Breaking Sound Barriers: Cultivating Expressive Language in Children with Hearing Impairment Through a Computer-Based Intervention Program

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Abstract

The aim of this study was to assess the effectiveness of a linguistic educational program in improving expressive language skills among individuals with mild hearing impairment in the UAE. To achieve this goal, the researchers designed a computer-based program that targeted expressive language abilities in children with language disorders. The study recruited 30 children who were randomly assigned to either an experimental group, who received the computer-based program, or a control group, who underwent traditional training methods at centers. After conducting an analysis of covariance (ANCOVA), the data showed that the experimental group exhibited noteworthy enhancements in expressive language skills compared to the control group. Moreover, the statistical analysis unveiled that the academic level (grade) had a significant influence on the results, with the third level demonstrating the most substantial progress. However, gender did not appear to have any impact on the findings. Ultimately, the results were thoroughly reviewed and deliberated, culminating in the formulation of a set of recommendations.

Keywords: Special Education; Hearing Impairment; Expressive Language; Curriculum Development; Computer-based solution

1. Introduction

During the formative years of a child, the early stages of life play a pivotal role in shaping their overall development and capacity to integrate effectively into society, with a particular emphasis on the acquisition of language. Language acquisition during this critical phase significantly impacts various facets of a child's growth, encompassing cognitive, social, emotional, and physical dimensions. The ability to acquire language at an early age facilitates expression, comprehension of others, and the assimilation of knowledge from their environment. Nevertheless, children facing hearing impairments may encounter challenges in their linguistic development, potentially leading to difficulties in communication and academic pursuits. Hearing loss in children can impede their language acquisition process, affecting speech production, comprehension, and overall cognitive advancement. Consequently, this may result in academic disparities, underscoring the importance of early intervention and support for children with hearing impairments (Al-Zureikat, 2009).

Language can be categorized into two main types: non-verbal language and verbal language. Receptive language, falling under non-verbal language, relates to an individual's ability to understand speech without necessarily vocalizing it. On the other hand, expressive language, which encompasses spoken and written language as well as sign language, falls under verbal language and pertains to an individual's capability to convey their thoughts and ideas through communication. Additionally, terms such as speech, communication, and pronunciation are closely associated with the concept of language (Al-Fari, Hamdan, Amaireh, & Anani, 2000; Hafsa & Mahmoud, 2017).

Abdul Fattah and Reda (2016) emphasize the importance of addressing the unique needs of hearing-impaired children to enhance their expressive language abilities. This can be achieved through a variety of strategies, including the use of auditory aids, instruction in listening skills, lip-reading techniques, sensory training, and promoting linguistic interaction. It is crucial to consistently utilize auditory aids and expose the child to diverse audio-visual stimuli. Moreover, focusing on the child's receptive language by engaging in stimulating conversations tailored to their interests and encouraging exploration of their environment through various senses such as touch, taste, and smell is essential. Additionally, maintaining an appropriate distance during communication with the child is emphasized.

Youssef (2015) emphasizes that the progression of expressive language development commences with physical maturation and continues to evolve as the child navigates through various grade levels. This developmental trajectory encompasses the acquisition of verbal sounds, syllables, words, and ultimately, the construction of coherent sentences, as noted by Abu Nabah (2010). Any inadequacy in expressive language skills can profoundly hinder a child's capacity to communicate proficiently, articulate their thoughts, and comprehend the speech of others.

Within the realm of special education, language disorders and speech sound pronunciation constitute integral areas of focus. Over the past two decades, the field of speech and language disorders has witnessed substantial expansion. Al-Zureikat (2005) suggests that language disorders and pronunciation challenges are frequently associated with an underlying disability, with hearing impairment emerging as a predominant factor. Individuals who are deaf or hard of hearing commonly experience challenges in mastering the correct beginnings and

endings of words, particularly concerning their phonological capabilities.

A child facing hearing impairment may encounter challenges such as distraction, difficulty sustaining focus, limited attention span, diminished social adaptability in communication settings, and struggles with recalling spoken phrases (Abdulwahid, 2001). The impact of hearing loss on a child's language development is profound, impairing their ability to perceive spoken words clearly, discern speech sounds, and express themselves verbally. Consequently, consistent and intensive training becomes imperative to enhance the child's comprehension of others and facilitate effective communication, thereby fostering improved social integration. Moreover, if the hearing device malfunctions or becomes defective, it can significantly impede the child's linguistic skills, adversely affecting speech and language development, abstract thinking, social-emotional aptitude, and learning capabilities. Initiating language training at an early stage yields greater benefits, positively influencing the language acquisition process of children with mild hearing impairments, encouraging the utilization of language in a functional, purposeful, and organic manner. It's important to note that individuals with simple hearing disabilities may exhibit differences in verbal and linguistic outcomes compared to those without such impairments.

