An Overview of The Use of Interactive Multimedia Teaching Aid For Deaf Students

Aidah Alias[1], Azahar Harun[2] and Norfadilah Kamaruddin[3]
{aidah637@uitm.edu.my[1], azahar581@uitm.edu.my [2] and norfadilah@uitm.edu.my}

Universiti Teknologi MARA, Cawangan Melaka[1,2], Universiti Teknologi MARA, Shah Alam[3]

Abstract. Interactive multimedia teaching aid is one of the effective teaching mechanisms for students with disabilities. It can help the students to focus better during the teaching and learning activities to improve their understandings. However, most of the existing teaching aids are designed for non-hearing impaired students, thus they may be less suitable for deaf students. The main factors contributing to this problem include insufficient and inappropriate teaching aids developed based on the latest information and communication technology (ICT), as well as challenges in integrating interactive multimedia teaching aid into the teaching and learning process of deaf students. Therefore, this study aimed to identify the current use of interactive multimedia teaching aid among deaf students and the factors influencing the development of an effective interactive multimedia design teaching aid specifically for deaf students.

Keywords: Interactive Multimedia, Teaching Aids, Teaching and learning, Deaf students

1 Introduction

According to the World Health Organization (WHO), more than 466 million people worldwide suffer from hearing problems, with 34 millions of them being children. The Malaysian Social Statistics Bulletin in 2018 reported a total of 453,258 people with disabilities registered with the Department of Social Welfare (JKM). Of those, 7.6 percent or 34,448 individuals were deaf [1]. The development of special education in Malaysia began in the 1920s and it remains an important agenda for the Malaysian government [2]. The government continues to be highly committed to addressing any issues in the development of special education for the deaf community. Furthermore, voluntary bodies and non-governmental organizations are also encouraged to assist and support the deaf in safeguarding their rights in various sectors in Malaysia [3].

Under the Education Act 1996, various improvements were proposed to fulfill special education needs. For example, special education classes would be provided if the needs arise among the community. In addition, the government would also equip the students with the skills and knowledge for them to learn effectively and live productively in an increasingly global and digital world. To achieve that, all teachers would be provided with the necessary Information and Communication Technology (ICT) training so that they can incorporate ICT in teaching. With the support of the teachers, the students can apply ICT innovations to practice distance learning and self-learning in an effective manner [2]. In the current learning environment, teaching and learning for the deaf incorporate the total communication method. It is an educational philosophy first introduced in the 1960s incorporating all modalities of communication (spoken, signed, and written), lipreading, and gestures in the education of deaf

DESIGN-DECODED 2021, August 24-25, Kedah, Malaysia

DOI 10.4108/eai.24-8-2021.2315098

children [4], [5]. However, the total communication method is not easy to learn and the teaching and learning of deaf students involve a variety of mechanisms and strategies [6]. Hence, proper teaching aid and technological support to strengthen the deaf learners' learning environment can be the key to fostering better communication and interaction skills in their learning process to enhance their academic performance [7].

According to Masran et al. [8], the use of technology can facilitate teaching and learning to become more simple, effective, productive, and engaging. Educational technology refers to the application of technology-related processes and materials to solve teaching and learning problems [9]. On a similar note, all materials in teaching and learning that involve technology are known as instructional technology. Instructional technology is a guide in the production of effective teaching aids. Teaching aids are objects or devices used by a teacher to enhance or enliven classroom instructions. It can be in the form of audiovisual such as videos, objects such as a book, picture, or map, and devices such as a DVD or computer [10]. To incorporate ICT in education, it is necessary to provide the necessary educational materials and tools to enable all students, including those who are underprivileged, to access education [11].

Education is the foundation of life. Therefore, the opportunity to receive education should be provided equally to all, including disabled people, regardless of their background. A better understanding of the need for new educational technology teaching aid among deaf students is vital. The findings can guide the interactive multimedia design in the teaching aid for deaf students to enhance the teaching and learning sessions. This study showed an overview of interactive multimedia teaching aids for deaf students and the determinant factors in developing an effective interactive multimedia design teaching aid specifically for deaf students.

