthened the descriptive finding. The paired-samples t-test showed a mean difference of -15.900, a t-value of -2.877, and a significance value of 0.018 with 9 degrees of freedom. Because the p-value was less than 0.05, the null hypothesis was rejected, and the alternative hypothesis was accepted. This means that there was a statistically significant difference between students' interest before and after the use of 3D animation media. Although the pre-experimental design does not permit a strong causal claim, the statistical result provides evidence that the treatment was associated with an increase in students' interest in learning.

Table 3. Paired-Sample Test

Mean Difference	Std. Deviation	t	df	Sig. (2-tailed)
-15.900	17.477	-2.877	9	0.018

The improvement can first be explained from the perspective of accessibility. Deaf students depend greatly on visual input; therefore, media that present English vocabulary through visible objects, actions, and contexts can make learning easier to follow. The 3D animation used in this study provided concrete scenes that helped students connect English words with visual meaning. This interpretation is consistent with Luckner and Cooke (2010), who emphasized that vocabulary instruction for deaf and hard-of-hearing students requires explicit and meaningful exposure. It is also aligned with Kurniawati (2017) and Rizki (2016), whose studies showed that visual resources are useful for English vocabulary learning among deaf students. In the present study, 3D animation extended the value of visual media by adding motion and contextual sequence.

A more specific interpretation concerns the role of movement. Movement in the animated scenes helped students notice actions, changes, and relationships that would be difficult to understand from still pictures alone. For example, when vocabulary was related to animals, fruits, or simple actions, students could observe how an object appeared, moved, or was used in a meaningful situation. This dynamic presentation likely increased attention because moving images naturally directed students' gaze toward the target object or action. For deaf learners, whose classroom access depends heavily on visual attention, movement can function as an attentional cue that helps them follow the lesson more easily. It also helped reduce abstraction because students did not only see a written English word but also saw the object or action represented visually.

Color also contributed to students' increased interest by making the learning material more vivid and distinguishable. Bright but controlled colors helped

students differentiate objects, characters, and background elements in the animated scenes. In English vocabulary learning, color can support recognition and memory because students can associate a word with a visually distinct object. However, the pedagogical value of color depends on careful selection. When colors are excessive or unrelated to the learning focus, they may distract students. In this study, the selected animations were used to highlight concrete vocabulary and familiar visual scenes, so color functioned as a support for attention rather than as unnecessary decoration. This is consistent with multimedia learning principles, which suggest that visual features should guide learners' attention to relevant information (Mayer, 2021).

Repetition was another important element. The teacher paused and replayed key scenes so that students could observe the same vocabulary item more than once. This procedure was especially important because deaf students may need time to shift visual attention between the screen, written words, teacher signing, and classroom responses. Repetition allowed students to review the animated content, confirm meaning, and connect the scene with the English label. It also supported memory because repeated exposure can strengthen the association between visual representation and vocabulary. In this sense, replaying animation was not a mechanical activity but a form of visual reinforcement that helped students process English input at a pace suitable for their learning needs.

Sign-supported explanation played a central role in transforming animation into meaningful instruction. The animation provided visual context, but the teacher's signs, gestures, facial expressions, and written labels helped students interpret that context linguistically. Without sign-supported explanation, students might enjoy the animation but fail to understand the English vocabulary being taught. The teacher's role was therefore essential in connecting animated scenes with English words and students' existing communication system. This finding supports the view that technology should not replace teacher mediation, especially in deaf classrooms. Instead, technology becomes effective when it is integrated with accessible communication, guided questioning, and direct feedback.

The combination of movement, color, repetition, and sign-supported explanation likely contributed to different dimensions of learning interest. Movement and color helped trigger attention and curiosity at the beginning of the lesson. Repetition helped maintain engagement by giving students more opportunities to understand and remember the material. Sign-supported explanation increased confidence because students could clarify meaning and respond through accessible communication modes. Together, these elements supported attention, response, memory, motivation, and environmental comfort, which were the five indicators measured in the questionnaire. This explains why the post-questionnaire results showed movement from moderate interest toward interested and strongly interested categories.