Computers, as a form of technology, encompass a wide array of functions including inputting, processing, storing, retrieving, and controlling information. Their fundamental operations involve receiving information, processing it, generating output, and making decisions based on the output received. In the realm of education, computers hold immense potential for both typical and special needs students, enabling them to input, store, retrieve, and process information, while also assessing the outcomes of their actions, particularly through specialized educational software. The integration of computer-based education can significantly augment the learning experience. Numerous studies published in esteemed special education journals, such as the Journal of the American Society for Mental Retardation, have delved into the effectiveness of educational computers in delivering tailored lessons to students with special needs and their integration into specialized education programs. These studies primarily concentrate on incorporating computer-based learning into individualized educational plans, delineating educational objectives, and assessing student performance across various skill domains. Moreover, computers can serve as effective tools in facilitating communication for children with language impairments, whether through written or spoken language mediums (Al-Zubaidi, & Shuqlabu, 2002).

Numerous scientific studies have underscored the significant effectiveness of computer-assisted teaching when employed as a supplementary tool alongside traditional teaching methods, rather than as a substitute for them, in both general and special education contexts. Through comprehensive analyses of pertinent literature, researchers have identified several key issues associated with research on computer-assisted education. Suwaidan and Al-Jazar (2007) conducted a thorough investigation and concluded that integrating computers into educational practices has proven beneficial in enhancing academic performance among students with disabilities when compared to conventional teaching methodologies.

Hearing impairment significantly impacts linguistic development, adversely affecting various facets of language acquisition. Before delving into the linguistic characteristics of individuals with hearing disabilities, it is essential to grasp the concept of language. According to Hallahan, Kauffman, & Pullen (2013), language entails the process of conveying, transmitting, and receiving ideas through a system of symbols governed by rules that dictate their meaning.

In a study addressing speech-language challenges among Emirati children (n=152) raised by multilingual caretakers, Almekaini et al. (2017) discovered delayed expressive language development in a considerable number of children, underscoring the critical importance of timely assessment and intervention. These findings underscore the necessity of employing effective language screening strategies for children. Although the study focused on typical toddlers, it sheds light on how expressive language development can be influenced by various factors, including the language spoken by caregivers.

Another study by Worsfold et al. (2010) analyzed expressive language data from children with permanent childhood hearing impairment (PCHI), half of whom underwent universal newborn hearing screening. The analysis encompassed aspects such as syntax, morphology, phonology, and narrative ability, aiming to identify the elements of spoken language in these children most sensitive to early confirmation of hearing impairment. The study aimed to enhance assessments of these children by emphasizing early screening for hearing impairment. Drawing from this research, expressive language data elicited from participants is influenced by hearing impairment and can be improved through early assessment and intervention.

According to Ambrose et al. (2014), there is substantial evidence indicating that early language development in children is greatly influenced by the linguistic input they receive. However, for children with hearing loss (HL), the sensory deficit they experience may impede consistent access to the auditory-linguistic information necessary for oral expressive language development. This challenge is also encountered by hard-of-hearing children (HH). While hearing aids can improve access to auditory signals, they cannot fully normalize auditory experiences or guarantee complete access to auditory-linguistic information for these children. Consequently, language delays may arise from the consistent lack of access to such input.

Mazlan et al. (2010) proposed that, unlike their hearing counterparts, deaf children often encounter delays in language development. The introduction of assistive computer technology (ACT) has provided opportunities for deaf students to enhance their language skills and participate in more interactive virtual learning environments. The researchers assessed the potential and effectiveness of ACT in improving linguistic skills and learning outcomes among deaf students. Dialogic reading interventions, according to Mazlan et al., have significantly boosted language development in deaf students, while technology interventions have proven effective in enhancing language skills among students with hearing impairments. These findings suggest that utilizing computer-based technology to enhance the

expressive language skills of students with mild hearing disabilities can be highly effective.

