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RESEARCH ARTICLE

Designing and validation of an educational software to improve writing skills of hearing-impaired students in primary schools

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Abstract

Background and Aim: Hearing impairment affects educational skills of hearing-impaired students, but its negative impact is far more on reading and writing skills. This study was performed to design and validate an educational software to improve writing skills.

Methods: In this study, the mixed-methods approach was used. In the first step, the qualitative method was used to design the educational software, which was based on the main themes of the conceptual model of the writing skill curriculum provided by Sharifi et al. (2016). Afterwards, quantitative method was used to validate the software. In so doing, we enrolled 31 teachers working in hearing-impaired special primary schools.

Results: The results indicated that more than 50% of the participants approved the software in terms of objectives, content determination, appropriateness of time of teaching the content, appropriateness of the selected places related to the learning subject, diversity of techniques with regard to individual differences, variety of techniques to control organizational shortcomings, as well as appropriateness of the educational software for improving language skills, social relationships, as well as educational achievement in all the curricular areas**.**

Conclusion: Designing an educational software capable of considering all the influential aspects and components for writing skill improvement can improve writing skill of hearing-impaired students.

Keywords: Educational software; hearing-impaired; writing skills; validation

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Introduction

Hearing is the basis of educational skills. When it comes to education, listening difficulties can greatly influence students. Hearing impairment, depending on its degree, has a significant impact on language development of hearing-impaired children, who as their peers, inherently have the ability to learn language rules and grammar [1].

Hearing impairment affects educational skills of these students, but its negative impacts are far more on language skills such as reading and writing [2]. Writing creates the obtained experiences of listening, speaking, and reading integrated. One who writes should be able to express their thoughts using words and sentences [3]. They have numerous problems in written language production [4]. Since one of the ways of communication, especially in today's world, is the use of written language, investigating the use of syntactic structures in the written

language of hearing-impaired students with serious language impairment has a remarkable significance [5]. In addition to vocabulary limitations, they have difficulty in organizing words in a sentence. One of the communication problems that they encounter is the selection and organization of words in a sentence. The level of this problem is to the extent that in many cases students' verbal message is incomprehensible for the audience and full of ambiguities [6]. Writing weakness of hearing-impaired children is evident even in adulthood, such that the complexity of their writing in comparison with their normal hearing peers is very poor [7].

Borg et al. showed that all children with hearing impairment have delay in all aspects of phoneme recognition, matching, rhyming, grammar test, and word expression. Additionally, they found a direct relationship between the degree of hearing loss and delay in these aspects [8].

Sharifi et al. conducted semi-structured interviews in an exploratory study with an approach based on grounded theory; they included 39 experienced participants working in the field of hearing impairment in special schools. During their study, the main and sub-categories of the writing skill curriculum and their relationships were attained through open, axial, and selective coding. To generalize the findings of the qualitative phase and validate the extracted model, a questionnaire was designed which was answered by 231 teachers of the hearing-impaired special schools. The results approved their conceptual model of the writing skill curriculum in the primary schools of educational system in Iran [3].

Due to the writing weaknesses of hearing-impaired students in the aforementioned studies, this study aimed to design and validate an educational software to improve their writing skills in the primary schools of educational system in Iran. This is the first attempt to develop a software to improve writing skill among these children.

Methods

In this study, the mixed-methods approach was used. In the first step, the qualitative method was used for designing the software, which was designed using the main themes extracted from the conceptual model of the writing skills curriculum of Sharifi et al. [3], the validity of which was approved. Their study indicated 8 main themes and 18 sub-themes (Fig. 1).

The titles of the steps of this educational software (totally 35 steps) were the same as grammar section headlines of the first to sixth grade Persian books used in primary schools of the educational system in Iran. Hearing-impaired students are different in terms of rehabilitation and psychological services [3], which influences their learning level. Thus, teachers' actions, such as the way they adjust their activities based on individual differences of the students, methods they adopt with an eye on specific content, the way they assess or evaluate students, as well as type of interaction they have with students, are crucial in this process. Therefore, a diversity of techniques was included in this software for teachers. With this intention in mind, software design philosophy replaced the course book to enable teachers both overcome lots of restrictions with the help of the software and pay more attention to individual differences of the students.

Hearing impairment affects language skills (listening, speaking, reading, and writing) of a person with hearing loss [9]. Improving all the four language skills, as well as visual skill were considered in this software to overcome students' individual differences and provide a learning context for all students, so that if a student with a profound hearing loss is not able to hear, his/her other language skills will be strengthened in the teaching process.

