Pegem Journal of Education and Instruction, Vol. 13, No. 4 , 2023 (pp. 158-163)

RESEARCH ARTICLE WWW.PEGEGOG.NET

Opportunity to Provide Augmented Reality Media for the Intervention of Communication, Perception, Sound, and Rhythm for Deaf Learners based on Cultural Context

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Abstract

The development of communication, perception, sound, and rhythm (DCPSR) is a learning subject that provides stimulation, and intervention for the appreciation of sound which is done intentionally or unintentionally so that the remnants of hearing and the feeling of vibration possessed by students with hearing impairment can be used as well as possible. This study aims to describe the current conditions for the implementation of DCPSR special schools and the need for Augmented Reality (AR)-based DCPSR media. Data was collected by distributing questionnaires through a google form by accidental sampling 131 special education teachers in Indonesia and focused group focus (FGD). Instrument validity uses content validity and reliability uses interrater reliability. The data analysis technique used the descriptive-qualitative analysis method. The results showed that 18.32% of teachers did not even understand the concept of DCPSR, while 72.51% of teachers thought that DCPSR needed to be taught. Schools still use conventional media (54.2%), and 99.24% of teachers feel the need and need innovative DCPSR media in the form of AR-based media, especially in communication material (oral motor) 34.45%, as well as sound and rhythm perception (detection) 46.56%. The results of the analysis show that teachers who teach the deaf need the development of AR-based DCPSR media that is easy to operate and reach, such as smartphones with additional facilities for audio, images, captions, and cues. The results of the FGD showed that prioritizing the development of this AR-based media on sound discrimination material on the essential sounds around students.

Keywords: Media, DCPSR, Augmented reality, Student with hearing impairment.

Introduction

In the last two decades, rapid advances in assistive technology have been made in the field of hearing loss, but it is still far from perfect so deaf people still face various challenges in communicating. Assistive technology for students with hearing impairment all has limitations and advantages. One of the limitations is that assistive technology can be used if students already have a language, and very few of these assistive technologies provide services/interventions regarding awareness of the sounds of students with hearing impairment. Effective educational programs are considered essential, including an experiential learning component where they can experience sound (Low & Phua, 2012).

Deafness is one of the most common disabilities in the human population and presents a great risk in daily life due to problems with speech recognition, communication, and language acquisition (Ohlenforst et al., 2017). Deafness at an early age is experienced by 1 out of every 200 births globally (Banda et al., 2018). Deafness will have a lasting impact on the sufferer. This condition makes the deaf need to receive early intervention, such as at school, so that they can adapt to the world of sound. Special services with learning or training programs can provide meaningful experiences for students with hearing impairment in Special Schools, such as DCPSR. Deaf learners need to master at least one language (spoken or sign) to reach their full potential (Mathew, L.H., Wyatte, C., H., & Naomi, K., C. (2019). Spoken or sign language requires concepts about sound awareness. One of the linguistic characteristics of students with hearing impairment is the emergence of problems in their phonological abilities or awareness and hearing difficulties in obtaining word prefixes and suffixes (Hadi, et al, 2019). Phonological awareness is the ability of students with hearing impairment to detect and manipulate sounds., which will be seen when students with hearing impairment can detect word, syllable, and onset-rime levels. The demands put forward by Alkhawaldeh and Khasawneh (2021) to respond to these conditions are to conduct

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How to cite this article: Subagya, Anggrellanggi A, Priyono, Sari EK (2023). Opportunity to Provide Augmented Reality Media for the Intervention of Communication, Perception, Sound, and Rhythm for Deaf Learners Based on Cultural Context. Pegem Journal of Education and Instruction, Vol. 13, No. 4, 2023, 158-163

Source of support: Nil

Conflict of interest: None.

DOI: 10.47750/pegegog.13.04.19

Received: 17.10.2022

Accepted: 07.01.2023 **Publication:** 01.10.2023

sound training courses that target parents or teachers of students with hearing impairment to develop receptive and expressive language for students with hearing impairment.