Second, the finding supports multimedia learning theory. Mayer (2021) argues that students learn more effectively when words and pictures are integrated coherently, while Mayer and Moreno (2002) explain that animation can help learners understand dynamic information. For deaf students, this multimedia advantage becomes especially important because visual representation compensates for limited access to spoken explanation. The students not only saw images; they observed actions, sequences, and relationships. This helped them understand English vocabulary as it relates to the scene. The result, therefore, suggests that animation is more pedagogically valuable when it is used to clarify meaning rather than simply to decorate the lesson.

Third, the findings show that learning interest is closely related to comprehension. Students rarely become interested in lessons that they cannot access. When the animation made vocabulary easier to understand, students were more willing to attend, respond, and participate. This supports Achru's (2019) view that interest encourages active learning and Al Fuad and Zuraini's (2016) argument that learning interest is influenced by teacher strategy and classroom conditions. The disappearance of moderate responses in the post-questionnaire indicates that more students perceived English learning as accessible and enjoyable after the treatment. The findings also align closely with Nappu et al. (2023), who reported that the Toontastic application improved vocabulary mastery and elicited strongly positive student attitudes. The present study extends that line of inquiry into the context of deaf education by showing that animation-based media can increase not only vocabulary-related engagement among general EFL learners but also interest in learning among deaf students.

The social and interactional aspect of the lesson also deserves attention. Rospinah et al. (2021) found that group work activities could improve English-speaking performance because students had opportunities to participate and communicate. Although this study focused on deaf students' learning interest, the same principle is evident: students became more engaged when they were invited to respond to animated scenes and participate in guided classroom interactions. For deaf learners, interaction may include signs, gestures, written responses, pointing, facial expressions, and visual confirmation. The use of animation created a shared visual reference, making such interaction easier. The emphasis on visible teacher support is also related to Muhayyang et al. (2023), who showed that lecturers' eye contact was associated with students' motivation to learn English; in deaf classrooms, visual attention, facial orientation, and shared gaze are even more crucial because they support access to meaning and classroom presence.

The findings are also consistent with studies on Toontastic and gamified digital vocabulary learning. Sam and Hashim (2022) found that pupils responded positively to Toontastic 3D for speaking practice, while Rojabi et al. (2022) showed that gamified vocabulary learning could increase engagement and motivation. These studies show that digital media can stimulate participation when learners feel that the task is concrete, enjoyable, and achievable. However, the present study

highlights a more specific contribution: for deaf students, visual digital media are not merely motivational tools but also tools for accessibility. Animation helps bridge the gap between English words and students' visual learning channels.

From a practical perspective, the results suggest that 3D animation media should be integrated into special-school English lessons through careful instructional steps. Teachers can use short animated clips to introduce vocabulary, pause scenes to ask questions, attach written labels to objects, invite students to sign the words, and ask students to identify actions or characters. Teachers can also replay scenes to reinforce memory and allow students to respond at their own pace. The specific elements of animation should be used strategically: movement should highlight the target action or object, color should clarify rather than distract, repetition should support vocabulary recall, and sign-supported explanation should connect visual scenes with English meaning. These procedures are important because multimedia learning is most effective when learners are guided to attend to relevant information and are not overloaded by unnecessary details (Mayer, 2021).

The study also has implications for inclusive English pedagogy. Inclusive teaching does not only mean placing students in a classroom; it means ensuring that students can access the lesson, participate meaningfully, and experience success. For deaf learners, visual access should be treated as a core design principle. The use of 3D animation can support this principle by making English lessons more concrete and creating an engaging atmosphere that encourages student participation. This implication is in line with deaf-education scholarship that emphasizes accessible language, visual scaffolding, and flexible communication modes (Cannon & Guardino, 2012; Hall, 2017; Humphries et al., 2012).