Similarly, Simpson et al. (2015) conducted a systematic review of research on the use of online or computer-based technologies to aid speech and language development in children with hearing impairments. The researchers reported positive outcomes at the group level regarding the effectiveness of these technologies in enhancing speech and language skills for these children. However, due to limitations in research quality and the scarcity of identified studies, the evidence supporting or refuting the use of these technologies remains limited. To draw more definitive conclusions, further research employing rigorous study designs is necessary regarding the utilization of these technologies in children with hearing impairments.

Considering the existing literature highlighting the need for and effectiveness of using computer-based technology to assist children with mild hearing impairment, there is a compelling need for experimental research on such technology due to the existing gap in providing research-based evidence. Additionally, as technology-based solutions are becoming increasingly prevalent in the hearing aid market, their efficacy should not be left in doubt, underscoring the importance of conducting research. The current study aims to contribute to bridging this gap by furnishing research-driven evidence on the efficacy of one of the computer-based programs in enhancing expressive language skills among children with mild hearing impairments (Sahar, 2015).

The primary objective of this study is to contribute to the existing body of research aimed at enhancing the expressive language skills of students with mild hearing impairments, a demographic often confronted with social, academic, and emotional obstacles due to their condition. The outcomes of this investigation will be leveraged for the development of an educational computer program tailored specifically to augment the expressive language capabilities of these students. More precisely, the present study seeks to evaluate the efficacy of an educational computer program designed for articulation training in bolstering the expressive language proficiencies of a cohort of students grappling with mild hearing impairment. In addition, the study endeavors to address the following research queries:

1. Does a significant difference exist, at a significance level of $\alpha = 0.05$, in the advancement of expressive language between the experimental group (who received the training program) and the control group (who did not receive it)?
2. Is there a statistically significant difference, at a significance level of $\alpha = 0.05$, in the development of expressive language among the experimental group participants based on gender?
3. Does a significant difference exist, at a significance level of $\alpha = 0.05$, in the development of expressive language among the experimental group participants based on their grade level?

2. Method

2.1 Sample

The study enrolled a total of 42 students, both male and female, with mild hearing disabilities, spanning across the first, second, and third grades. Participants were purposefully chosen from Al Ain city in the UAE, with considerations including the availability of sufficient student numbers, consistent follow-up, and the feasibility of ongoing training. These participants were divided into two distinct groups: an experimental cohort and a control cohort, each consisting of 21 students, encompassing both genders, who were medically and educationally diagnosed with mild hearing impairment. Table (1) delineates the specifics of the sample demographics.

Table 1. Distribution of study sample members according to the variable (group, gender, and grade)

Group	Gender	Class			Total
		first	second	third	
Control	Male	4	3	4	11
	Female	3	4	3	10
	Total	7	7	7	21
Experimental	Male	4	4	3	11
	Female	4	3	3	10
	Total	8	7	6	21
Total	Male	8	7	7	22
	Female	7	7	6	20
	Total	15	14	13	42

2.2 Study Instruments

Following an exhaustive examination of pertinent literature, including seminal works by Al-Zubaidi and Shaqlabo (2002), Saeed (2009), Cannon (2010), Fung, Chow, and Chang (2005), Gaad and Qaryouti (2002), and Mortenson (2009), the researcher developed the following assessment tools: A language assessment comprising 65 images was crafted. Participants were instructed to observe each image and convey its meaning using linguistically appropriate vocabulary to demonstrate precise Arabic language phonetic patterns. These words encapsulated a total of 214 phonemes. The grading criterion was predicated on the number of accurate responses provided by the examinee corresponding to adult speech phonemes, divided by the total phonemes (214), and multiplied by 100%. The ensuing formula illustrates this: Student's grade = (number of accurate responses / total number of phonemes) x 100%.

2.2.1 Validity

To validate the test, the researcher utilized the test-retest method with a cohort of 15 children with hearing impairments, distinct from the

study's main sample, administered two weeks apart from the initial test. The validity coefficient was computed employing the Pearson equation, yielding a stability coefficient of 0.71. Additionally, the internal consistency of the test items was assessed using the Codrichardson equation (KR-20), resulting in an overall stability coefficient of 0.76. These stability coefficients are considered adequate for fulfilling the study's objectives.

