ENGAGEMENT
Jurnal Pengabdian kepada Masyarakat
Vol. 09, No. 01, May, 2025, pp. 135 -150

Improving Inclusive Students Competence through 3D Flashcard Animation-Based Animal Exploration

Muhaimin Hasanudin, Karisma Riskinanti, Hadi Santoso, Kevin Novrizal, Mulyati Lestari, Afiyati Afiyati

Universitas Mercu Buana
Email correspondence : muhaimin.hasanudin@mercubuana.ac.id

Article History:
Received:
Received: Feb 15th 2025
Revised: April 16th 2025
Accepted: May 30th 2025

Keywords: *Augmented Reality, Special Needs, 3D Animation, FlashCard, Animal Exploration*

Abstract: *Children with special needs often face challenges in recognizing animal shapes and sounds. This community service program (PKM), based on the Service Learning approach, developed an application called Teh Melati, which utilizes Augmented Reality (AR) by combining 3D animation with traditional 2D flashcards to aid in animal recognition. The PKM was conducted over one day with 32 students with disabilities aged 6–14 years (N=32) at HS-Lantaburo. The Service Learning methodology involved actively engaging the community (teachers, parents, and students) in the design, implementation, and evaluation of the learning intervention. Students participated in an interactive animal exploration game that focused on animal images and sounds. Pre-intervention test scores averaged 63.75, while post-intervention scores increased to 81.25. A total of 25 students (78% of the participants) showed significant improvement. The active participation of teachers and parents in hands-on workshops further extended the impact of the intervention. These results demonstrate that learning gaps in special needs education can be addressed through community involvement and the integration of 3D flashcard animation technology, with Service Learning serving as an effective framework for creating meaningful educational experiences for both the students and the community.*

Introduction

Education in the world of children with disabilities such as autism, ADHD (Attention Deficit Hyperactivity Disorder), Celebral Palcy, Epilepsy is not only limited to academics but they need education related to independence for their daily activities. Special education follows sound pedagogical principles that can benefit all children. Child-centered learning is more effective and beneficial for all involved especially the children as a whole [1] How they adapt and develop the remaining skills they have to safeguard and protect themselves from harm and anything related to skills in general [2].

HS Lantaburo provides quality education as the cornerstone for individual and community growth [3]. However, they are faced with challenges, one of which is related to students' difficulty in recognizing the shape and sound of animals directly [4]. The integration of 3D animation technology in educational environments has emerged as a transformative approach to enhance students' understanding of complex biological concepts, particularly in the context of animal recognition. Recent studies have shown that 3D animation not only facilitates a more engaging learning environment but also significantly improves knowledge retention and understanding among students [5]. For example, Dinçer et al. highlighted that the combination of 3D animation with traditional educational methods leads to a marked improvement in the knowledge level of nursing students, indicating that visual aids can effectively complement theoretical learning [6]. Similarly, [7] reported that students expressed higher satisfaction and understanding when taught through 3D animated illustrations, indicating that this method caters to diverse learning styles and preferences. Moreover, the use of AR along with 3D animation has

[1] Belva Saskia Permana, Lutvia Ainun Hazizah, and Yusuf Tri Herlambang, "Teknologi Pendidikan: Efektivitas Penggunaan Media Pembelajaran Berbasis Teknologi Di Era Digitalisasi," *Khatulistiwa: Jurnal Pendidikan dan Sosial Humaniora* 4, no. 1 (2024): 19–28; Rohita Rohita et al., "Pemanfaatan Aplikasi Powtoon: Alternatif Media Pembelajaran Untuk Penanaman Nilai Agama Moral Pada Anak Taman Kanak-Kanak," *Wikrama Parahita : Jurnal Pengabdian Masyarakat* 8, no. 1 (2024): 37–46.

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[4] M Yunanda, I N Karma, and M I Zain, "Pengembagangan Media Kartu Gambar Berbantuan Teknik Scrambel Dalam Membaca Permulaan Siswa Kelas III SDN 5 Danger Tahun Ajaran 2022/2023," *Renjana Pendidikan Dasar* 3, no. 1 (2023): 1–9.

[5] Yenni Nuraeni, Program Studi Akuntansi, and Negeri Jakarta, "Aplikasi Canva Sebagai Media Promosi Produk" (2024).