2 Integration of Interactive Multimedia Teaching Aid for Deaf Students

In the literature, several studies have highlighted how the use of interactive multimedia managed to transform the field of education. One obvious improvement was in the area of the utility of education. The incorporation of technology as one of the teaching aid/tools/ medium has changed teaching and learning sessions to become more simple, memorable, productive, and engaging [8], [9]. Apart from that, interactive multimedia can produce effective and efficient learning in education via the selection of the most suitable communication media between text, audio, video, animation, graphics, and sound based on the intended outcomes among the end-users [10], [12], [13]. In other words, interactive multimedia is effective in improving the students' comprehension as positive and effective communication can be easily established by the teachers using multimedia such as text, audio, and animated video on the same screen [14]–[16].

However, some of the existing teaching aids are not suitable for deaf students as they are mostly designed with the interest of non-hearing impaired students in mind. Furthermore, the lack of teaching aid and difficulties in accessing different types of content is another common challenge faced by the teachers and students [17]–[19]. Compared to their peers, deaf students often fall behind academically because they face more difficulties in problem-solving sentences due to their ineptitude in verbal and written abilities [20]. These obstacles can also arise in the form of misinterpretation, unresolved attention, or lack of comprehension, resulting in poor understanding of the content of the material taught [21]. Some of the postulated reasons behind this problem are the insufficiency of teaching aid, lack of appropriate teaching aid

tailored to the latest ICT, and poor integration of interactive multimedia teaching aid in the teaching and learning process for deaf students.

In view of these factors, schools must collaborate with other relevant departments in developing teaching aid suitable for deaf and hard-of-hearing students. For example, schools can work with other specialized educational institutions with expertise in providing teaching aid for these particular students [17]. Yasin et al. stated that the most common obstacle faced by both students and teachers in deaf education is the lack of teaching aid, for example, the reference for sign language [22]. With technological advancement, ICT-driven teaching aid should also be implemented in special education for the deaf. Electronic media and ICT incorporation in teaching and learning, such as in the forms of music and visuals, can be more interesting for the students, thus improving their understanding [23]. Many published studies have reported the significant benefits of multimedia content, including video, graphics, and audio, in enhancing the learning process and outcomes of deaf students [7], [24], [25].

However, the lack of exposure to ICT training can be a barrier for teachers to provide more creative teaching and learning [26], [27]. Furthermore, well-equipped facilities are also necessary to facilitate digital-based learning among deaf students. For instance, all media should be equipped with sign language [21]. In today's world, the global influence of ICT is widespread and can be felt in every part of daily human life. There is also a growing number on the impact of multimedia technology in various fields of study.

3 Method

This review follows the seven main aspects of the essential Systematic Literature Review (SLR) methodological guidance, i.e. the development and validation of the review protocol/ publication standard/ reporting standard/ guidelines; the formulation of research questions; systematic searching strategies; quality appraisal; data extraction; data synthesis; and data demonstration [28]. We conducted a process of literature review with four primary phases and a document-based qualitative approach based on the following steps: Plan the review, perform the search, conduct the review, study the study selection, and report the results [29], [30].

In the first stage for planning this literature review, we reviewed the latest literature in the application of interactive multimedia-based teaching aids among deaf students. The two research questions in this review included i. What is the interactive multimedia teaching aid used among deaf students? and ii. What are the determinant factors in the development of an effective interactive multimedia teaching aid for deaf students?

Then, a preliminary exploratory search was conducted in four electronic databases as shown in Table 1. The summary of the search result was used to determine the relevant areas for deaf students, including the teaching aids, multimedia mechanism, and interaction of technology. Therefore, the search was focused on the areas dedicated to the teaching and learning materials to assist the teachers and deaf students in the teaching and learning sessions.

