V International Forum on Teacher Education

Research-Based Teaching of Hearing-Impaired Students

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Abstract

The main objectives of this paper are to present the primary results of our study conducted at M.T. Kalashnikov Izhevsk State Technical University and aimed at identifying special features of information perception by hearing-impaired students. The paper also presents the analysis of the experiment results and general recommendations concerning teaching deaf and hearing impaired students. The results of this study make a definite contribution to the theory of teaching students with hearing impairments. The recommendations presented can be taken into account when developing curricula and syllabus for future educators and trainee teachers in order to develop their competency to work in an inclusive education system. The experimental work was aimed at analyzing the differences in levels of cognitive construal while processing information (perception, attention, memory, etc.) based on using digital versus non-digital platforms (paper and interactive whiteboard, etc.). The main preliminary result of the experiments at the moment is the confirmation of significant difference in some cognitive construal indicators of deaf and hearing impaired students regarding memory and information processing skills in reading, as well as in prevailing mental models. The recommendations formulated on the basis of the study results are considered in Pedagogical Communications course at M.T. Kalashnikov ISTU included in Vocational Education curriculum, and we believe it will contribute to developing students' competency to work with hearing-impaired students in the system of inclusive education.

Keywords: educational research; project management; organizational and pedagogical conditions; inclusive education.

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Introduction

According to the Concept of the long-term social and economic development of the Russian Federation for the period up to 2020, today expanding inclusive education at universities is an urgent task for the Russian educational system. Accessibility of education for people with hearing impairment and their further involvement in the labor activity contributes to positive changes not only in economic but also in the social development of the modern Russian society. The use of the intellectual and labor potential of people with hearing disabilities ensures a shift in perception and attitude towards them in society, affirming its democratic and humanistic values.

The idea of providing quality education for all students, regardless of their individual development, is the conceptual basis of modern educational policy. However, the implementation of inclusive education in Russian universities requires the creation of appropriate learning environments and the use of research-based pedagogical approaches which ensure effective educational process, taking into account students' special educational needs (Serebryakova & Shishkina, 2016). The research being held at M.T.Kalashnikov Izhevsk State Technical University is supposed to answer some questions in the above field.

Problem statement

When teaching hearing-impaired students, visualizing learning material is one of the key methods to address their special educational needs. In this context, ICTs and modern technologies are vital for presenting learning material, both during in-class activities and in the self-study process. However, recent studies have documented the difference in levels of cognitive construal while performing information processing tasks based on using digital versus non-digital platforms (degree of abstraction, memorizing, etc.). So, one can question the need for using digital learning materials instead of conventional printouts in order to achieve certain learning objectives. There is also a problem of selecting certain forms of presenting the information (text, graphics, and diagrams, images) to improve the efficiency of its perception when teaching hearing-impaired students. Our research is supposed to answer these questions and to give recommendations for presenting information when teaching hearing-impaired students taking into account the specific nature of information perception and processing.

Research questions

Our research contributes to studying the difference in levels of cognitive construal while performing information processing tasks based on using digital versus non-digital platforms (degree of abstraction, memorizing, etc.). It is aimed at learning how to use e-board and printed educational materials more effectively in educating hearing-impaired students. Besides, it also takes into consideration the forms of presenting the information, i.e. using text, graphics, diagrams, mind-maps and images. The research findings and conclusions will be useful in designing training manuals, e-courses and selecting educational materials or hearing-impaired students taking into consideration the development of various mental models.

Purpose and objectives of the study

The main objective of the study is to create an effective learning environment for teaching students with hearing impairments by analyzing how the type of information carrier (digital or physical – paper) and its presentation affects perception, memorization, and emotional evaluation of the material, and how it contributes to the development of different mental models.