2.3 Training Program

The researcher developed a computer program to facilitate the training of pronunciation and expressive language skills. This program underwent a meticulous creation process. Initially, an in-depth review of relevant literature pertaining to linguistic development in children aged 4-7 years was conducted, identifying pivotal aspects. Subsequently, field visits were conducted at the center for the Deaf, enabling the researcher to observe language deficits and educational methodologies employed for teaching hearing-impaired students. Finally, utilizing Microsoft PowerPoint, a user-friendly software, the researcher designed the computer program. This choice of software ensures accessibility for any teacher of hearing-impaired students following requisite training on the technology. The program was structured with a group system in mind, fostering simultaneous learning and training in expressive language. It comprises an introductory screen outlining program objectives, followed by a series of lesson titles accessible via mouse cursor clicks.

2.3.1 Program Interaction Level

The software employs a range of multimedia elements, including audio, written text, images, and animations. Its purpose is to facilitate student achievement in the following areas:

1. The ability to read written text (letters, syllables, and words) and comprehend accompanying visual representations.
2. The capacity to listen to written text (letters, syllables, and words) being read aloud by a child's voice, consistent with the lesson's style.
3. Interactive features that allow students to hover over images and hear accompanying sounds.
4. Feedback mechanisms that evaluate student responses to computerized images and tests, while also providing appropriate positive reinforcement.

2.3.2 Program Control Level

The program offers several ways for the student to control their experience, including:

1. Navigation buttons that allow them to exit the program, return to the main menu, go back to the first menu, introduce the program, and move to the previous or next slide.
2. The option to repeat the entire presentation at any point.
3. The ability to replay the audio of the written text (letters, syllables, and words) at any time.

2.3.3 General Program Goal and Implementation

The aim of this educational software is to improve the expressive language skills of children with mild hearing impairments through verbal instruction. The researcher conducted a comprehensive two-hour training session to instruct female teachers on the effective utilization of the computer program. These teachers, responsible for educating students with hearing impairments at the center, then proceeded to implement the program under the direct supervision of the researcher. Additionally, the researcher actively participated in numerous treatment sessions. Furthermore, the researcher provided counseling sessions to the parents of children with mild hearing impairments.

2.3.4 Program Sessions

The researcher employed a computer-based program to develop the expressive language skills of students with slight hearing impairments. This training approach involved the presentation of letters, their corresponding sounds, syllables, and words. The program consisted of 73 sessions that spanned nine weeks. These sessions were grouped into three categories:

1. Preliminary session, which comprised two sessions.
2. Training sessions, consisting of 70 sessions that were further divided into two levels. The first level involved training students in the 4-5 and 5-6 age groups, while the second level focused on training students in the 6-7 age group.
3. Closing session, which was the final session.

2.3.5 Computer Program Arbitration

Prior to its implementation, the efficacy of the computer-based training program for developing expressive language skills was assessed by a group of 13 experts. These experts were drawn from a range of educational institutions, as well as language, hearing, and pronunciation specialists. The program was also reviewed by a specialist from the Office of Audio Research and Studies at one of the public universities in Jordan to ensure the safety of the technology utilized and to determine its suitability for students with slight hearing impairments. The experts provided feedback on any necessary modifications to the program.

The program developers carefully considered the feedback provided by the experts and incorporated their recommendations into the final

version of the program before its implementation. Specifically, the suggested modifications that were agreed upon by at least 80% of the experts were incorporated. Notably, the experts recommended the removal of the training sessions focused on writing letters, as well as changes to the pictures and words used in the program to better reflect nouns and verbs. For instance, the experts suggested replacing the image of a person performing the act of prostration with a different image to represent the verb. The experts also recommended changing the order in which letters were taught, adding more slides on the sounds of short and long vowels, and modifying the sub-goals of the program. Additionally, the experts recommended changes to the words that indicate the plural form.

The judges also recommended that an engaging and visually appealing background be used consistently across all slides. The developers took their feedback into account and made the necessary changes to the program's background. The sound specialists recommended that the speaker's voice remain consistent throughout the program, while also suggesting changes in tone to maintain the user's attention and prevent boredom. They also suggested adjusting the sound frequencies to eliminate any echo. With these recommendations in mind, the program was finalized and prepared for implementation.