Table 1. Summary of the search result

Electronic Database	Search Results	Relevant Papers
Emerald Insight	4	1
IEEE	35	3
Springer	30	1
Scopus	22	6
Total	91	11

Table 1 shows the selected electronic databases including Emerald Insight, IEEE, Springer, and Scopus. A search was carried out in January 2020. The keywords used in the search were (factor OR effect OR develop) AND (interactive OR multimedia OR design) AND (aid OR material) AND (deaf) AND (student OR children). To ensure high quality, only peer-reviewed articles of completed research or surveys involving deaf students published between 2016 and 2020 were included. A total of 91 papers were retrieved. The abstracts were read through to determine the articles relevant to the research questions. The articles must show the usability of interactive multimedia-based teaching aids and discuss the factors influencing the development of interactive multimedia teaching aid for deaf students. Furthermore, the methods must be included in the article and the study population must be deaf students. Finally, only 11 papers fulfilled the inclusion criteria. Table 2 is the summary of the review papers that met the criteria. The final phase of the review was to synthesize the results from the included articles.

Table 2. Summary of the review papers included

Authors	Objective	Design & development methodology	Sample size & demographics	Evaluation method & data capture
Mohd Hashim et al. [7]	The usability of an e-learning environment embedded with sign language videos, deaf students' related academic performances, and learning patterns.	A mixed-method with and pre-test and post-test design	Two groups of 52 and 60 deaf students	Usability questionnaire, testing, observation, and interviews. Performance increment.
Kourbetis et al. [11]	Innovative interactive applications for the education of Deaf and Hard of Hearing (D/HH) students.	Qualitative methodological approach	A group of experts, teachers, and pre-service teachers of deaf children. Hybrid books (4 subjects) and an interactive digital library	Thematic and content analysis of texts The multimedia electronic form of the benefits of the Hybrid book.

Pelayo et al. [19]	Contribute to the comprehension of texts for people with deafness.	Preliminary Study	1st to 6th primary school grades	Reading comprehension metrics. A preliminary step in the course of the design of a software interface.
Deveci Topal et al. [20]	Identify the effects of algorithm teaching on the problem-solving skills of D/HH students.	Pre-test and post-test	A pre-test and post-test problem-solving scale was applied to 16 D/HH students at a secondary school level	Observation forms. Implemented algorithm of teaching showed a significant effect.
Pratiwi et al. [21]	Develop an effective digital video-based learning media for Rampak Kendang learning in Special Schools (SLB).	Need analysis	One-on-one Trial for three students Small group trials (five students) Large group trials.	Observations, interviews, and questionnaires. Experts validation The learning media and the programming aspect of digital video are beneficial.
Gurov et al. [31]	Develop a collection of educational video materials on chemistry as a part of special conditions for students with hearing impairment.	Comparative study	Deaf and hard hearing students from 2017 to 2018	Video experiment Development of demonstration experiments as part of the educational process.
Boudreault et al. [32]	Describe the development of the Cancer Genetics Education Module (CGEM) and to determine if viewer demographic characteristics are associated with two measurable aspects of CGEM viewing behavior, i.e. length of time spent viewing as well as the number of pauses, play, and seek events.	Focus group	Pre-test Three focus groups with different ages Two moderators Post-test 43 individuals	Content, visual image, and video quality Development of the CGEM content.

Nikolaeva T.V. [33]	Develop an approach to the creation and application of virtual professional practices in the system of continuous education of teachers for the deaf.	Experimental	28 students	An experimental model of virtual practice. Fundamental increase in the effectiveness of the formation of professional competencies.
Anindhita et al. [34]	Develop a design with proper interaction and user interface that fulfills the proposed usability goals and user experiences through the mobile app.	User-centered design (UCD)	Interview-five students Questionnaire -19 high school students	Observation, interview, and questionnaire. Designing a product focusing on usability, user characteristics, environment, task, and workflow.
Hashim et al. [35]	Investigate the key factors that can positively impact teachers' motivation to adopt cloud-based e-learning systems for deaf students.	A survey research	Questionnaire-30 teachers of deaf students	Questionnaire Factors that may affect teachers' motivation.
Costa et al. [36]	An approach to support the communication of deaf people and iLibras communicators through collaborative and mobile computing tools.	Design science research (DSR), Interaction design (ID), User-centered design (UCD), and participatory design (PD)	Deaf People-Device 38 educators (11 interpreters and 27 teachers)	Evaluation, interview, and questionnaire evaluation. Design, knowledge, problem, difficulties in communication, and its influencing factors.