DCPSR is a learning program given to students with hearing impairment so that they can use their remaining hearing to experience vibrations and train sound perception. DCPSR can develop the receptive ability of deaf children through optimizing hearing function, and developing vibrational abilities so that they can perceive, associate, and analyze information in the form of language symbols (Aprilia, 2017). The formation of the language of students with hearing impairment is not in line with language development as occurs in children in general. Language formation for students with hearing impairment at school is charged to DCPSR subjects. Some students will access information through their residual hearing, whereas others will benefit from visual or tactile/kinesthetic strategies. Many of the strategies are multi-modal, utilizing multimedia. Without this strategy, students with hearing impairment receive input in spoken language, including quite limited voice (Novogrodsky et al., 2018; Hall, 2017), the further impact is that students with hearing impairment are not skilled in language, they have only a little vocabulary, it is difficult to understand abstract sentences. , and less able to perceive rhythm and motion (Setyaningsih & Rahmawati, 2018).

Culture is part of the pattern of thinking in acting that affects almost all aspects of an individual life (Sendayu, Muslihati, Mappiare, & Atmoko, 2022). Culture is traditionally learned by both parents. In particular, early childhood marks a cultural period of intense learning, with parents and loved ones playing an important role in structuring children's experiences (Broesch et al., 2021; Kartner, Schuhmacher, & Giner Torr´ens, 2020). Deaf students are usually born to parents who do not know deaf culture (Jackson, 2011). Most parents do not know how to communicate with their children. This limitation results in the lack of stimulus obtained by deaf students and language delays. Lack of communication is a common experience experienced by deaf individuals. The communication vacuum and the inability to communicate with the world are the first of many cultural experiences that show that individuals are different and belong to deaf culture. When deaf individuals become exposed to sign language and other deaf people, the enculturation process is complete, and deaf people identify themselves as ethnically deaf (Miller, 2010). The perception of deafness as ethnicity is more due to different feelings towards ways of communicating.

The ability to detect sound has an important role for deaf students. The ability to detect noise is closely related to safety information for example a fire alarm ringing up to more sounds is commonplace but still as useful as a clothes dryer ending cycle (Matthews et al, 2006). Hearing aids and cochlea implants can improve speech and speech recognition. Deaf students communicate with partners using sign language and lip reading. Lip reading incorporates body language, facial expressions, situational cues, and whatever auditory input is available to understand the spoken parts of a conversation (Lee, 2006). Voice awareness needs for spoken conversation range from knowing who is speaking to a desire to speak real-time text.

Awareness of detecting sounds for deaf students requires a variety of technology designs. In early work on non-speech voice awareness needs, Matthews et al (2006) conducted two interview studies with a total of 18 deaf learners to assess needs in three contexts: home, work, and on the move. Their findings highlight the need to be aware of other people and their activities, the importance of voice awareness when outside the home, and the desire for end-user customization of voice information. While safety-related sounds are generally attractive (e.g., alarms), awareness needs vary across contexts, such as home (e.g., doorbell), transit (e.g., honking), and work (e.g., coworker activities). Jain et al (2019) have also more recently examined the need for in-depth home sound awareness through interview studies with deaf learners. The selection of objects as a medium for detecting sounds is not only determined by the cultural context of the listener but the cultural context of the deaf students must be considered so that the selection of media in this study is a slice of the cultural context of the two.

Implementation of multimodal DCPSR learning strategies can be prepared by using multimedia. Multimedia can stimulate all the senses that are owned/multimodal. Characteristics of the Millennial generation, there are some concerns about the effect on their learning process including deaf learners. Not a few children at a young age do monotonous things every day such as interacting with people, talking through technology or social media, doing homework, and so on (Iso-Ahola, 2022). This impact can be more serious if the school where deaf children study does not have DCPSR learning media that accommodates their needs, especially if the media used is still conventional and not digital-based. Meanwhile, children have been exposed to a lot of screen media such as cellphones, television, DVDs, and computers from an early age (Samudra, Flynn & Wong, 2019). Media has been experienced as a new development in everyday life in society (Moe & Madsen, 2021).

This study seeks to describe the current conditions and opportunities for the use of AR in DCPSR learning. The research attempts to provide a systematic analysis of the condition of school infrastructure related to conceptual understanding, media availability, and applicable learning hours. The focus of this research is the opportunity to use AR-based learning media.