Nevertheless, the findings should be interpreted carefully. The study involved only ten students from one school and used a one-group pre-post design without a control group. Therefore, the improvement cannot be compared with that of students taught by another method. The study also measured learning interest using a questionnaire and did not examine long-term vocabulary retention, reading comprehension, or productive use of English. In addition, the study did not isolate which animation element had the strongest effect on learning interest. Movement, color, repetition, and sign-supported explanation were used together as part of one instructional treatment. Future studies should involve larger samples, comparison groups, longer treatment periods, and mixed-method data such as interviews, classroom observation notes, and students' work samples. Despite these limitations, the study provides useful classroom evidence that 3D animation media can strengthen deaf students' interest in learning English when combined with sign-supported explanations and guided interaction.

CONCLUSION

This study concludes that 3D animation media significantly improved deaf students' interest in learning English at SLB Negeri 1 Makassar. The students' mean score

increased from 87.40 in the pre-questionnaire to 103.30 in the post-questionnaire, and the paired-samples t-test showed a significance value of 0.018. The distribution of responses also shifted from moderate and interested categories to interested and strongly interested categories only. These findings indicate that 3D animation media can help create English lessons that are more visually accessible, enjoyable, and motivating for deaf learners. The most important pedagogical implication of this study is that inclusive English classrooms should be designed around students' access to meaning. For deaf learners, visual access is not a supplementary support but a central principle of instruction. English teachers in special-school contexts should therefore move beyond conventional verbal explanation and static vocabulary presentation by using media that make words, actions, and contexts observable. 3D animation can support this goal because it combines movement, color, characters, sequence, and concrete visual scenes that help students connect English vocabulary with meaning. When integrated with written vocabulary, sign-language-supported explanation, guided questioning, and teacher feedback, animation media can encourage students to pay attention, respond actively, remember vocabulary, and feel more confident in English learning.

Based on the findings, several practical recommendations can be offered for teachers. First, teachers should select short and simple animation clips that match the students' vocabulary level, classroom topic, and visual learning needs. The animation should contain clear objects, actions, and situations, and should not depend heavily on spoken narration or sound effects. Second, teachers should prepare written English labels before showing the animation so that students can connect the visual scene with the target vocabulary. Third, teachers should pause and replay important scenes to give students enough time to observe, understand, and remember the vocabulary. Fourth, teachers should combine the animation with sign language, gestures, facial expressions, and pointing so that students can access the meaning through familiar communication modes. Fifth, teachers should ask guided questions after key scenes, invite students to sign or identify the vocabulary, and provide feedback to ensure that students are not only watching but also participating.

Teachers should also manage animation media carefully to avoid visual overload. The use of too many colors, fast movements, long videos, or crowded scenes may distract students from the learning target. Therefore, animation should be used selectively and purposefully. Teachers may begin with one small vocabulary set, use one short animated scene, and then build interaction through repetition, signing, and written reinforcement. In this way, 3D animation becomes an instructional scaffold rather than a form of passive entertainment. Although the findings are promising, the study has several limitations. It involved only ten students from one special school and used a pre-experimental one-group design without a control group. Therefore, the findings should be interpreted as classroom-level evidence rather than broad generalization. The study also measured learning interest through a questionnaire and did not examine long-term vocabulary retention, reading comprehension, or English production. Future studies should involve larger

samples, comparison groups, longer intervention periods, and additional instruments such as interviews, classroom observations, and vocabulary tests. Further research may also compare different types of visual media to determine which features are most effective for supporting deaf students' English learning.

Overall, this study emphasizes that the effective integration of 3D animation media in deaf students' English instruction depends not only on the attractiveness of the technology but also on the teacher's ability to use it as part of inclusive pedagogy. Animation media can increase learning interest when it is visually clear, appropriately paced, connected to written English, supported by sign language, and used through interactive classroom procedures.

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