

Formation of intersubject competencies of hearing-impaired students on the basis of information and communication technologies

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Abstract — The article presents the results of longitudinal research of the intersubject competencies of hearing-impaired students at a technical university. Six competencies have been identified to help these students adapt to the university's inclusive environment: self-development, communication, perception of information, teamwork, activity, social openness. Information and communication technologies are considered as the most important component of intersubject competencies. They contribute to the minimization of communication barriers, and due to this, the development of personal activity. The formation of selected intersubject competencies is considered on the example of intersubject integration of two disciplines of the first course: humanitarian and natural science. The humanitarian course "Workshop on social communications" is aimed at promoting the socio-psychological adaptation of first-year students. The adaptation course "Cognitive technologies of the maintenance of the "Chemistry" is designed to help improve the educational and professional capabilities of hearing-impaired students in the development of fundamental engineering subjects. Organizational, methodological and information technology support for classes is presented. According to the results of the study, the criteria for assessing the dynamics of the intersubject competencies of hearing-impaired students are described.

Keywords — *inclusive education, technical university, deaf and hearing-impaired students, cognitive technologies, social adaptation.*

I. INTRODUCTION

Today, inclusive vocational education is considered both as a tool for improving the economic status of people with disabilities, and as an effective way to include these young people in society. In order to maximize the creative potential of hearing-impaired students, their professional success, it is important to form not only professional skills and abilities - hard-skills, but also soft-skills in the process of studying at the university. The second group of skills is inherently over-subject competencies that are essential for socio-psychological adaptation and social interaction in an integrated environment.

The socio-professional success of hearing-impaired graduates is determined by their ability to minimize communication barriers in business communication. It is possible on the basis of the use in the educational process of special information and communication technologies for the development of the inner activity of the individual, the formation of proactive behavioral strategies of students with audio limitations. In this case, a hearing-impaired professional takes the initiative to destroy communication barriers and to teach hearing employees how to deal with deafness [1-3].

The article purpose is: to summarize the experience of the formation of intersubject competencies in hearing-impaired students in the university's inclusive educational environment.

II. RESEARCH METHODOLOGY

The most important methodological basis of research in the psychology and pedagogy of inclusive education are the provisions on the professional development of the individual in the inseparable and interdependent process of activity, communication and self-knowledge. The problem of the formation of intersubject competencies of hearing-impaired students has an intersubject status which requires a systematic approach.

The research focus of the article authors is based on the concept of an integrative approach in the psychology and pedagogy of inclusive education. The most important provisions of the integrative approach in inclusive education are based on the principles: 1) the formation of a developing educational environment through the integration of academic subjects and the use of innovative information and educational technologies - intersubject integration; 2) the dialogical interaction of the subjects of the developing environment of the university - interpersonal integration; 3) the personal and professional development of students with disabilities - intrapersonal integration. Organizational and methodological support of intersubject integration is associated with the use of

active learning methods in the educational process. A wide range of such methods includes the method of discussions, the method of creative projects, business games, holding round tables, conferences, festivals, case-based technology, etc. [4-7].

Intersubject competencies are considered as an activity style, abilities and skills that ensure the success of an individual's self-realization in the sphere of social interaction and professional activity. The substantive content of intersubject competencies reflects the personal characteristics of students as stakeholders of activity and communication. Intersubject competencies differ in a broad scope of application, they are universal and reflect the level of personal and professional development of the personality of hearing-impaired students. The classification of intersubject competencies depending on the types of universal learning activities includes: 1) personal competences presented through the skills of self-determination, moral and ethical features of behavior; 2) regulatory competencies which include skills in targeting, planning, controlling, correcting, evaluating, predicting behavior and activity; 3) cognitive competencies reflecting general educational, logical, and symbolic skills; 4) communicative competences aimed at mastering speech activity, culture of oral and written communication, skills of using language in interpersonal communication and in various social situations [8, 9].

III. RESULTS OF THE RESEARCH

The authors of the article, basing on a multi-year study, present the results of the development of a technology for the formation of intersubject competencies of first-year students with audio limitations at MSTU named after N.E. Bauman. The first course of study at a technical university is very difficult for hearing-impaired students. There is a difficult process of adaptation to training activities, to a new team, to new conditions of life activity, requiring increased discipline, responsibility, motivation, etc. in the initial period of training. Hearing-impaired students face a complex of motivational, communicative and cognitive barriers. At the first stages of integration at the university, they are characterized by an orientation towards the establishment of new connections in the integrated environment and the enjoyment of student life. The values of obtaining new knowledge are overshadowed, the need for independent work is underestimated. Under the influence of a new social status of a "prestigious university student", they tend to overestimate self-esteem and overestimate their capabilities [10]. Among the cognitive difficulties the following ones are highlighted: a small vocabulary, difficulty in understanding some grammatical forms, slow in comparison with hearing students, the formation of a terminological stock in the subjects taught [11]. Communicative barriers are associated not only with objective difficulties, but also with the discrepancy between the system of students' value orientations, social attitudes and different types of students' identities - as a result of their socialization in different cultural environments (special school / general education school, deaf / hearing parents, etc.) [12]. These barriers inhibit the adaptation of a hearing-impaired first-year student at the university and affect the effectiveness of their mastering of educational programs. Based on the study, six main intersubject competencies were identified that ensure the success of adaptation of hearing-impaired first-year students at the university [3].