4 Discussion and Finding

In the teaching and learning process, teachers always endeavor to have their learning content being delivered in an active and interactive manner. For deaf children, sign language is considered as the first language while spoken language comes next [19]. Undoubtedly, deaf students may experience certain challenges in the learning process when the knowledge is

transferred by teachers who are not hearing impaired. Sometimes, a special communicator or certified person is needed to assist the education of deaf students [7]. To enhance the teaching process, the teachers and the deaf students need to master sign language. The teachers need to use the correct facial expression and sign language gestures [37] for better delivery of the learning content to enable greater understanding among the deaf students [4], [6]. The incorporation of visuals can significantly improve the sign language movements and gestures, thus enhancing making the teaching process for the teachers and enable the deaf students to learn and understand the content better [38].

Learning contents can be delivered in various ways including verbally, through listening, and assisted with a tool, i.e. teaching aid [21], [39]. The result of this review indicated that research on interactive multimedia-based teaching aid for deaf students is growing. Furthermore, our review highlighted the optimistic influence of interactive multimedia usability in the teaching and learning of deaf students. The rapid growth of technology has led to the development of teaching aid as an integral tool for students in any classroom, including deaf students [34]. Technology is incorporated into many teaching aids nowadays, such as multimedia, embedded videos, and word processing to improve the learning process for the students to become more skillful and innovative [11], [31]. Studies have shown that such teaching aids can present information in a new and exciting way, thus highly beneficial in improving the reading and comprehension skills, illustrating or reinforcing a skill or concept, differentiating instruction, and relieving anxiety or boredom [19], [20]. In other words, teaching aid is a highly fundamental supporting tool in the delivery of learning content as it can sustain the student's attention [7], [15], [40].

Sign language is vital for the learning process of deaf students. There are many challenges associated with the learning of sign language among teachers and deaf students, including the lack of facilities [34], source references, teaching aids such as sign language books and materials [17], [22]. A strong command of sign language must be integrated for any teaching and learning to be effective for both the teachers and the students [21], [41]. Insufficiency of interpreters [11] and a lack of suitable teaching aids for deaf students further complicate the problem [17]. Consequently, these obstacles will affect the early intervention program for dead students and eventually affect the student assessment in the examination [23]. Therefore, alternatives in the form of technology-driven teaching aids equipped with multimedia features have been put forth to facilitate the teaching and learning process of deaf students. Interactive multimedia teaching aid is effective when teaching students with disabilities as it can help the students to understand and focus better.

Many factors contributed to the development of an interactive multimedia teaching aid that is specifically effective for deaf students. In this review, these factors can be categorized as multimedia, interactivity, design, connectivity, and creativity. For the first factor, the use of multimedia when formulating the teaching courses enables the students to apply information technology to learn more from the lessons [35]. Instances of multimedia include subtitles, audio, and animated video on the same screen as the lesson content [14]–[16]. Appropriate use of multimedia in the learning process can assist teachers in overcoming common obstacles in the teaching and learning process [11], [20], [21], [31], [34].In addition, the students become more interested in the course and are less likely to be distracted because the learning content has been made more entertaining. The incorporation of multimedia in teaching aid also leads to better content delivery and a positive impact on the teaching and learning process [20].

The second factor is interactivity. When embedding multimedia in teaching aid, text, audio, video, and other related features should be emphasized to create lively learning sessions via interaction between teachers and students. For example, to assist interaction with deaf

students, digital video-based learning media should be equipped with sign language. Engaging and interactive content is especially essential in the teaching and learning process of deaf students because they focus more on visual modalities as opposed to vocal/verbal modalities of spoken language [11], [21], [32], [34]. One example of interactivity is the option to pause and resume the video under the control of the students so that they can have sufficient time to understand and explore the content of learning [32].