Literature review

The problem of interaction between a computer and a man is based on the cognitive processes of human consciousness, which are studied by cognitive psychology. These include perception, attention, pattern recognition, memory, information transmission using language, information processing (knowledge formation), logical thinking, decision making, etc. Research in this scientific area began in the 30s-40s of the last century. Later, with the growth of achievements in the field of computer science and artificial intelligence in the late 20th century, more and more researches became involved in it. The main cognitive characteristics were identified; their structural components were described in detail and considered by Miller (1981), Solso (2006) and others. The main theories in research concerning main factors influencing the process of cognition are theories of situated cognition (the influence of content on cognitive processes) (Clancey, 1993; Suchman, 2014) and embodied cognition (interaction of cognitive processes with the environment) by Varela, Thompson, & Rosch (2017). The basic principles of these theories provide the foundation for studying cognitive processes in learning with computers and other digital media, resulting in modern principles of creating interfaces for computer products, the foundation for the design of e-books, teaching aids and courses. However, considering the development of an inclusive education system, these general provisions and conclusions do not always take into account the special educational needs of students whose mental and physical development is not diagnosed as normal.

Methodology

The study involved experimental, qualitative and quantitative research methods: tests, questionnaires, interviews, and discussions. To assess the reliability of the experimental results it is planned to use the methods of mathematical statistics.

The purpose of the experimental work is to analyze the differences in quantitative and qualitative characteristics of cognitive processes of human consciousness (such as perception, attention, pattern recognition, memorizing, information transfer by language, information processing, logical thinking, decision making, etc.) depending on the form of information representation (text, graphics, tabular, etc.), as well as the type of its carrier (paper, computer screen, interactive whiteboard, tablet, smartphones, etc.). Conducting further experiments involves identifying the levels of development of different mental models in hearing-impaired students and design methodology for effective teaching practice.

The methodological basis of our research is the theory of situated cognition (Clancey, 1993; Suchman, 2014), and embodied cognition (Varela, Thompson, & Rosch, 2017); the concept of Computer-based learning environments (CBLEs); the social-cognitive theory of self-regulated learning and academic achievement by Zimmerman (1990) and Moos & Azevedo (2009).

The following assessment and evaluation materials are supposed to be used: (1) for the experiments involving perception and attention analysis: standard tests on the determination of stability, volume, distribution and switching of attention (Anfimov table, tables with Landolt rings, Schulte technique, etc.), customized author's tests; (2) for the experiments involving the analysis of memory:

standard tests for determining the volume and productivity of short-term and long-term memory (memory for words), customized author's tests; (3) for the experiments involving the processing of information, and logical thinking: reading texts from computer and paper media with subsequent analysis of the speed of reading and reading comprehension, taking into account the stored information in the verbal working memory, determining the coefficient of reading technique - Standardized Methods of Reading Skills Evaluation, Operational Test Units of Reading (TOPECH); customized author tests; (4) for the experiments involving mental models: tests for defining mental models development type.

Results

The experiment is conducted in the Center for Inclusive Education at M.T.Kalashnikov Izhevsk State Technical University.

The experiment is planned to be carried out in three stages. The purpose of the first stage is to identify special features of information perception by students with hearing impairment, depending on the type of information carrier, and comparing their performance with those of students without hearing impairment. In the first stage, the same diagnostic materials are offered to healthy students and hearing-impaired students; later, testing and questionnaires on the qualitative characteristics of cognitive processes are differentiated, taking into account the results of the first stage.

The purpose of the second stage is to identify the features of information perception by students with hearing impairment, depending on its form, and to compare their performance with the performance of students with standard hearing.

The purpose of the third and final stage is to identify the relationship between the information perception and the development of mental models in students with hearing impairments. According to the results of the experiment, it is planned to develop methodology including methods, schemes, and teaching materials for teaching Russian and English languages and Engineering Graphics in accordance with the research-based formulated recommendations.