1. *Self-development* is a focus on the achievements, the desire to acquire new knowledge and skills. It manifests itself in demonstration of a positive attitude towards learning, motivation for learning and the achievement of learning outcomes.

2. *Communication* is a skill of applying the communicative potential. The skill is based on confident, proactive behavior, reflexive listening; the ability to apply digital technologies to minimize communication barriers.

3. *The perception of information* is a level of development of verbal speech perception skills. It means the ability to dialog with a companion, to understand them and to be understood by them. It includes their own clear speech (understandable to a companion) and the skill of using hearing to perceive a companion's speech. This indicator does not always reflect the student's good hearing, but in some cases is a consequence of the comprehensive rehabilitation measures initiated to compensate and correct the hearing impairment. Competence is evaluated in favorable conditions - the absence of intense background noise, the presence of an operable hearing aid in a student, the distance between companions is no more than 1.5 meters.

4. *Activity* is a high behavioral activity in educational and professional activities. It includes concentration and workability. It manifests itself in the independent study of the material, the search for additional sources of information on the problem, in a fact that the student asks adequate questions in the classroom.

5. *Teamwork* is an orientation on cooperation, achievement of group goals.

6. *Social openness* is an openness to a new social experience, adaptability in the new educational environment, acceptance of the values and norms of the new social environment. It manifests itself in the fact that a student expands social connections in a higher educational institution, not on the basis of the state of hearing.

We consider formation of the selected six competencies on the example of intersubject integration in two subjects of the first course: the humanitarian cycle - "Workshop on social communications" and the natural science cycle - "Cognitive technologies of the maintenance of the subject "Chemistry" (hereinafter "CTMS Chemistry").

Organizational and methodological support of classes. Workshop on Social Communication includes four training modules. Module 1 is aimed at the orientation of students in the integrated environment of the university, the adoption of the social role "student", the formation of the responsibility and independence qualities associated with this role (proactive attitude). The main topics of the module are related to the problems of interpersonal communication, the ability to compensate for communication barriers, based on an understanding of the personal and communication characteristics of other students (both hearing and hearing-impaired).

There is a complex joint work of a student and a teacher-psychologist in setting life and career goals, analyzing internal and external factors affecting their implementation in the process of studying Module 2. Diagnostics of educational motivation, vocational aptitudes and abilities of students is being conducted. Vocational guidance is provided and students choose a further educational path on the basis of data from testing and self-analysis. Students have the opportunity to correlate their professional interests and the requirements of the professional standard.

Module 3 provides an in-depth view of social communication technologies. A socio-psychological diagnostics of qualities important for interpersonal communication is conducted and the determination of own personal communicative abilities by a student in the course of classes. The material is divided into the following topics: types of communication, types of communication barriers and opportunities to overcome them, the factors of effective communication. Students should form an individual strategy of communicative interaction in an integrated environment according to the results of the module.

Module 4 solves problems of the formation of a professional identity. Classes are aimed at the formation of ideas about the professional community of engineers; norms of behavior, traditions, values shared by this community; the formation of the image of a "successful professional", the correlation of oneself with this image, give an idea of the tactics of interaction in the professional environment.

The modular program of the adaptation subject "CTMS Chemistry" substantially and structurally corresponds to the program of the main subject "Chemistry" and is being implemented in parallel with the last one in the format of student service learning, organically integrated into the educational process in chemistry. Subject on the basis of *an individualized approach* provides hearing-impaired students with special methods and technologies for conducting an educational process in chemistry that will help them develop these intersubject competencies [13].

Classes are held in specialized multimedia classrooms equipped with modern technical teaching aids based on information and communication technologies, sound-amplifying equipment. The teacher takes into account the possibilities of the environment in the preparation of teaching and methodological materials for classes in accordance with the individual characteristics of students' perception. As a rule, a class is held in a joint lecture-seminar format using interactive forms of working with students: a short (20-30 minutes) overview *lecture* on the topic of the class (or a training video) turns into a *practical class*. The teacher formulates the condition of a standard task and proposes an algorithm for its performance on an electronic whiteboard (or computer). After that, students receive similar individual tasks for independent performance with the obligatory subsequent analysis of solutions on an electronic whiteboard. *All the students* are involved in the solution analysis. Such organization of classes contributes to the development of such intersubject competencies as: *self-development, activity, perception of information and teamwork*.