[6] Berna Dinçer, Cemile Savci, and Hasan H Mutlu, "Effect of 3D Animation Assisted Education on Knowledge Level of Nursing Students for the Evaluation of Respiration," *Journal of Academic Research in Nursing* (2019).

[7] Mpapho J Motsumi, Alemayehu G Bedada, and GezahenNegusse Ayane, "The Role of Moodle-Based Surgical Skills Illustrations Using 3D Animation in Undergraduate Training," *African Journal of Health Professions Education* 11, no. 4 (2019): 149.

been shown to further enhance the educational experience. [8] describe a project that utilized AR to project animated 3D models of marine animals, creating an interactive learning experience that captured students' attention and encouraged deeper engagement with the subject matter. This is in line with the findings from [9] who assert that 3D animation helps visualize abstract concepts, making them more accessible and comprehensible to students. The immersive nature of 3D animation allows learners to visualize and interact with difficult-to-understand content thus bridging the gap between theoretical knowledge and practical understanding. The application of 3D animation in educational contexts has been shown to increase inclusivity and accessibility in learning [10]. Researchers [11] emphasize that 3D printed models and animations create opportunities for inclusive learning environments that benefit students with varying levels of prior knowledge and learning abilities. This was echoed by [12] who discussed how the use of 3D digital models in anatomy training not only increased student motivation but also fostered a sense of belonging among diverse learners.

The integration of technology into educational frameworks has gained momentum in recent years, especially for learners with diverse needs. Previous studies have shown that the use of immersive tools to enhance engagement and understanding such as developing an augmented reality (AR) application to project marine animal models so that students can interact with three-dimensional visuals has an impact on increasing their curiosity and retention of biological concepts[13]. The implementation of 3D animation to enhance an abstract topic like atomic structure simplified understanding for students who found traditional diagrams challenging[14]. Tactile 3D animation models have inclusiveness for all levels of cognition[15]. The models motivate learners so that their participation increases, which suggests that the use of multiple senses makes practical work easier than working with purely theoretical concepts[16]. developing AR-based

[8] Vinothini Kasinathan et al., "Augmented Reality in Ocean's Secrets: Educational Application With Attached Book for Students," *Linguistics and Culture Review* 5, no. S1 (2021): 1123–1137.

[9] Hena D Ayu, Akhmad Jufriadi, and Ratri Andinisari, "High Impact on Students' Understanding of Atomics Radius on Crystals Geometry Concept Through Implementation of JITT With 3D Animation," *Momentum Physics Education Journal* (2021): 153–160.

[10] Nia Kusuma Wardhani and Saruni Dwiasnati, "Pemberdayaan Masyarakat Dalam Peningkatan Kompetensi Literasi Informasi Kewirausahaan Di Wilayah Kecamatan Kembangan Jakarta Barat," *Media Abdimas* 3, no. 2 (2023): 104–109.

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[12] Katie L Staab, "Implementing Fabrication as a Pedagogical Tool in Vertebrate Anatomy Courses: Motivation, Inclusion, and Lessons," *Integrative and Comparative Biology* 61, no. 3 (2021): 1013–1027.

[13] Kasinathan et al., "Augmented Reality in Ocean's Secrets: Educational Application With Attached Book for Students."

[14] Kasinathan et al., "Augmented Reality in Ocean's Secrets: Educational Application With Attached Book for Students."

[15] Borgeat et al., "Three-Dimensional Printed Models of the Heart Represent an Opportunity for Inclusive Learning."

[16] Staab, "Implementing Fabrication as a Pedagogical Tool in Vertebrate Anatomy Courses: Motivation, Inclusion, and Lessons."

Android applications provides dynamic visuals and interactive features that enhance users' ability to distinguish animal characteristics beyond what static images offer[17]. Such technological innovations reveal the flexibility of using AR and 3D technologies in different areas, especially to cater to the learning difficulties of students with disabilities.