The third factor in the development of suitable teaching aid is the design. To date, there is a lack of research on the principles, elements, and design features for teaching aids. Visually enhanced educational materials have been developed for sign language users with a multimodal/language approach. However, little is known about the ideal design features for a broad audience that consists of multiple sign language users [19], [32]. For example, the detection of the click patterns on different elements in the sign language video should be explored to determine its contribution in supporting the learning of deaf students [7], [36]. In addition, the interface design and aspects also need to be considered when designing interactive multimedia [19]. An interface design intended for deaf students should be able to motivate the deaf students to focus more during the lesson, as well as to anticipate what the students may need. To achieve these outcomes, it is vital to ensure that the interface contains elements that are easily accessible and understandable.

Next, connectivity is also an important factor based on our review. Due to the increased popularity of the Internet, it is necessary to establish standards to ensure equitable access to the content for everyone [11], [34]–[36]. By providing good connectivity, a more widespread practice of virtual design can be incorporated in the teaching aids, teaching materials, and multimedia not only for teachers involved in the education of deaf but also for those from other various professional areas [33], [38]. Last but not least, creativity is another vital factor in the teaching and learning of deaf students. Teachers need to be creative on how to communicate with the students and to devise the best ways to deliver the content, information, and materials. In today's world, teaching and learning methods can be highly varied [34], [42]. Therefore, the five main factors identified in the review should be taken into consideration when constructing an effective interactive multimedia design in the teaching aids dedicated to deaf students.

5 Conclusion

This SLR was conducted to identify the usability and determinant factors of effective interactive multimedia design teaching aid among deaf students. All peer-reviewed journal articles that met the inclusion criteria from four electronic databases were screened. A total of 11 articles were included in the final review. The limited number of publications shows that further research is still necessary for an important topic such as this one. The analysis reveals the significance of the development of interactive multimedia teaching aid and the importance of further research and practice of this topic among the minority community with disabilities.

Despite the advancement in technology and the knowledge that technology-assisted teaching aid can improve teaching and learning experience, there is still poor progress in the development of interactive multimedia teaching aid. Research has established that the use of teaching aids equipped with multimedia features and sign language can improve the teaching and learning environment, will thus helping the deaf students to better focus and understand during the lesson to enhance their skills and abilities. However, there are various challenges

related to the use of interactive multimedia teaching aids such as shortages of materials and references, lack of ICT facilities, and insufficient teaching aids.

As a result, deaf students encounter difficulties in accessing the different types of content, and worse still, some of the materials are not suitable for them. Proper integration of interactive multimedia teaching aid into the teaching and learning process must be emphasized. Close collaboration from all the stakeholders involved in the development of effective interactive multimedia for deaf students is vital. This review also identified five contributing factors to the development of effective and interactive multimedia teaching aids. Multimedia, interactivity, design, connectivity, and creativity are the five main factors to be considered. For deaf students, the primary aim when developing interactive multimedia teaching aid is to identify and fulfill their cognitive needs and to expand the multimodality design in the teaching aid. The integration of technology can introduce novelty in the learning process to motivate them to study and understand better. However, the review also highlighted the limited number of available studies that evaluate the significance, role, and features of the visual and interface design on interactive multimedia teaching aid for deaf students, thus posing a potential barrier towards the development of an effective multimedia teaching aid. In summary, an in-depth understanding of the significance, role, and features contribution of visual and interface design is necessary so that the teaching aids produced will be beneficial for deaf students.

Acknowledgement

This research would like to acknowledge their research partners, namely the Community of Research (CoRE) UiTM Malaysia, the Institute of Research Management (IRMI) UiTM Malaysia and Public Art Creative Aesthetic Quality (PACAQ/ EK Tier 5) UiTM Cawangan Melaka for supporting this study.