Method

This study uses a descriptive research approach. The population is all Special School teachers who are tasked with teaching students with hearing impairment. The sample was determined by accidental sampling, namely by sending a questionnaire via google form to various communities of special school teachers throughout Indonesia and getting a response of 131 teachers. Collecting data through the distribution of questionnaires/ questionnaires with 16 closed questions, one open question, and a focused focus group (FGD). Instrument validity uses content validity and reliability uses interrater reliability. The questionnaire contains questions about the current situation/ condition of DCPSR learning infrastructure and opportunities for using AR-based DCPSR learning media. The questionnaire was filled out for three days on May 21-23 2022. The data collected was then analyzed descriptively qualitatively by analyzing the percentage of each component.

Results and Discussion

Among teachers who teach DCPSR to students with hearing impairment, there is a significant difference in the proportion of both sexes (Table 1). The number of female teachers has a difference of 58.6% from the number of male teachers. This also happened to the number of teachers who teach DCPSR, as many as 71% of classroom teachers who also teach DCPSR. In particular, teachers with multiple roles (such as classroom teachers and special teachers) will have certain effects, including detrimental effects on students, so it is necessary to have a special DCPSR teacher role to prioritize students' ability improvement (Sappa, Boldrini, Aprea, 2015; Campion, Caza, & Moss 2020; Nurhayati, 2014). This role is quite difficult for teachers to fulfill because it requires a different approach to their students from ordinary teaching activities (Draaisma, Meijers, & Kuijpers, 2018).

Teachers also need competencies to adapt teaching and learning processes to meet the needs of all children (Alhassan, 2012; Das, Gichuru, & Singh, 2013). This study found that 53.4% of teachers had never attended special training for DCPSR, and even 18.3% of teachers lacked and did not understand the concept of DCPSR. Meanwhile, teachers who teach the deaf are obliged to understand the general principles of learning, understand the differences in approaches, strategies, and learning methods, be able to identify student learning experiences, be able to apply the development program for communication of sound and rhythm perception (DCPSR) and apply the techniques to deaf children. (Aprilia, 2017).

Teachers' understanding of the DCPSR concept becomes doubtful when they see the results of the study (Table 2) that 30.5% of schools do not have special learning guidelines and many teachers have never attended the special training program. This uncertainty of competence is increasingly doubted when it is known that 54.2% of media in DCPSR learning activities use conventional media and 26% use multimedia (a combination of several conventional media), where this media is non-electronic or non-digital (Setyaningsih & Rahmawati, 2019) which is widely used by the majority of Special Schools in Indonesia.

DCPSR is not taught in all Special Schools, 32.8% of the 3 levels (elementary school, junior high school, & senior high school) are not taught this special program. This decreases the perception skills of students with hearing impairment because the remaining hearing is not utilized. Various studies have shown that intensive long-term training for many years can be beneficial for rhythm perception so that it can improve auditory perception and cognitive performance in deaf learners (Rochette, et al, 2014), pitch perception and vocal identification can lead to speech habits and reduce language difficulties of students with hearing impairment (Hidalgo, et al, 2020, Iskandar and Supena, 2021).

Teachers of students with hearing impairment agreed that the DCPSR program needed 72.5% and needed 27.5% to be taught to the deaf (table 5) in improving sound perception

Table 1: Basic Information of Participants

		Number of teachers	*Proportion (%)*
Gender	Male	27	20.6
	Female	104	79.4
Teacher	Subject teachers	1	.8
	Classroom teacher	93	71.0
	SNE teacher	37	28.2
Training	Never	70	53.4
	1 time	27	20.6
	>1 time	34	26.0
DPS	Do not understand	2	1.5
	Not understand	22	16.8
	Understand	104	79.4
	Understand	3	2.3

Table 2: Availability of DCPSR Facilities in Special Schools in Indonesia

		Frequency	*Percent*
Availability of DCPSR Guidelines	None	40	30.5
	Available	91	69.5
Kind	Other Media	26	19.8
DCPSR	Conventional	71	54.2
Media	Multimedia	34	26.0

skills. There are two general approaches to improving music perception in deaf people, namely improving devices/media or increasing perceptual abilities (Fuller et al, 2018).

Different training approaches, such as Augmented Reality-based media, appear to offer different benefits for DCPSR. Due to its multimodal and dynamic nature, technology-based DCPSR is a more attractive approach to hearing rehabilitation (Fuller et al, 2018). The same thing is also seen from the results of this study (table 3), that 58% of teachers need and 41.2% of teachers need AR-based technology media to support the DCPSR learning program.