The ability to manipulate and explore 3D animal models can significantly enrich the educational experience, allowing students to engage with the material directly which traditional methods do not [18] Teaching at HS Lantaburo Tangerang focuses on a conventional approach that emphasizes direct interaction between teachers and students, some students have difficulty identifying or distinguishing the shapes and sounds of animals, this could be due to a lack of exposure to certain animals or a lack of understanding of the unique characteristics of each animal and using 2D flashcard media. In an effort to address this challenge, the PKM Team consists of a collaboration between the Faculty of Computer Science and Psychology as well as UMB students engaged in a close partnership with HS Lantaburo. Through intense interaction, both through in-person and online meetings, the problem of students' lack of understanding of school materials was identified. Therefore, the team is committed to providing innovative solutions that are not only conventional but also integrate three-dimensional (3D) technology with the aim of creating a more interesting and enjoyable learning experience for students. the innovative solution provided is to conduct training in the technique of Animal Exploration Through Inclusive Technology abbreviated as three-dimensional (3D) based *Teh Melati* to students, teachers and parents, after the training the activity continued with interactive games in the form of Guessing Animal Pictures and Sounds which also used computer applications so that the training atmosphere became more exciting and interactive.

Method

The methodology used in the implementation of the community service (PKM) project at HS Lantaburo is based on the Service Learning approach. This approach integrates meaningful community service with instruction and reflection to enrich the learning experience for all participants. Below is the description of the method used in the implementation of this educational intervention

The method of implementing the stages of PKM in implementing solutions for recognizing animal object shapes and sounds based on three-dimensional (3D) animation at HS Lantaburo is to identify the needs [19] of HS Lantaburo related to student education,

[17] Siti Fatmala Sari, Fitriana Destiawati, and Lengsi Manurung, "Implementasi Augmented Reality Pada Aplikasi Pengenalan Hewan Mamalia Berbasis Android," *Jurnal Riset dan Aplikasi Mahasiswa Informatika (JRAMI)* 5, no. 2 (2024): 333–338.

[18] Sari, Destiawati, and Manurung, "Implementasi Augmented Reality Pada Aplikasi Pengenalan Hewan Mamalia Berbasis Android."

[19] W Gunawan et al., "Pemanfaatan Aplikasi Cam Multimedia Pada Teknik Photo Editing Untuk UMKM

especially in terms of recognizing animal object shapes and sounds, the next step is to plan a three-dimensional animation-based solution to introduce animal object shapes and sounds by selecting the appropriate animation technology, namely Augmented Reality (AR) technology [20] The next stage is to develop interesting and educational three-dimensional animation-based learning materials. This includes creating animal animations with realistic three-dimensional models, clear and real sounds, and learning content that is appropriate to the level of development of early childhood, the next step is to test the solution with HS Lantaburo, namely teachers, students, and parents. Evaluation is carried out to evaluate the effectiveness of learning materials in teaching about the shapes and sounds of animal objects and to obtain feedback for further improvement [21]. The next stage is to organize training for teachers, students and parents on how to use learning materials [22] and three-dimensional animation-based applications. Dissemination is carried out through workshops, seminars, or community meetings to introduce solutions to HS Lantaburo and the wider community. The following is Figure 1. Flow of PKM activity implementation

Figure 1. The flow of PKM activities

The intervention's effectiveness was evaluated through monitoring changes in pre-test and post-test scores of the participants. Prior to the training sessions, students underwent a pre-test to evaluate their understanding of animal shapes and sounds that yielded an average score of 63.75. The introduction of 3D animations, games, and

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[20] Muhaimin Hasanudin et al., "Increasing Independence of Cerebral Palsy Children Using Virtual Reality Based on Mlearning," *Journal of Physics: Conference Series* 1764, no. 1 (2021); Kevin Kindangen, Debby Paseru, and Michael Sumampouw, "Pembuatan Aplikasi Ar Metamorfosis Tidak Sempurna" 16, no. 1907–0837 (2020): 25–31.

[21] Ina Magdalena et al., "Pentingnya Evaluasi Dalam Proses Pembelajaran Dan Akibat Memanipulasinya," *Masaliq* 3, no. 5 (2023): 810–823.

[22] Wawan Gunawan, Muhaimin Hasanudin, and Wawan Ridwan, "Pembelajaran Algoritma Naïve Bayes Dan Apriori Untuk Siswa SMK Media Informatika Jakarta" 3, no. 1 (2024): 90–98; Sabar Rudiarto, Sukma Wardhana, and Saruni Dwiasnati, "Pelatihan Penggunaan Microsoft Power Point Untuk Guru Smp 215 Jakarta," *PEMANAS: Jurnal Pengabdian Masyarakat Nasional* 1, no. 1 (2021): 8–17.

interactive sessions during the training boosted post-test scores to 81.25, demonstrating improved comprehension. Individual results varied with most participants showing higher scores although some experienced no change or a slight decrease. This comparison of numbers clearly depicts the effects of the PKM program on learning outcomes. Feedback from teachers, students and parents during this testing phase was used to develop the program further. These groups' contributions emphasized changes that were central to the learning resources and to the application. For example, whereas teachers emphasized the importance of simplifying navigation in the Teh Melati application, parents pointed out the lack of guidance on how to use the application at home. These comments changed the design of the 3D animations and the structure of the guessing game to render the tool more user-friendly.