A significant factor in the formation of students' competence of *self-development* and *perception of information* is individual creative tasks within the framework of the modules of the subject "CTMS Chemistry", performed in abstract and presentation formats under the guidance and advisory assistance of a teacher. When performing tasks, the subject of study is the cognitive aspects of perception and understanding of chemical information. Indicative titles of the tasks: "Symbolism of the "Chemistry" subject language"; "Chemical terminology: the origin of chemical names and terms"; "The connection of terms and concepts in chemistry", etc.

A special component of the subject "CTMS "Chemistry" is the design and research activity of students in the development of demonstration chemical experiments on the topics of Chemistry course and the creation of a set of educational video

materials. The video materials created by students, including the stages of preparation, execution and analysis of experiments, represent an educational resource that is organically incorporated into the educational process in chemistry for hearing-impaired students in multimedia classrooms. The involvement of deaf and hearing-impaired students in design and research activity is a significant cognitive and social factor for the formation of these specified inter-competencies [14, 15].

Partnerships arising in the framework of joint design and research activity without which the functioning and development of subjects of vocational (technical) education is impossible, imply the development of hearing-impaired students of social openness, activity and teamwork. A necessary condition for partnership is the ability and desire to be useful in achieving a common goal, skills in communication, self-development and, ultimately, understanding the need for self-restraint in one's desires and emotions. The final defense of projects at student conferences also contributes to the formation of student inter-competencies.

Each training exercise (task) of the modules of the described subjects necessarily includes information about the scenario of the class — the goal, the main tasks, the definition of working concepts. The mandatory final stage of the exercise is group reflection - a discussion of the exercise results. Each student answers questions about what the new, interesting, important things they learned. After each exercise of the module, teachers show grades reflecting the degree of manifestation of each of the six intercompetencies on a three-point scale. If a student demonstrates a high level of manifestation of the skill during the performance, they get 2 points; if the competence is partially manifested when performing the exercise, they get 1 point, if the did not show any skills, they get 0 points. The results of the expert evaluation are recorded in a table (Table 1).

TABLE 1. EXPERT EVALUATION OF STUDENT INTERCOMPETENCIES.

Intersubject competencies	Student A	Student B	Student C	Student D	Student E
Self-development					
Communication					
Perception of information					
Activity					
Social openness					

Information technology support of the classes A PowerPoint presentation or the layout of the material in MS Word format is used as a class abstract. This allows the hearing-impaired students to give visual confirmation of auditory images. Students also use this technology when making their own presentations. After an individual presentation, the quality of the material presentation is discussed and assessed. The assessment process is carried out as a joint discussion of the teacher and all the students; the nuances that allow a person with limited hearing and speech capabilities to effectively present their work in a learning and professional environment are highlighted. A special attention is paid to key words, supporting series, graphic and digital information.

The classes use online testing and subsequent introspection of their strengths and weaknesses by the student, the identification of development zones, and personal consultation with a teacher-psychologist is held. This form of work involves the preliminary selection by the teacher of test material on the

Internet, that is adequate for communication skills of hearing-impaired students, coordination of the self-test process in the classroom, assistance in analyzing the result.

The next method used is a glossary. Work with a dictionary is carried out in real time with the help of online dictionaries. In some cases, a function google- or yandex-pictures can help. The correctness of the choice of word interpretation by hearing-impaired students is controlled by the teacher. The preliminary compilation of the glossary is not carried out, since vocabulary gaps are individual. In addition, the word is included in the context when referring to the dictionary in connection with a misunderstanding of the semantic meaning of a word in a particular situation. The most frequently common unknown words for students are written on the blackboard. At the end of the course, the student provides their own individual glossary.

Messengers, social networks and emails are used for consulting with the teacher in the preparation of homework. Experience shows that hearing-impaired students in most cases prefer this method of seeking additional explanations due to the priority of writing, the possibility of dialogue in real time, less anxiety arising in this format of communication.

Outside equipping the classroom with a projector and laptops, all these technologies can be used when students use smartphones. In this case, the process of presenting the material is transformed - the technology of "inverted" training is implemented. The presentation on the topic is sent in advance, students get acquainted with the key points of the topic which the teacher explains in the classroom. This technology can be recommended for a lecture. In this case, students present abstracts at the end of the module. The performance of the abstract after the lecture is considered as a way of repetition. A smartphone can and should also be used to guide students in Internet resources on the topic. We consider the use of a smartphone to remove communication barriers outside a specially equipped classroom as a necessary element of a training session with hearing-impaired students. This

simulates the situation of business communication that does not always provide an equipped classroom at hand.