2.4 Study Design and Statistical Processing

This study employed a quasi-experimental approach, employing purposive sampling to select participants. The students were then divided into two groups: the experimental group, comprising 15 students, and the control group, comprising 15 students selected randomly. To address the research questions, the researcher utilized a non-equivalent control group pre-test and post-test design, supplemented by a one-way analysis of variance (ANCOVA) test to discern any disparities in expressive language test scores between the experimental and control groups. Furthermore, within the experimental group, a two-way ANOVA and t-test were conducted to identify any internal differences. Figure (1) visually illustrates these methodologies.

Experimental Group	O2	X	O1
Control Group	O2	-	O1

Figure 1. Study design, control group and experimental group

3. Results

The first research question examined whether there were significant differences in expressive language development between the experimental group who received the training program and the control group who did not. To address this query, the researcher computed the mean and standard deviation of participants' performance on both pre and post expressive language development assessments. Furthermore, adjusted mean scores on the post-test were calculated for the entire sample and for each group individually. The outcomes are detailed in Table (8).

Table 2. Mean and standard deviation of the study sample's performance on both pre and post expressive language development tests

Group	Pre-test		Post-test		Average	
	Mean*	SD	Mean*	SD	Mean*	Error
Control	5*2.27*	2.*29*	61.69	3.74	6*1.14*	1.70
Experimental	53.97	2.87	74.34	9.92	7*2.98*	1.70

*maximum grade (100)

Table (2) presents the mean and standard deviation of the study sample's overall performance on both pre and post expressive language development tests, and the adjusted mean scores on the post-test for the control and experimental groups. Based on the observed differences in the mean scores of the post-test between the groups, a one-way analysis of variance (ANCOVA) was performed on the post-test scores while controlling for the pre-test scores to establish the significance of these differences. Table (9) displays the findings of this analysis.

Table 3. Results of the analysis of variance conducted on the arithmetic means of the study sample's performance on the post-expressive language development test as a whole, categorized by the group variable (control and experimental), after adjusting for the effect of the pre-test scores

Source of variance	**Sum. Sq.**	**Df**	**Mean. Sq.**	**f**	**p**
pretest	471.563	1	471.563	11.518	0.002
group	914.478	1	914.478	**23.328**	***0.000**
error	1101.128	27	40.857		
total	2578.269	29			

*statically significant at the level (a=0.05)

Table (3) indicates a significant statistical disparity between the average scores of the control and experimental groups on the post-expressive language development test with a significance level of 0.05. The students who received the educational computer program (experimental group) achieved a higher modified mean score of 72.98, whereas the control group obtained a lower modified mean score of 61.14. The calculated P-value was statistically significant (0.000).

The study's second objective was to investigate if there were any significant gender-based differences in the development of expressive language among the experimental group participants, with a significance level of 0.05. To achieve this objective, the mean scores and standard deviations of the experimental group on the pre and post expressive language development test were computed. Furthermore, the adjusted mean scores for their post-test performance were calculated based on their gender (male and female). Table (10) presents the

outcomes of these computations.

Table 4. Mean and standard deviation of the overall performance of the experimental group on both the pre and post expressive language development tests. It also shows the adjusted mean scores on the post-test based on gender (male and female)

gender	pretest		posttest		average	
	Mean*	SD	Mean*	SD	Mean*	SD
Male	54.35	1.72	74.74	10.35	72.89	1.86
Female	53.98	3.70	73.93	10.02	75.78	1.99

*Maximum score (100)

Table (4) provides the mean and standard deviation of the post-expressive language development test scores for the experimental group, stratified by gender (male and female). It also encompasses the adjusted mean scores of participants on both pre and post-tests, categorized by gender. To examine the significance of the observed disparities in post-test scores attributed to gender, a one-way analysis of variance (ANCOVA) was conducted on the post-expressive language development test scores while controlling for pre-test scores. Table (11) presents the results of this analysis.

Table 5. Results of an analysis of variance performed on the arithmetic means of the post-expressive language development test for the experimental group, according to gender (male and female), after controlling for the effect of the pre-test

Source of variance	Sum. Sq.	Df	Mean. Sq.	f	p
pretest	1039.409	1	1039.409	37.679	0.000
gender	30.498	1	30.498	1.070	0.316
error	330.496	12	29.136		
total	1414.671	14			

Table (5) reveals that there is no significant difference in the overall performance of male and female experimental group members on the post-expressive language development test, with a significance level of 0.05. The adjusted mean score for males was 72.89, while the adjusted mean score for females was 75.78. The resulting P-value (1.070) was not statistically significant (0.316).