This paper presents experimental data on the following aspects: short-term memory, attention, and concentration, reading and comprehension (general understanding and details). Today electronic interactive board and printed hand-outs are the most common media for information in a lecture audience. That is why they were involved in the first stage of our experiment. To receive results on short-term memory, the standard "10 words" method was used. Students were asked to memorize 10 words for 1 minute, and then to write them down by heart. We repeated the test twice: the first time using words printed on a paper, and the second time using an electronic board. In order to analyze concentration and attention, Schulte tables were used, it is a technique which involves finding the numbers from 1 to 25 and recording the time it took to complete the task. Students recorded the time on their own and in pairs. The test with Schulte's tables was also carried out twice: using paper and electronic boards. For reading comprehension test the students were asked to read a text of 200 to 250 words for 2 minutes, and then answer questions concerning general understanding and details without relying on the text. Like other tests, it was also repeated twice: using paper and an interactive board.

The first stage of the study involved 98 students of M.T. Kalashnikov ISTU including 79 first and second-year students with standard hearing and 19 students with hearing impairments (13 deaf student and 6 hearing-impaired students).

The main result of the experiments at the moment is the confirmation of difference in some cognitive construal indicators of deaf and hearing impaired students regarding memory and information

processing skills in reading compared to healthy students and results obtained for digital and non-digital media.

The experiments revealed the following results:

1) The results of experiments on the short-term memory ("10 words" technique) indicate a difference in students' performance. Both for most hearing impaired students and most students without hearing impairment (more than 60%), it was easier to remember words displayed on the interactive board. On average, students remembered one word more from the board compared to that from the printout. Results for students with a health standard: from an electronic board they memorized on average 7.24 words, and from a printout - 6.39. For deaf and hearing-impaired students, these figures are 6.2 and 5.8 respectively. At the same time, there is no connection between the degree of deafness and the test results, the rates of deaf students are comparable, and sometimes even better than those of hearing-impaired students. To be even more precise, the indicators of completely deaf students turned out to be both in the "best" and in the "worst" category. However, for students with hearing impairment, these indicators can be associated with the time spent at university: for there is positive dynamics for short-term memory.

2) According to the results of the adapted attention and concentration test (Schulte's tables), a slight difference was found in the performance of students with hearing impairments and students with a health standard. In general, students with a health standard accomplished the proposed task faster, but the difference in performance is insignificant and makes up about 8%. At the same time, for most students with a health standard (66%), this indicator is on average 14% better when working with printed tables. Interestingly, the same trend is relevant for students with hearing impairments. And again, the direct link between perception speed, concentration and degree of deafness is not recorded.

3) According to the results of experiments with the standardized methodology for reading skills analysis, the results were quite discouraging. While students without hearing impairment coped with the task without difficulty and answered all the questions, the majority of hearing-impaired students did not manage to complete it. In other words, reading and understanding of the text of 230 - 250 words in a time-limited to 2-3 minutes is a serious challenge for them. When asked whether they had finished reading the text, they answered in the affirmative. However, their answers to questions related to the content of the text were erroneous and showed their misunderstanding of the general idea and details. This applies to both hearing-impaired and deaf students. In general, 60% of students with hearing impairment did not cope with the task at all, other works contained significant errors, and only 12% of the works testified partly correct understanding of the text. At the same time, the experiment conducted in this form did not reveal much of a difference when using different information carriers; however, when working with a paper source, the results of the students were slightly better.

Discussions

The results of the first stage of our experiment allow us to draw some conclusions about the information perception by deaf and hearing-impaired students from paper and electronic media, as well as to give some recommendations on their use.

Memorization speed and short-term memory are among the most important factors ensuring successful learning. It is vital, for example, when solving problems that require thinking (which are, in fact, the most valuable for learning), and the task that must be "kept in mind", that is, remember the whole task wording (Solovjev et al., 1971). Our experiments showed that after leaving a school (as a rule, special education school) and during the first years of study at a higher educational institution, indicators of deaf

and hearing impaired students are generally worse than those of students with a health standard, but this difference is not critical. As the experiment showed, memorization with the use of an electronic board for students occurs faster (more efficiently) than with the use of paper sources. Perhaps this is due to the fact that today's students are adapted to perceive information from electronic media.