Fig. 2 shows the cycle of the relationship between language skills and visual skill. In one form of training, the student, in a chain, sees an image and hears the name or description of the image, in another chain, s/he looks at the image and tells the name or explains the description. In the third chain, the child sees the image and reads its written form, and finally, in the fourth chain, the hearing-impaired student looks at the image and writes the name or its explanation, and if the child is unable to write it correctly,

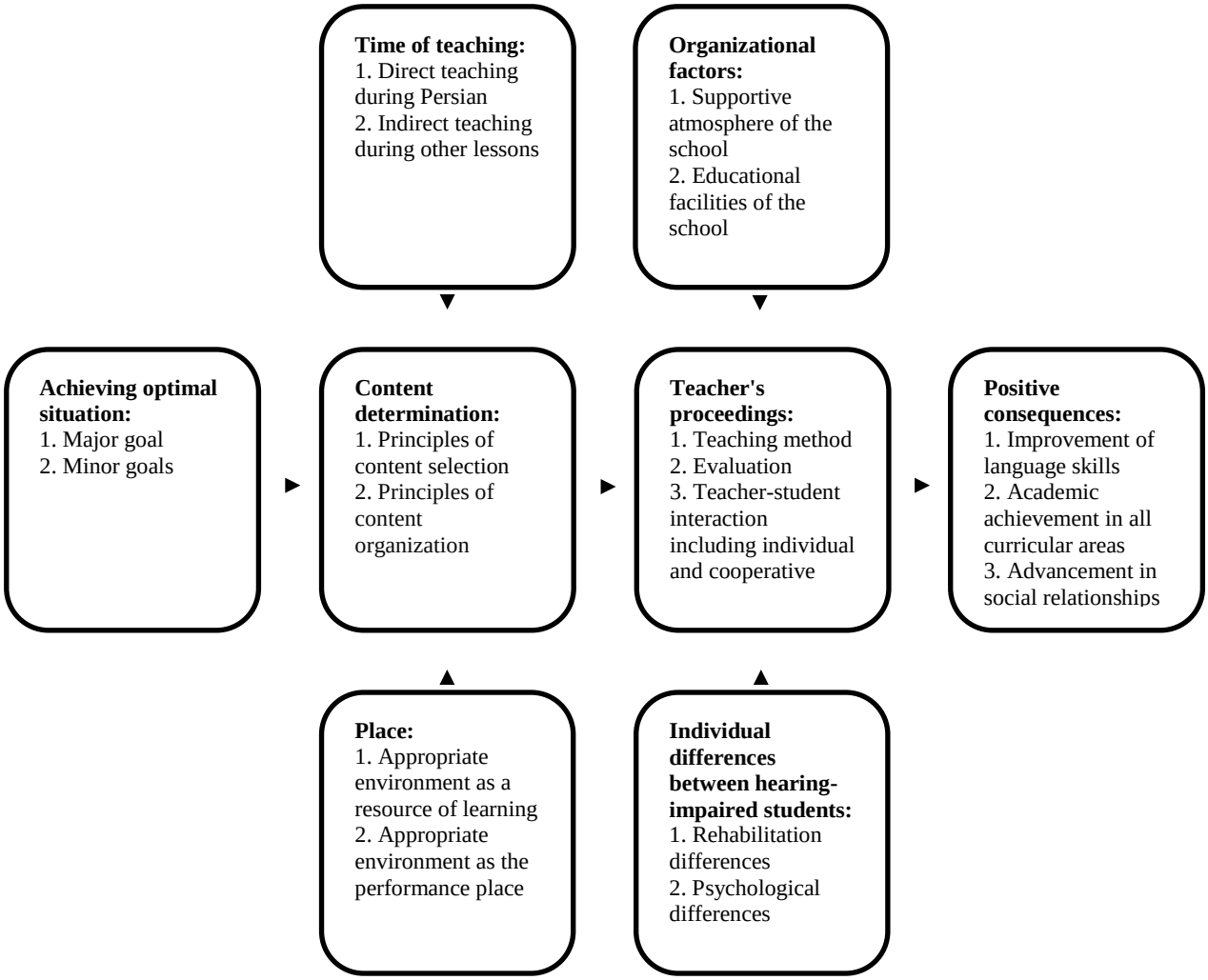

Fig. 1. Conceptual model of writing skill curriculum for hearing impaired students in primary schools [3].

this cycle will be repeated again. In another form of training, chains are linked to each other and do not operate separately. The student looks at an image, hears, tells, reads, and writes. The software is designed in such a way that training can vary according to the teachers' opinion and recognition. For example, the student can only hear or read its written form without looking at the image, or s/he can hear and write without seeing the image.