References

[1] SIti Salwa Salleh, "Sistem Pendidikan Khas Bantu Pelajar OKU Kompetitif," *Berita Harian Online*, no. Mac 7, 2020, 2020. [Online]. Available: https://www.bharian.com.my/rencana/komentar/2020/03/662805/sistem-pendidikan-khas-bantu-pelajar-oku-kompetitif

[2] K. P. Malaysia, *Malaysia Education Blueprint 2013 - 2025*, vol. 27. 2013. [Online]. Available: http://linkinghub.elsevier.com/retrieve/pii/S0742051X10001435

[3] Malaysia of Education, "Laporan Jawatankuasa Kabinet Mengkaji Pelaksanaan Dasar Pelajaran 1979 (7hb. November, 1979)," Kuala Lumpur, 1979.

[4] V. T. Mueller, "Total Communication (TC) Approach," in *Encyclopedia of Autism Spectrum Disorders*, F. R. Volkmar, Ed. New York, NY: Springer New York, 2013, pp. 3138–3143. doi: 10.1007/978-1-4419-1698-3_1708.

[5] H. C. Omar, *Penterjemahan dan Bahasa Isyarat*. Itnm, 2009. [Online]. Available: https://books.google.com.my/books?id=V2lcfqpMd6AC

[6] N. Kholis, P. Purwowibowo, and M. A. Ibra, "The Total Communication Learning Model to Support the Effectiveness of Social Interaction for Deaf Children," vol. 409, no. SoRes 2019, pp. 482–484, 2020, doi: 10.2991/assehr.k.200225.104.

[7] M. H. Mohd Hashim and Z. Tasir, "An e-learning environment embedded with sign language videos: research into its usability and the academic performance and learning patterns of deaf students," *Educational Technology Research and Development*, vol. 68, no. 6, pp. 2873–2911, 2020, doi: 10.1007/s11423-020-09802-4.

[8] S. H. Masran, M. F. Marian, F. A. N. Yunus, M. B. Rahim, and J. A. Baser, "Effectiveness of using an interactive media in teaching and learning: A case study," *Proceedings of the 2017 IEEE 9th International Conference on Engineering Education, IEEE ICEED 2017*, vol. 2018-Janua, no. September 2018, pp. 222–227, 2017, doi: 10.1109/ICEED.2017.8251197.

[9] B. B. Seels and R. C. Richey, *Instructional Technology: The Definition and Domains of the Field, 1994 Edition*. Information Age Publishing, 2012. [Online]. Available: https://books.google.com.my/books?id=O_pcLwEACAAJ

[10] M. K. Abadi, H. Pujiastuti, and L. D. Assaat, "Development of Teaching Materials Based Interactive Scientific Approach towards the Concept of Social Arithmetic For Junior High School Student," *Journal of Physics: Conference Series*, vol. 755, no. 1, 2016, doi: 10.1088/1742-6596/755/1/011001.

[11] V. Kourbetis, K. Boukouras, and M. Gelastopoulou, "Multimodal Accessibility for Deaf Students Using Interactive Video, Digital Repository and Hybrid Books," in *Universal Access in Human-Computer Interaction. Users and Context Diversity*, 2016, pp. 93–102.

[12] A. Gouhar and B. C. Mahapatra, "Review Article Interactive Media and Its Impact on Education," *International Journal of Current Research*, vol. 8, no. 12, pp. 43964–43966, 2016.

[13] H. Knoors and M. Marschark, *Evidence-Based Practices in Deaf Education*. Oxford University Press, 2018. [Online]. Available: https://books.google.com.my/books?id=xpRqDwAAQBAJ

[14] M. T. Razali, M. Hanafi, and M. Yasin, "Penggunaan bahan bacaan multimedia dalam meningkatkan kemahiran bacaan dan kefahaman Bahasa Melayu murid berkeperluan khas pendengaran," *Journal of Educational Research & Indegenous Studies*, vol. 1, no. 1, 2020.