As for the tests for attentiveness and concentration, here the results were better for paper carriers. At the same time, there is no particular difference between students with hearing impairment and without it. Thus, tasks that require concentration and attentiveness (for example, search problems) would be preferable to offer using printouts.

A significant difference between the hearing impaired students and hearing students is observed in the perception of textual information. As part of the proposed assignment, students had to read a small artistic text, understand it, remember the general meaning and details in a limited time interval, and then answer questions about it. For students with hearing impairments, this has proven to be an impossible task. Interpretation of this result in the conditions of the educational process means that the popular method of presenting educational material in the form of texts on a slide for students with hearing impairments will be extremely ineffective.

Thus, according to the results of this experiment when organizing training for deaf and hearing-impaired students, the following recommendations can be given: (1) the development of methodological support should take into account the peculiarities of perception of information, in particular, it is better to use different sources of information, both electronic and paper, during the lesson; (2) it is not effective to offer theoretical material on slides in the form of textual information, the information should be as simple as possible and presented using images, symbols, tables, charts, etc .; (3) material for memorization (formulas, terms, rules) will be expedient to put on the slides and demonstrated on the electronic board; (4) tasks requiring concentration and attention (instructions, search problems) are advisable to offer as printed material on paper.

As for the correlation between the students' degree of deafness and their performance, the situation here is not quite straightforward. On the one hand, in general, the deaf students are usually less successful in their studies (Serebryakova, 2016), but our experiments have shown that this relation is not direct, as completely deaf students showed both "worst" and "best" results. After analyzing the results and interviewing students, the following explanation was formulated: in most cases, the perception of information is influenced mostly not by the degree of deafness, but by the factors that contribute to the mental development of the child, including the child's mental characteristics, the cause of deafness and the resources provided by his environment. Deafness acts as a limiting factor of self-cognition and self-knowing of the world, but if there are factors in the child's environment that help overcome this limitation, they contribute to his development considerably.

Conclusion

The large-scale introduction of an inclusive education system in higher educational institutions is a challenge for the Russian educational system, especially when it comes to hearing-impaired students. One of the greatest challenges is the training of teachers who are able to deal with deaf students and students with a health standard in one classroom. While in the system of special education for deaf schoolchildren, teachers, as a rule, undergo special training aimed at developing skills for special needs education, the university teachers are not prepared to respond equally to the educational needs of hearing-impaired students studying together with hearing students. Our study may help to answer the question

about the possibility of inclusion for the deaf students in general, and some ways to make it more effective. As the results showed, there is a difference in the perception of information, it is not critical, which means that taking into account the peculiarities of the perception of information by deaf students, the training material can be modified and used in the inclusion system. In addition, there is a positive trend in the perception of information among senior hearing-impaired students. This provides a basis for planning various models for organizing inclusion, for example, with the gradual inclusion of deaf students in the general educational process.

The data obtained should be taken into account when training teachers. In particular, the recommendations formulated on the basis of all the study results are considered in Pedagogical Communications course at M.T. Kalashnikov ISTU included in Vocational Education curriculum, and we believe it will contribute to developing students' competency to work with hearing-impaired students in the system of inclusive education. In addition, future teachers themselves are involved in the research process, in the framework of graduation project or pre-teaching service practice. They help to select tests and process the results, which largely contributes to their motivation for future educational activities.

This article presents only the initial results of the research. The experiments confirmed that there is a difference in the perception of information by hearing-impaired students and students with health standard triggered by digital and non-digital platforms. Further research is needed on in-depth analysis of other important indicators of information perception, such as the perception of textual and graphical information from various types of media, and the combined use of information sources in teaching deaf students.

Acknowledgments

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