The scoring method was considered in a way that the student can immediately receive the feedback for any correct answer; despite the psychological differences, learning enthusiasm is provided for the student through promoting motivation and curiosity, actually, the student cannot go to another step unless s/he reaches mastery level in each written step. Families should help students to repeat and practice these learning materials at home, and the interaction between teacher and student and other staff, including rehabilitation staff, is emphasized. Learning to write some content or materials such as Persian grammar takes longer for the learner and no one can consider a set time for teaching different materials. In this software, some steps are divided into several parts to assign an appropriate time for students to learn.

Since the lack of organizational factors such as lack of supportive atmosphere and limited educational resources and facilities in schools are the restricting factors for the writing skill

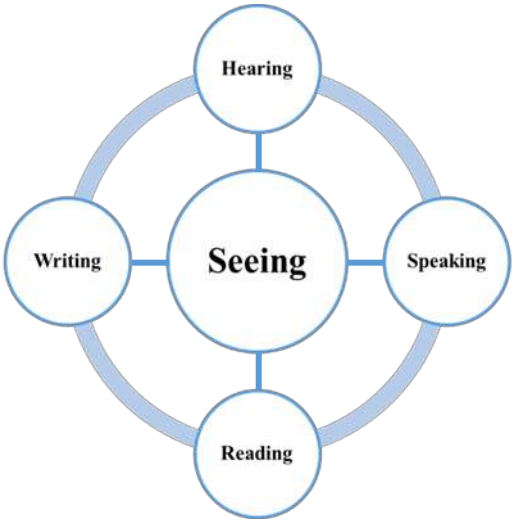

Fig. 2. The cycle of language skills and seeing skill

curriculum [3], to rule out these factors, the features and places relevant to the learning subject are displayed in a variety of images. Therefore, if the scientific camps and training facilities are not available due to organizational shortcomings, students, however, will be able to better link natural concepts to the images included in the software, which can facilitate deep learning. Thereafter, the quantitative method was performed. To validate the content of the software, 31 teachers participated in the survey, eight of whom were among the winners of the festival of superior teaching models. Furthermore, 13 of the participants were those who contributed to the semi-structured interview section to identify influential dimensions of the curriculum model of writing skill in the study conducted by Sharifi et al. [3], and 10 teachers were randomly selected from 10 available special schools of cities in Tehran Province, Iran. Table 1 presents the characteristics of the selected teachers in the survey of the educational software. First, all the chosen teachers were informed of the general purpose of the software, and if they wanted to examine the educational software and answer the questions, they could receive the software package and the eight related questions. All the teachers expressed their willingness to cooperate and the researcher presented the educational software and the questions to all the selected teachers.

Each of the 31 evaluators examined the software based on an 8-item questionnaire rated using a 5-point Likert scale: strongly disagree (0), disagree (1), no idea (2), agree (3), and strongly agree (4). After the evaluation, the evaluators made recommendations about content of the package in terms of sound and colour of the images, which were applied in the final edition of the software.

Data analysis was performed using nonparametric test of binomial. Binomial test is used for a binary variable. This test was used to analyze the agreement or disagreement of teachers regarding the content of the educational software. Data analysis was conducted using SPSS 21.

Results

The degree to which the evaluators agreed on the characteristics of the educational software steps was examined through nonparametric test of binomial. Its results indicated that 87% of the evaluators agreed on the compatibility between

Table 1. Characteristics of the evaluators in the survey of educational software

	Gender		Work experience		Education degree		
Selected teachers	**Female**	**Male**	**Years≥20**	**Years<20**	**BA**	**MA**	**Ph. D.**
The winners of the festival of superior teaching models in the country	7	1	6	2	2	4	2
Teachers participating in the qualitative research conducted by Sharifi et al. (2016)	11	2	9	4	2	10	1
Randomly selected	6	4	6	4	6	4	-

BA; Bachelor of Art; MA; Master of Art; Ph. D.; Philosophy Doctorate

Table 2. Degree to which the evaluators agreed upon the characteristics of the educational software