The study's third research question aimed to explore if there were any significant differences in the development of expressive language among experimental group participants based on their grade level. To answer this question, the mean and standard deviation of the experimental group's performance on the pre and post-tests were computed. Furthermore, the adjusted mean scores of the participants on the post-test, as a whole and according to their grade level, were calculated. Table (12) presents these outcomes.

Table 6. The arithmetic means and standard deviations of the experimental group members' performance on both the pre and post expressive language development tests as a whole. It also presents the adjusted arithmetic means of their scores on the posttest as a whole and according to the grade variable

Grade	pretest		posttest		average	
	Mean*	SD	Mean*	SD	Mean*	SD
3-4	51.36	2.14	62.49	2.24	63.53	1.26
4-5	54.61	0.52	69.53	1.65	77.49	0.87
5-6	57.10	0.81	78.75	1.11	86.43	1.53

Maximum score (100)

Table (6) delineates noticeable discrepancies in the mean scores of the experimental group's post-expressive language development test, attributable to the grade variable. To gauge the statistical significance of these differences, a one-way analysis of variance (ANCOVA) was performed on the post-test scores of the experimental group, controlling for pre-test scores. The findings of this analysis are depicted in Table (7).

Table 7. Findings of the variance analysis conducted on the arithmetic means of the experimental group's performance in the expressive language development test after the intervention. The table presents the outcomes both collectively and categorized by the students' grade level

Source of variance	Sum. Sq.	Df	Mean. Sq.	f	p
pretest	0.003	1	0.003	0.001	0.981
Grade	316.872	2	157.981	44.318	*0.000
error	38.231	11	3.565		
total	1377.500	14			

*statically significant at the level (a=0.05)

As indicated in Table (7), the adjusted mean scores of the experimental group on the post-expressive language development test exhibit significant variation depending on the grade variable, with a statistically significant value of P=0.000 at a significance level of $\alpha = 0.05$. To delve deeper into the nature of these differences, Scheffe's test was employed for post-hoc comparisons, the results of which are detailed in Table (8).

Table 8. The results of the Scheffe's test, which was conducted to investigate the significance of the differences observed in the adjusted arithmetic means of the experimental group's performance on the post expressive language development test as a whole, based on the grade variable

Grade				
3-4	4-5	5-6		
86.43	77.49	63.53	Mean	Grade
*22.87	*12.98		63.53	3-4
*9.01			77.49	4-5
			86.43	5-6

*statically significant at the level (a=0.05)

Table (8) indicates that there are significant differences, with a level of significance of $\alpha \leq 0.05$, in the performance of the experimental group across different grade levels on the post-expressive language development test. Notably, there is a significant advantage for the group aged (5-6 years) over those aged (3-4 years) and (4-5 years). Additionally, there is a significant difference between the group aged (3-4 years) and the group aged (4-5 years), with the latter group performing better.

4. Discussion

To address the first research question, examining whether significant differences (at the $\alpha = 0.05$ level) exist in the development of expressive language between the control group (without the training program) and the experimental group (with the program), the study revealed noteworthy improvements in the experimental group compared to the control group. This advancement can be attributed to the computer-based training program utilized in the study, offering a distinctive and engaging learning experience for the students. The program incorporated various stimuli, such as interactive pictures, dynamic letter movements on the screen, and intuitive menu and slide navigation, effectively capturing the students' attention and fostering motivation to learn. Consequently, participants in the experimental group demonstrated notable enhancements in their expressive language abilities.

The current study aligns with prior research examining the efficacy of computer programs in educating deaf and hard of hearing students. Al-Mallay's (2002) investigation focused on utilizing a computer program to instruct deaf children, while this study aimed to enhance the development of expressive language skills in English. Despite this difference, both studies demonstrated the effectiveness of computer programs in teaching hearing-impaired children. Similarly, our study resonates with Gaad and Qaryouti's (2002) research, which utilized PowerPoint to educate deaf and hard of hearing students, albeit with a distinction: our focus lay on improving classroom performance through computer training programs. Nonetheless, both studies underscored the efficacy of computer programs in educating students with hearing disabilities. Furthermore, our findings are consistent with those of Yang et al. (2007), who employed computer-assisted language training programs to educate hearing-impaired students. While Yang's study concentrated on developing speaking skills and sound articulation, our study aimed to enhance expressive language development. Nevertheless, both investigations agreed on the efficacy of computer programs in bolstering expressive language skills and sound pronunciation among hearing-impaired students.