[15] N. Zhou and A. Yadav, "Effects of multimedia story reading and questioning on preschoolers' vocabulary learning, story comprehension and reading engagement," *Educational Technology Research and Development*, vol. 65, no. 6, pp. 1523–1545, 2017, doi: 10.1007/s11423-017-9533-2.

[16] A. Alias, N. M. Sharif, N. fariza Baharuddin, M. H. M. Hamzah, and F. Zahari, "Exploring the effects of teaching and learning using visual images among hearing impaired children," *Jurnal Komunikasi*, vol. 32, no. 1, pp. 145–162, 2016, doi: 10.17576/JKMJC-2016-3201-16.

[17] N. H. Seman, M. C. Omar, A. Yusoff, and M. Y. Abdullah, "Analisis Permasalahan Pelajar Cacat Pendengaran Dalam Pembelajaran Mata Pelajaran Pendidikan Islam Di Malaysia," *Jurnal Ilmi Ilmi Journal Jilid*, vol. 6, pp. 105–124, 2016.

[18] M. H. M. Yasin, M. M. Tahar, S. Bari, and F. N. Manaf, "The Sign Language Learning in Deaf Student and Special Education Teacher in Integration Program of Hearing Problem," *Journal of ICSAR*, vol. 1, no. 2, pp. 166–174, 2017, doi: 10.17977/um005v1i22017p166.

[19] C. Q. Pelayo, J. R. G. Pulido, S. F. Flores, and M. Andrade-Aréchiga, "Códice: Assisting vocabulary learning for students with deafness," *ACM International Conference Proceeding Series*, pp. 1–4, 2018, doi: 10.1145/3293578.3293579.
[20] A. Deveci Topal, E. Çoban Budak, and A. Kolburan Geçer, "The effect of algorithm teaching on the problem-solving skills of deaf-hard hearing students," *Program*, vol. 51, no. 4, pp. 354–372, 2017, doi: 10.1108/PROG-05-2017-0038.
[21] A. S. Pratiwi *et al.*, "Digital Video Based Rampak Kendang Learning Media for Deaf Students," *Journal of Physics: Conference Series*, vol. 1179, no. 1, pp. 6–11, 2019, doi: 10.1088/1742-6596/1179/1/012040.
[22] M. H. M. Yasin, M. M. Tahar, S. Bari, and F. N. Manaf, "The Sign Language Learning in Deaf Student and Special Education Teacher in Integration Program of Hearing Problem," *Journal of ICSAR*, vol. 1, no. 2, pp. 166–174, 2017, doi: 10.17977/um005v1i22017p166.
[23] M. Nadhir, A. Nasir, A. Nur, and A. Erman, "Special education for children with disabilities in Malaysia : Progress and obstacles Muhamad Nadhir Abdul Nasir," *Geografia - Malaysian Journal of Society and Space*, vol. 12, no. 10, pp. 78–87, 2017.
[24] N. E. Abuzinadah, A. A. Malibari, and P. Krause, "Towards Empowering Hearing Impaired Students' Skills in Computing and Technology," *International Journal of Advanced Computer Science and Applications*, vol. 8, no. 1, 2017, doi: 10.14569/ijacsa.2017.080116.
[25] N. Vinoth and K. Nirmala, "Deaf Students Higher Education System Using E-Learning," *Journal of Education and Learning (EduLearn)*, vol. 11, no. 1, pp. 41–46, 2017, doi: 10.11591/edulearn.v11i1.5131.
[26] M. D. Abdulrahaman *et al.*, "Multimedia tools in the teaching and learning processes: A systematic review," *Heliyon*, vol. 6, no. 11, p. e05312, 2020, doi: 10.1016/j.heliyon.2020.e05312.
[27] UNDP, "Goal 4: Quality education," *United Nations Development Programme*, 2020. https://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-4-quality-education.html
[28] H. A. Mohamed Shaffril, S. F. Samsuddin, and A. Abu Samah, "The ABC of systematic literature review: the basic methodological guidance for beginners," *Quality and Quantity*, no. 0123456789, 2020, doi: 10.1007/s11135-020-01059-6.
[29] S. (2020). Kraus, S., Breier, M. y Dasí-Rodríguez, "The art of crafting a systematic literature review in entrepreneurship research," *International Entrepreneurship and Management Journal*, vol. 16, pp. 1023–1042, 2020.
[30] Z. Cheng and K. Sabran, "User Interface Design for The Asia Elderly: A Systematic Literature Review," in *e-Proceedings of International Conference on Language, Education, Humanities &Social Sciences (i-LEdHS2021)*, 2021, pp. 589–599.
[31] A. A. Gurov and O. A. Oreshkina, "Development of educational video materials collection as a part of special conditions for hearing impaired students while studying chemistry at technical university," *Journal of Physics: Conference Series*, vol. 1348, no. 1, p. 012066, Dec. 2019, doi: 10.1088/1742-6596/1348/1/012066.
[32] P. Boudreault, A. Wolfson, B. Berman, V. L. Venne, J. S. Sinsheimer, and C. Palmer, "Bilingual Cancer Genetic Education Modules for the Deaf Community: Development and Evaluation of the Online Video Material," *Journal of Genetic Counseling*, vol. 27, no. 2, pp. 457–469, 2018, doi: 10.1007/s10897-017-0188-2.
[33] T. v. Nikolaeva, "Virtual professional practice for teachers of the deaf "diagnosis of development options of young children with impaired hearing," *Annals of Tropical Medicine and Public Health*, vol. 9, no. Special Issue, 2018.
[34] V. Anindhita and D. P. Lestari, "Designing interaction for deaf youths by using user-centered design approach," *4th IGNITE Conference and 2016 International Conference on Advanced Informatics: Concepts, Theory and Application, ICAICTA 2016*, 2016, doi: 10.1109/ICAICTA.2016.7803135.
[35] N. A. Hashim, N. Safie, and M. Mukhtar, "Factors Affecting Teachers' Motivation to Adopt Cloud-based E-learning System in Iraqi Deaf Institutions: A pilot Study," no. July, pp. 9–10, 2019.
[36] S. E. da Costa, C. D. M. Berkenbrock, L. E. Rosa De Freitas, and F. F. S. Sell, "iLibras: Using Assistive and Collaborative Technology to Support the Communication of Deaf People," *Revista*