Items of evaluation	Number	Agreement coefficient	p
Compatibility between content determination and objectives	27	0.87	<0.001
Diversity of techniques with regard to individual differences	28	0.90	<0.001
Compatibility between content determination and time of teaching	26	0.84	<0.001
Appropriateness of the selected places related to content determination	23	0.74	0.011
Diversity of techniques in controlling the organizational shortcomings	22	0.71	0.029
Appropriateness of the educational software in improvement of language skills	26	0.84	<0.001
Appropriateness of the educational software in advancement of social relationships	25	0.81	=0.001
Appropriateness of the educational software in advancement in all curricular areas	26	0.84	<0.001

content and objectives. Furthermore, 90% of them agreed on diversity of techniques appropriate for individual differences, 84% on the compatibility between content and time of teaching, 74% upon appropriateness of the selected places for the content, 71% on diversity of techniques in overcoming the organizational shortcomings, 84% upon appropriateness of the educational software for improving language skills, 81% upon appropriateness of the educational software in promoting social relationships, and 84% upon appropriateness of the software in advancement in all the curricular areas. Agreement coefficient and significance level show that the software developed for the writing skill curriculum and its consequences have content validity ($p<0.05$; Table 2).

Discussion

The main and sub-themes of the conceptual model of the writing skill curriculum of hearing-impaired students were extracted from a study conducted by Sharifi et al. [3]. Results of that study were based on the content analysis of the interviews with the staff working in special schools such as rehabilitation personnel (i.e. speech therapists and audiologists), psychologists of special children, educational supervisors, and teachers. People who are involved in the process of teaching can better identify the needs of hearing-impaired students [9]. This educational software was inspired by the study of Sharifi et al. that was designed with a holistic view in terms of rehabilitation, educational, and psychological factors. This software is in line with the needs of hearing-impaired students, and it provides a context for the development of their writing skill [3].

The choice of a teaching method is one of the influencing factors in hearing-impaired students' curriculum, and that a single approach cannot be applied for all students, but each student's needs and abilities should be considered separately [10]. Marschark et al. proposed some useful factors, such as equal access to educational opportunities, motivation, and diverse methods in teaching and learning, as well as effective communication, in overcoming weaknesses of hearing-impaired students [9].

Simultaneously with the reinforcement of language skills, our software motivates students to hear, expand their vocabulary to speak, become familiar with accurate reading, and learn the position of words, conjunctions, and other grammatical rules. Furthermore, to be allowed to move to the next step, it encourages the students become more careful while writing with regards to grammatical rules. If a student, unlike the others, is unable to achieve the specified objectives at the particular time, s/he receives more time to achieve mastery in learning. The underlying assumption of this learning method is that

if the right conditions of training and sufficient time are taken into account, almost all learners can achieve educational objectives of a course or lesson [11].

This software emphasizes on learning for all students. As Hallahan and Kauffman point out, hearing-impaired students are not inherently unable to reach higher levels, but they need more training to be able to compensate for their hearing impairment [12].

This software can provide an opportunity for deep learning by presenting a variety of images related to the subject, so that the subject will not be forgotten. Fung et al. indicated that visual strategies are effective in learning among hearing-impaired students. Within the educational framework, the implementation of this strategy should be considered [13]. Berge and Thomassen suggested that the type of teaching method is very important and that students better learn by providing visual input [14].

When students are asked to describe the explanations related to the image, more expressive interaction will be provided between teacher and student. On the other hand, students can better use their vocabulary by seeing the image. Teachers who encourage students to have more dialogue and interaction, in fact, let them think more; as a result, these students will become more proficient writers [15,16].

The software will have positive consequences as it can create a platform to strengthen language skills, and it promotes verbal interaction between teacher and student. Students who interact more with their teachers better learn to speak and act with more confidence in social relations [3]. Students who are more successful in written tests, achieve higher grades easier, while those with poor writing skills show little progress in higher grades [4].

All the teachers evaluating the inner content of the software agreed on the package as a tool for teaching writing skills. However, the statistical results showed that in controlling organizational factors and selecting the places related to the learning subject, the coefficient is lower than other items, which confirms the fact that training a hearing-impaired student requires teamwork [2]. With the absence of collaboration between administrators, rehabilitation personnel, and teachers, proper educational facilities, as well as proper conditions for students to visit real places related to the learning subject, novel strategies should be employed in educational process. Nevertheless, these strategies cannot completely eliminate the negative impact of these shortcomings.

Conclusion

Given the evident weaknesses of hearing-impaired students in language skills, especially in writing skill, it is mandatory to emphasize on the need to improve writing skill, which is an essential language skill. Moreover, designing an educational software capable of taking into account all the influential aspects and components in developing writing skills can facilitate hearing-impaired students' writing progress.

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