Result

Activities carried out in the form of community service are located on Jl. kenaiban rt 02/rw 02 no 16, Pabuaran, Kec. Karawaci, Tangerang City, Banten. You can see the google map on the link https://maps.app.goo.gl/7spNfKjRJLYb9hgS9. The target of the activity was 32 student participants who were accompanied by 11 teachers and parents. In terms of gender, 71.88% of participants were male and 28.13% female, aged between 6 - 14 years old with children with disabilities diagnosed with 53.13% Adhd, 15.63% Learning Difficulties, 12.50% Impaired, 6.25% Down Syndrome, 6.25% Speech Delayed, 3.13% Hydrocephalus and 3.13% Mental Retardation. Community service activities are carried out in the form of socialization, training and mentoring (Hidayat, 2020). This community service was carried out offline at HS Lantaburo, cimone - Tangerang. The implementation of PKM activities was carried out on 1 (one) day starting from 09:00 - 12:00.

Table. 1 Schedule of *Teh Melati* PKM Activities

Day, Date	Hour	Activity
Wednesday, September 18, 2024	08.30 – 09.00	Workshop Participant Registration
	09.00 – 09.30	Opening of PKM Event
	09.00 – 09.10	Greetings from UMB
	09.10 – 09.20	Partner Greetings
	09.20 – 09.30	PKM Chairman's Speech
	09.30 – 12.00	Work Shop PKM
	09.30 – 10.00	Materi : Psikoedukasi tentang Pendekatan Berbasis Kekuatan kepada Orangtua dan Guru Anak-anak Spesial
	10.00 – 10.30	*Teh Melati* : Eksplorasi Hewan dengan Teknologi Animasi 3D (Dimensi)
	10.30 – 12.00	Game of *Teh Melati* : Guess the Animal Picture and Sound
	10.30 – 12.00	Psychological Consultation

During the implementation of the community service activities, we took some photos showing the learning process and the workshop to the partners. The partner has given us permission to carry out this activity in their school environment. The photos can be seen in Figure 2.

(a) (b)

Figure 2. (a). Partner's welcome and (b) Workshop participants

Community service activities with the theme PKM *Teh Melati*: Animal Exploration Techniques Through Inclusive Technology to Improve Information and Communication Technology Competencies for Lantaburo students, began with the provision of material with the theme of Psychoeducation on Strengths-Based Approaches to Parents and Teachers of Special Children and continued in a separate room for a psychological consultation session guided by the Head of UMB Psychology Department, namely Mrs Karisma Riskinanti, M.Psi., Psychologist, and her students, Parents get the opportunity to consult about the psychological development of their children in facing the challenges of the digital environment.

Figure 3. Provision of Psychology Materials

In the next session, HS Lantaburo students and accompanying teachers were taught to explore the animal world through the use of two-dimensional flashcards which were then converted into three-dimensional animations using a computer application called *Teh Melati*. This session was guided by Muhaimin Hasanudin, S.T., M.Kom., along with two UMB students, Kevin Novrizal and Mulyati Lestari. The students showed

enthusiasm in following this creative process, which not only improved their skills in technology but also stimulated creativity and curiosity in animal exploration through the *Teh Melati* application. Furthermore, the activity continued with an interactive game, namely Guess the Picture and Sound of Animals, which also utilised computer applications to add excitement to this training.

Figure 4. Workshop of *Teh Melati*

The results of the theoretical training were measured by calculating the participants' average scores from the pre-test and post-test. The average pre-test score of participants was 63.75 while the average post-test score was 81.25.