Iberoamericana de Tecnologias del Aprendizaje, vol. 14, no. 1, pp. 11–21, 2019, doi: 10.1109/RITA.2019.2909849.

[37] M. Marschark, C. Morrison, J. Lukomski, G. Borgna, and C. Convertino, "Are deaf students visual learners?," *Learning and Individual Differences*, vol. 25, pp. 156–162, 2013, doi: 10.1016/j.lindif.2013.02.006.

[38] S. M. Zaid, N. C. Rameli, A. Alias, M. Fahmi, A. Hamid, and N. Nordin, "Virtual Learning Of Deaf Students : We Miss Pupils , We Hate Covid19 Turkish Journal of Computer and Mathematics Education," vol. 12, no. 11, pp. 5197–5201, 2021.

[39] L. S. Riza *et al.*, "A concept and implementation of instructional interactive multimedia for deaf students based on inquiry-based learning model," *Journal of Engineering Science and Technology*, vol. 13, no. 7, pp. 2016–2035, 2018.

[40] A. K. Masitry, M. A. Majid, and T. Herawan, "A Design of Educational Multimedia Software for Disability : A Case Study for Deaf People," *The International Conference on Modeling and Simulation 2012 (MAS 2012)*, pp. 1–8, 2012.

[41] UNDP, "Goal 4: Quality education," *United Nations Development Programme*. p. September, 2020. [Online]. Available: https://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-4-quality-education.html

[42] N. A. Hashim, "Cloud-based E-learning System in Iraqi Deaf Institutions : A pilot Study," no. July, pp. 9–10, 2019.