A necessity in today's society, because people are now entangled in a collection of various technologies (Kuntsman & Miyake, 2019, Bucher, 2020; Hesselberth, 2017). Children aged 2-4 years view screen media for more than 2.5 hours per day (Rideout, 2017). The American Academy of Pediatrics (AAP) recommends that adults view high-quality media with children (AAP, 2016). If this is related to learning for students with hearing impairment with the basic potential of relying on visuals and utilizing residual hearing, SPECIAL SCHOOL teachers in Indonesia need DCPSR media that can accommodate this, such as the use of AR-based technology that includes various materials (table 4).

A total of 32.1% of teachers want AR-based communication program materials with voice formation exercises and 23.7% want direct communication training materials. Teachers want to ensure that they can provide effective education and learn in Special Schools (Majoko, 2016; Mpofu & Shumba, 2012). 70.2% of teachers of students with hearing impairment in Indonesia also need AR-based DCPSR media that are easy to reach and easy to operate, both by teachers and students with hearing impairment, such as cell phones/smartphones.

Technology is very developed in the world of education today. Starting from digital tools and applications have emerged at many points of education (Şimşek & Tuğluk, 2021). High-quality programming often comes in the form of educational media, such as programs specifically intended to teach schoolchildren about meaningful information and skills (Patil, et al, 2016, Kurniaman, et al, 2021), such as DCPSR-based media. AR. Unfortunately, 43.5% of teachers in Special schools do not understand the type of AR-based content needed and only know smartphones as one of them.

Table 3. Perception of DCPSR Learning Needs

		Frequency	*Percent*
Necessary	Important	36	27.5
	Very important	95	72.5
DCPSR AR needs	No need	1	.8
	Need	54	41.2
	very necessary	76	58.0

The use of smartphones does provide various conveniences (Elhai, Levine & Hall, 2019), but the problem of excessive smartphone use can also occur (Lee et al, 2022). To prevent these problems, the researcher wants to develop AR-based DCPSR learning media that accommodate the learning needs of students with fun concepts. In addition, the need for the development of needs-based media with additional facilities such as audio and text (caption) to facilitate the operation and evaluation of teachers.

Table 4: AR-Media Needs Bases

		Frequency	*Percent*
AR-based Communication Content	Direct	31	23.7
	Articulation exercises	12	9.2
	Voice shaping exercises	42	32.1
	Breathing exercises	1	.8
	Oral motor activity exercises	45	34.4
AR-based Rhythm Sound Perception Content	Sound comprehension	30	22.9
	Sound identification	25	19.1
	Sound discrimination	15	11.5
	Sound detection	61	46.6
AR Model	no answer	57	43.5
	Superimposition AR-based	8	6.1
	Projection AR-based	35	26.7
	Markerless AR-based	6	4.6
	Marker AR-based	25	19.1
AR-based Support	Virtual retinal displays (VRD)	20	15.3
	AR glasses	5	3.8
	Special AR devices	14	10.7
	Smartphone/ HP/tablet	92	70.2
AR-based additional facilities	Other	1	.8
	Sign	28	21.4
	Caption	45	34.4
	Audio	57	43.5

The objects that can be used as augmented reality media for cultural context-based DCPSR interventions according to the 131 DCPSR teachers in special schools are as follows.

Conclusions

Development of Communication, Perception of Sound, and Rhythm (DCPSR) must be accompanied by accommodative and interesting learning media, and continue to be improved according to technological developments and the needs of students with hearing impairment. In addition to increasing competence for teachers, Augmented Reality-based DCPSR learning media also urgently needs to be developed to meet multimedia needs in DCPSR learning activities, and will substantially improve the communication skills, sound perception, and rhythm of students with hearing impairment. The development of AR-based DCPSR media will create a new atmosphere in DCPSR learning activities by following the development of Information Technology and Science.

The DCPSR intervention media which was developed by utilizing augmented reality technology by considering the cultural context of the students must start from the objects that are around the students. The local cultural context cannot be separated from the deaf cultural context itself. The selection of objects should consider the intersection of the two cultural contexts

Acknowledgments

Thank you to Sebelas Maret University for fully funding this research, especially the Institute for Research and Community Service who assisted us in all research procedures. We also express our gratitude to the special school teachers in Indonesia who volunteered to fill out the questionnaire so that we could obtain the required data.

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