Table. 2 Pre-Test and Post-Test Results

No	Nama Peserta	Pre-test	Post-test
1	Akbar	70	95
2	Aldilla Putri	70	90
3	Anka Satria	70	90
4	Annaya	70	80
5	Arkansyah	70	95
6	Atallah	70	80
7	Bian	50	50
8	Clarrisa	65	95
9	Devin	60	60
10	Fachry Salim	70	95
11	Fadlan	65	95
12	Habib	45	40
13	Hauzan Rizky	45	45
14	Ibam	70	80
15	Ilham Kurniawan	70	80
16	Jibran	70	95
17	Kaila	65	95
18	Khadijah	65	95
19	Muhamad Devan	70	100

20	Muhamad Dhafin	70	95
21	Muhamad Zaki	75	100
22	Muhamad Zein	65	90
23	Nabila	70	80
24	Nadira	40	35
25	Naja	65	95
26	Nizam	45	50
27	Putri	70	95
28	Rafif	55	95
29	Sahla	70	95
30	Syafirah	45	40
31	Syifa	75	80
32	Zein Orlanda	65	95
	Nilai Rata-Rata	63,75	81,25

Based on the graph shown, there is a comparison of participants' scores before and after the PKM training. This graph shows that most participants experienced an increase in scores from pre-test to post-test. For example, some Fadlan participants who initially had a score of 65 in the pre-test, showed a significant increase with a score of 95 in the post-test. However, there were also some participants who showed a decrease in scores such as participant Nadira whose pre-test score of 40 decreased to 35 in the post-test. In addition, some participants showed relatively stable scores, such as participant Bian who had the same pre-test and post-test score of 50. The variation in score changes suggests that the effectiveness of the intervention varies for each participant and a more personalized approach is needed to optimize outcomes for all participants. As shown in figure 5.

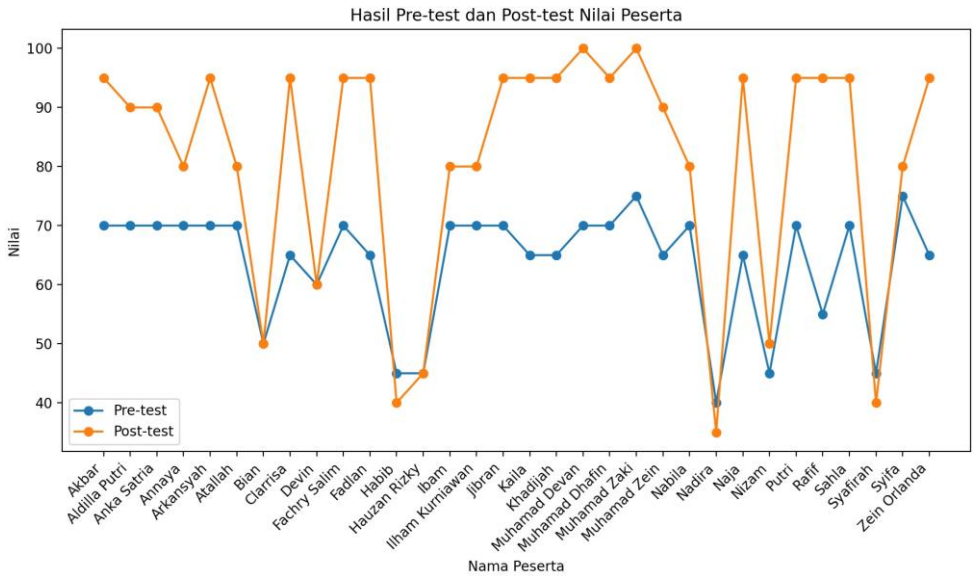

Figure 5. Pre-test and Post-test results of participants' scores

In the interactive gaming learning experiences, the students were knowingly and enthusiastically engaged in guessing while enjoying the expression of matching the

sounds of animals with animated 3-dimensional models. Throughout the sessions, many of the learners were physically leaning into their seats, pointing to the screen, and making guesses vocalizations; when they were guessing vocalizations that were correct, they erupted into laughing or cheers. For instance, one student kept exclaiming, "A lion! It roars!" while performing the vocal representation of the animal, demonstrating that they had grasped an animal in question as having been a very accessible and productive understanding of the lesson through representations of many modalities (auditory and visual). However, the teachers noted that students who were typically shy or reluctant in the typical lesson setting, were raising their hands and appearing excited to engage in classroom discussions about the lesson. The fun of the game seemed to mitigate classroom anxiety in this manner, allowing for students who were typically quieter, to share their thinking and to engage in a discussion with other students. After the sessions, parents remarked that their children were excited to express their learning about the habitats and behaviors of the animals in the lesson, and most notably, they thoughtfully could share that the interactivity helped their memory of animals. This ability to shift momentum through interactivity provoked sustained attention in students and provoked a sense of accomplishment through the excitement of answering the correct response. Moreover, naturally play and learning created an intentional and stimulating space that sparked curiosity while feeling much more tangible to abstract concepts through enjoyment.