YouTube and other video resources are used to select popular science films and short fragments from feature films (10-15 min.), illustrating typical communication barriers. Watching them through a projector or smartphone activates students' interest in the topic of classes. An important selection criterion is the presence of subtitles.

The classes in the described subjects use active learning methods: discussions, business games, brainstorming (group tasks), projective graphical methods, presentations and messages from students. Business games contribute to the emotional involvement of students, form teamwork experience, develop thinking flexibility, communication skills. The method of analysis of specific situations develops social perceptual abilities and skills in hearing-impaired students. The use of technology of socio-psychological training forms the skill of self-regulation and reflection in students with audio limitations. The playful nature of group exercises provides personal inclusion in the learning process, it contributes to the formation of positive learning motivation and the development of behavioral self-regulation skills and activity in an integrated environment. The problem-search nature of training session is also carried out in an individual form - the preparation of essays, presentations and reports, speeches.

IV.DISCUSSION OF RESULTS

According to the results of work in the semester, each student needs to rate the dynamics of the development of intercompetencies on the basis of the final generalized ratings of teachers. The results of the teachers' rating is important to bring to the attention of hearing-impaired students, and note their achievements, discuss areas for further development of these competencies. Table 2 presents the content of each level of metacompetence.

TABLE 2. THE LEVELS OF DEVELOPMENT OF INTERCOMPETENCIES AND THEIR CONTENT.

Intercompetencies	High level	Average level	Low level
Self-development	An expressed motivation to learn. Demonstrates positive attitude and interest towards learning. Aims to achieve results.	Motivation is unstable. Study interest is situational. Loses interest when difficulties in the performance of tasks appear.	There is no motivation to learn. Does not show any interest in learning.
Communication	Confident, proactive behavior. The student knows their communicative potential, knows how to listen to and understand a companion. Can organize an interaction situation by applying special technologies.	Confidence is situational. The student lacks communication initiative: expects somebody to contact them. The skill of reflexive listening needs development: may not listen to a companion, interrupt them.	Does not take the initiative in communication, the skill of reflexive listening is absent.
Perception of information	Dialog without the use of special methods is possible. The student perceives speech well. Their own speech is intelligible, legible - understandable to a companion.	Dialog is possible if a companion uses special methods: rephrasing, repeating, writing some difficult words and terms.	Dialog is possible only with the use of gestures or writing language. The student's own speech is vague, incomprehensible to a companion. From the request speech, the student perceives only individual words, phrases.
Activity	Focused and active in the classroom, asks appropriate questions. Works on the material himself, looks for additional sources of information on the problem at home.	Not always focused, distracted. Activity is unstable, does not always ask questions. Questions do not always reflect student's understanding of the topic. Underestimates the role of independent work.	Not focused, distracted, does not ask questions, it is difficult for them to answer the questions raised. Does not study at home.
Teamwork	Focused on cooperation, achievement of group goals. Friendly, helps other students.	Cooperates with a small group of students, is friendly with them. Helping other students is selective.	Focused on their own interests, focused on individual work. Does not help other students.
Social openness	Open to a new social experience,	Social connections are selective in	Not aimed at expanding social

	focused on the adoption of values and norms of the university. Extends social connections in the university not according to the principle of the state of hearing.	terms of the presence / absence of hearing impairment. In the structure of social identity, there may be a specific role "disabled".	connections. Demonstrates belonging to a specific deaf subculture.
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The experience of conducting classes showed the positive dynamics of social competencies of hearing-impaired students.

V. CONCLUSION

Competencies of self-development, communication, perception of information, teamwork, activity and social openness should be considered as important intersubject competencies - soft skills - promoting integration and subsequent effective professional realization of hearing-impaired students. They help overcome the motivational, communication and cognitive barriers in the process of learning in university. For their successful formation and development of students, it is necessary to apply an intersubject approach, providing the appropriate types of work and their evaluation in both humanitarian and technical subjects.

To speed up the process of adaptation at the university, a special adaptation course may be recommended for first year hearing-impaired students. It should go in close connection with the course that supports the development of main subjects by students through teaching them cognitive technologies.

Among the types of activity that ensure interdisciplinarity and the formation of all six competencies, it is necessary to single out design and research activity. It develops the cognitive and communicative abilities of students, creates conditions for the interaction of deaf, hearing-impaired and hearing students.

Information and communication technologies are a significant component of the formation of intersubject competencies of hearing-impaired students. They make it possible to make verbal information available to students, develop opportunities for effective self-presentation, and reduce the concentration of the audience on speech disorders. The presence of a specially equipped classroom is an important condition for the implementation of the educational process for hearing-impaired students. At the same time, it is necessary to train students to use the potential of a smartphone to reduce the environmental barrier (Internet capabilities, applications, including special ones). Specially equipped classrooms are not always available in everyday and business life. The potential of using a smartphone in an inclusive educational process needs further study.

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