The current study aligns with prior research conducted by Oramas, Moreno, and Chiluiza (2006), which sought to explore the efficacy of technology in improving comprehension of sign language and expressive language usage among deaf individuals. Our findings corroborate the effectiveness of technology-based programs in facilitating expressive language development in individuals with hearing impairments. Similarly, Carey's (2006) study, which investigated the impact of computer software on promoting expressive language skills among school students with mild hearing impairments, yielded positive results, highlighting the efficacy of computer programs in enhancing participants' expressive language abilities.

Furthermore, our study supports the conclusions drawn by Al-Qudah (2013), who examined the effects of a computer-assisted training program on verbal and linguistic learning among hearing-impaired students. The results indicated that the computer program contributed to the enhancement of language skills, including expressive and communicative language, in hearing-impaired students. Additionally, the findings of Malkawi's (2011) investigation into the effectiveness of a computerized educational program in improving language skills and expressive language abilities among children with hearing difficulties align with our study. Malkawi's study reported favorable outcomes, indicating that the program effectively improved the expressive performance of students with hearing disabilities.

Next, we turn to the results pertaining to the second research question: "Are there any significant gender-based differences ($\alpha = 0.05$) in the development of expressive language among members of the experimental group?" The results revealed no statistically significant disparities between males and females in terms of expressive language development following the implementation of the computer-based teaching method. This indicates a lack of variation in test scores based on gender when it comes to acquiring expressive language skills through the computer program. Such findings may stem from the participants' shared enthusiasm for learning expressive language, potentially influenced by the uniform training environment provided to both genders. Additionally, the engaging nature of the computer program used for training could have contributed to the participants' inclination towards learning expressive language.

Moreover, the study observed that the congruence in linguistic development patterns among individuals with mild hearing disabilities within the sample does not lead to gender-based differences. Individuals with mild hearing disabilities encounter common challenges such as difficulty perceiving low or distant sounds, comprehending diverse speech topics, and building an expressive vocabulary. These challenges, being non-gender-specific, affect both males and females similarly.

Hallahan, Kauffman, and Pullen (2013) contend that hearing impairment poses a significant obstacle to linguistic development and accurate speech pronunciation. Consequently, individuals of all genders with hearing impairments encounter delays in both language acquisition and speech development, with the severity of the delay correlating with the extent of the hearing impairment. The presence of hearing disability during the babbling stage results in inadequate auditory input for the child, leading to diminished babbling and insufficient auditory stimulation or verbal interaction from caregivers. This deficiency may stem from the hearing impairment itself or from caregivers' hesitance to provide auditory stimulation due to negative expectations, or possibly a combination of both factors. The absence of suitable linguistic models for imitation further hampers the child's linguistic progress.

The outcomes of the present study are consistent with Al-Mallay's (2002) findings, which similarly revealed no gender-based discrepancies in reading development among individuals with hearing impairment. Likewise, our study found no significant differences between males and females in terms of expressive language development. This finding is also congruent with Al-Shaheen's (2007) research, which uncovered no gender-based variations in the enhancement of reading skills among hearing-impaired students. In contrast, Malkawi's (2006) study indicated statistically significant differences between males and females in improving Arabic verbal sounds among children with moderate hearing impairment, with females exhibiting greater progress. However, it's worth noting that our study focused on individuals with mild hearing disability and their expressive language development, diverging from Malkawi's research, which concentrated on speech sounds among individuals with moderate hearing impairment. The researcher posits that females may demonstrate superior verbal abilities during the kindergarten stage (ages 4-6). Furthermore, our study aligns with Al-Shaheen's (2007) findings, reinforcing the notion of no gender differences in reading skill enhancement among hearing-impaired students and underscoring the efficacy of personalized learning programs in bolstering these skills.

In addressing the third inquiry, which delves into potential variations in expressive language development among members of the experimental group based on their grade level, the results unveiled statistically significant effects of class at a significance level of $\alpha = 0.05$. Notably, the experimental group comprising 6-7-year-olds demonstrated superior performance in expressive language development compared to their counterparts. Furthermore, a discernible performance gap emerged within the experimental group across different classes (4-5 years) and (5-6 years), with the latter exhibiting more robust expressive language development.