Discussion

The PKM initiative, titled *Teh Melati*: Animal Exploration Techniques Through Inclusive Technology, was designed to address the learning difficulties faced by children with disabilities, particularly in recognizing animal shapes and sounds. This program utilized 3D animation and Augmented Reality (AR) to create an engaging and interactive learning experience for children with special needs at HS Lantaburo, a school dedicated to children with disabilities. The community service approach not only targeted the students but also engaged teachers and parents, ensuring a comprehensive and collaborative educational environment. This discussion delves into the outcomes of the intervention, reflecting on the theoretical frameworks that supported the initiative, and examining the social changes that occurred through the process.

The Role of Technology in Special Education

The integration of 3D animation and AR technology in special education has become a transformative approach to enhance the learning experience for students with disabilities. Traditional methods, such as 2D flashcards, often fail to address the diverse needs of children, particularly those with sensory and learning challenges. As highlighted

by research on inclusive education [23], these students often struggle with traditional visual aids, which can be abstract or difficult to grasp. By incorporating interactive technology such as AR, the students at HS Lantaburo were able to engage directly with the material in a more dynamic and accessible way. The ability to manipulate 3D animal models and interact with them in a virtual space allowed for a more hands-on learning experience, which is essential for students with special needs.

The success of this intervention in improving animal recognition skills among students aligns with the findings of several studies that emphasize the benefits of multimodal learning. According to Kasinathan et al. [24], when learners are exposed to multiple forms of sensory input—such as visual (3D models), auditory (animal sounds), and kinesthetic (interactive gameplay)—their ability to understand and retain complex concepts improves significantly. This approach caters to diverse learning styles and ensures that children with special needs are given the tools they require to succeed academically and personally.

Engagement Through Interactive Learning

The *Teh Melati* application and the accompanying Guess the Animal Picture and Sound game exemplified the power of game-based learning. This interactive approach proved to be a catalyst for increasing engagement and motivation among students. As seen in the post-test results, there was a significant improvement in student comprehension, with an average increase in scores from 63.75 to 81.25. However, it is crucial to recognize the variation in individual results, which suggests that some students benefited more than others from the intervention. This disparity highlights the importance of considering personalized learning approaches in future interventions, ensuring that each child receives support tailored to their individual needs.

The engagement levels observed during the interactive game also underscored the effectiveness of hands-on learning in children with disabilities. The game allowed students to not only learn but actively participate in the process, encouraging them to express themselves verbally and through gestures. Teachers noted that students who were typically hesitant or shy in a traditional classroom setting became more vocal and participatory during the interactive sessions. This shift is indicative of the positive impact of interactive technologies, which can reduce anxiety and create a more inclusive environment for students with special needs [25].

[23] Staab, "Implementing Fabrication as a Pedagogical Tool in Vertebrate Anatomy Courses: Motivation, Inclusion, and Lessons."

[24] Kasinathan et al., "Augmented Reality in Ocean's Secrets: Educational Application With Attached Book for Students."

[25] Staab, "Implementing Fabrication as a Pedagogical Tool in Vertebrate Anatomy Courses: Motivation, Inclusion, and Lessons."

Inclusive Education and Technology Integration

The use of 3D animation and AR in this PKM project directly supports the principles of inclusive education. Inclusive education advocates for the provision of educational opportunities that are accessible to all students, regardless of their abilities. The application of 3D technology in this context allowed for an inclusive approach to teaching animal recognition, which is often a challenging subject for children with disabilities. By incorporating 3D animations into the learning process, the project provided a more visual and tangible representation of animals, making the abstract concept of animal shapes and sounds more accessible to all students.

Furthermore, the use of AR technology added an interactive dimension, allowing students to engage with the material in a way that traditional methods could not offer. This aligns with the findings from Kasinathan et al. [26], who emphasized that the immersive nature of AR facilitates a deeper connection to the material and increases student engagement. The interactivity of the learning tools not only made the experience more enjoyable but also improved students' retention of information by providing a more hands-on and interactive approach to learning.

Personalized Learning and Teacher-Parent Collaboration

The variability in pre-test and post-test scores suggests the need for a more personalized approach to education, especially when working with students who have disabilities. While many students showed significant improvements, others either remained the same or showed a slight decrease in their scores. This could be attributed to factors such as individual learning styles, the severity of their disabilities, or the amount of support they received during the intervention. Future interventions could benefit from more individualized instruction that addresses these differences, such as providing additional guidance or tools for students who require extra support.

The success of the workshops for teachers and parents is another key takeaway from this initiative. The collaborative nature of the intervention ensured that both teachers and parents were actively involved in the learning process. The psychological consultations provided by the Head of the UMB Psychology Department allowed parents to gain insights into their children's developmental needs and how they could support them in the digital learning environment. This collaborative engagement between the school, teachers, parents, and students is crucial in creating an environment where learning is not only supported by technology but also by the broader community [27]. This reflects the importance of community-based education, where all stakeholders are

[26] Kasinathan et al., "Augmented Reality in Ocean's Secrets: Educational Application With Attached Book for Students."

[27] Staab, "Implementing Fabrication as a Pedagogical Tool in Vertebrate Anatomy Courses: Motivation, Inclusion, and Lessons."

involved in fostering the educational growth of children.

Social Impact and Long-Term Benefits

The social impact of this PKM initiative goes beyond improving students' academic skills. By using interactive technology, the program also contributed to social change within the school community. The students, teachers, and parents all experienced an increased sense of ownership and confidence in using modern educational tools. This shift is particularly important in the context of special education, where students often feel marginalized or less capable than their peers. The interactive sessions and the fun, game-based approach helped to alleviate some of the anxiety and self-doubt that can be prevalent in children with disabilities.

Moreover, the involvement of teachers and parents in the learning process led to a broader community engagement in the students' education. This collaborative approach ensured that the students received continued support both in and out of the classroom, reinforcing the positive effects of the intervention and ensuring its sustainability in the long term.

The *Teh Melati* PKM initiative demonstrated the profound impact of 3D animation and AR technology in creating an engaging, inclusive, and effective learning environment for students with disabilities. By providing interactive learning experiences that catered to the diverse learning styles of the students, the project not only improved their ability to recognize animal shapes and sounds but also fostered a sense of confidence and engagement. The positive results of the intervention, alongside the valuable feedback from teachers and parents, highlight the potential of technology-enhanced learning to revolutionize education for children with special needs. Moving forward, personalized approaches and continued collaboration between teachers, parents, and the broader community will be key to ensuring the long-term success and sustainability of such initiatives.

Conclusion

The implementation of the Community Service (PKM) programme at HomeSchooling Lantaburo successfully achieved the set objectives in the introduction of three-dimensional animation-based animal object shapes and sounds. Through a structured method, the PKM team identified students' educational needs and designed a suitable solution using Augmented Reality (AR) technology. Three-dimensional animation-based learning materials were developed in an attractive and educational manner, plus intensive training for teachers, students, and parents. Evaluation results measured through pre-test and post-test showed that the average student score increased from 63.75 to 81.25 after the training. This increase reflects the effectiveness

of the activities undertaken in not only making learning more interactive but also improving students' understanding of the material. In addition, the involvement of parents and teachers in the learning process has created a supportive environment and encouraged information and communication technology skills for students.

Suggestions for continued development include regularly refreshing AR content to reflect current material, creating space for activities to adapt to each student's learning pace, and collaborating with technology groups to sustain use. Likewise, teacher training and engaging parents will foster a culture of using AR as part of each child's learning. Feedback sessions to assess and track progress require follow-up to evaluate the process and adjust strategies. The concepts mentioned meet the discussion requirements for customized solutions because not every participant has the opportunity to use a uniform approach. Although they all have different learning requirements, the recommendations focus on collaboration, a passion for adaptability, and a commitment to community. The overall goal of these recommendations is to maintain excitement, address learner growth for all, and make it a hope that AR will be a part of student learning in the future.

Acknowledgements

Thank you to Homeschooling Lantaburo, LPPM UMB and DRTPM Kemdikbudristek for providing funding for this community service activity.

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