The researcher hypothesizes that these disparities in expressive language development among distinct age groups could stem from several factors. Firstly, students in the (6-7)-year-old category have benefitted from several years of schooling for the deaf, including instruction on reading. Upon examination of student records, it was revealed that these students had enrolled in the school three years prior, with their proficiency in utilizing educational computer programs enhancing their motivation to learn and refine expressive language skills. Additionally, it was noted that less than a year ago, these students lacked sufficient training in pronouncing Arabic letters, particularly those with short and long durations. Based on these findings, the researcher inferred that these factors may contribute to the observed differences in expressive language proficiency across the three classes scrutinized in the present study.

Both the current study and Al-Shaheen's (2007) research findings align in affirming the significant improvement in reading skills among hearing-impaired students through educational programs. However, a notable distinction arises in the current study's identification of age-dependent variations in the development of expressive language among students with mild hearing disabilities. The researcher attributes this discrepancy to the age range of the study participants, spanning 4-7 years, compared to Al-Shaheen's focus on students aged 10-12 years.

In contrast to Richter et al.'s (2002) findings, the current study diverges by suggesting that the quality of expressive language in children with hearing disabilities is influenced not only by the age at which the disability occurs but also by the effectiveness of related treatment programs. Moreover, the study underscores that the expressive language level in hearing-impaired children tends to surpass that of other students at an earlier stage. However, the current study elucidates that age significantly impacts the development of expressive language among students with mild hearing impairment, leading to variations in their language skills.

5. Conclusion

The results of the present study reveal the effectiveness of a computer-based training program in enhancing expressive language skills among children with mild hearing impairments. The interactive and engaging nature of the program significantly contributed to the language development of the experimental group, highlighting its efficacy as an educational tool. Although gender did not appear to influence improvement, age-related differences were evident, with children aged 6-7 exhibiting greater language proficiency, likely due to early tailored educational interventions. These findings underscore the critical importance of early intervention and emphasize the potential benefits of technology-driven educational approaches. The implications of the study are significant for parents, educators, hearing aid manufacturers, and researchers, emphasizing the necessity of timely and engaging interventions to improve expressive language abilities in hearing-impaired children. The findings suggest that technology-driven solutions should be integrated into intervention plans, necessitating that parents, therapists, and educators not only possess literacy in such technologies but also receive adequate training to effectively utilize them for the benefit of children with hearing impairments. It is incumbent upon experts and support centers to promote these tools and provide training to those interacting with hearing-impaired children. Future research should delve into specific components of computer-based programs to refine interventions for optimal outcomes and ensure comprehensive support for language development in children with mild hearing impairments.

6. Limitations

The current article discussing ways to improve expressive language skills among individuals with mild hearing impairment in the UAE brings attention to some key strengths, such as its dedicated focus on an important educational issue and the use of a computer-based program tailored for this purpose. However, it also has notable limitations worth considering. Firstly, the study's small sample size of 30 children might limit how broadly we can apply its findings to the larger population of individuals with mild hearing impairment in the UAE. Moreover, its narrow focus on a specific group and context could make it difficult to generalize the results to other cultural settings. Furthermore, the study didn't account for potentially influential factors like socioeconomic status or the participants' history of language intervention, which could have affected the outcomes. To improve the reliability of its findings, the study could address these limitations by providing more detailed methodological descriptions and considering these confounding variables in its analysis.

5. Future Implications

The findings of this study have important implications for how we approach education for individuals with mild hearing impairment in the future. Firstly, they suggest that computer-based programs could be highly effective in helping these children improve their expressive language skills. Further research could delve into how well these programs continue to work over time, how long and how intensely they should be used, and which types of computer-based interventions are most effective. Secondly, the study emphasizes the need to tailor educational interventions to each child's specific needs and stage of development. For instance, the study showed that the effectiveness of interventions varied depending on the child's academic level. This highlights the importance of personalized approaches that take into account factors like age, academic level, and language abilities. Additionally, the success of the computer-based program underscores the benefits of integrating technology into educational interventions for individuals with hearing impairment. This suggests that policymakers and educators should consider investing in technology-enhanced learning tools to support language development and academic success in this population. As technology continues to play a larger role in education, it's crucial for educators working with students with hearing impairment to receive ongoing professional development and training. They may need specialized training to effectively implement computer-based programs and meet the diverse learning needs of their students. By addressing these future implications, we can work towards improving educational outcomes and fostering the inclusion and success of individuals with hearing impairment in educational settings.

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