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Involving Employers in the Vocational Training of Individuals with Disabilities in IT Specialties in the Secondary Vocational Education System

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Abstract: This article addresses one of the challenges of inclusive vocational education: training competitive IT specialists from among individuals with disabilities. In the context of digital transformation and the high demand for IT personnel, this study focuses on analyzing the gap between employer requirements and the actual level of professional competencies among college students. Based on a comparative analysis of data obtained from employers and expert assessments by faculty, the study reveals challenges in developing the "Software Code Development and Debugging" job function. Empirically, it is shown that second-year students, including those with disabilities, have low proficiency in competencies such as working with version control systems, code debugging, task formalization, and documentation, while employers rate these competencies as incredibly important. Particular attention is paid to the fact that the identified deficit is systemic and equally affects both neurotypical students and those with disabilities, indicating the need for changes in the educational process as a whole. In conclusion, the authors propose a set of practice-oriented measures, including the introduction of project activities, integration with employers, and the development of support measures for students with disabilities, aimed at overcoming this gap and the successful professional integration of graduates.

1 INTRODUCTION

In the contemporary context of digital transformation, information and communication technologies have become an integral part of the professional activities of specialists across various fields. This is particularly evident in the sphere of information technology, where mastery of digital competencies serves as a key factor determining competitiveness in the labor market. The issue of professional training for individuals with disabilities and special health needs (SHN) in the IT sector is acquiring particular significance, as this field offers extensive opportunities for realizing professional potential regardless of physical limitations. Inclusive education within the system of secondary vocational education has become a crucial instrument for social integration and professional self-fulfillment of this category of learners.

The relevance of the present study is determined by several factors, including the inclusivity of education, the flexibility of IT disciplines and professional modules, the adaptation of the educational process to meet the needs of people with disabilities and SHN, the high potential of the IT sector for creating inclusive workplaces, and the growing demand for IT professions in the labor market. It should be emphasized that employers function as full-fledged partners in designing and implementing inclusive educational processes. However, educational standards do not always fully reflect employers' requirements for future IT

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specialists. For graduates with disabilities and SHN, this discrepancy may result in an extended adaptation period in the workplace. Consequently, for the educational process to be effective, it is necessary to align employers' requirements with the expected learning outcomes, which are expressed in terms of labor functions and professional competencies.

Inclusive education is aimed at creating a flexible educational system that considers the individual characteristics of each learner. It focuses on the development of adaptive pedagogical approaches, the recognition of each student's uniqueness, flexible teaching methods, and an emphasis on learning efficiency. The improvement of the educational process within the inclusive approach enhances the quality of education for all students without exception (Kazimirova, 2020). It is quite evident that there exist groups of children for whom joint learning with peers is impossible for objective reasons. At the same time, excessive segregation and isolation substantially infringe upon the rights of those who are fully capable of studying and developing in a general educational environment (Grebennikova, 2015). Thus, the research conducted by D.Yu. Petukhov demonstrates a strong correlation between life meaningfulness and subjective well-being among students with disabilities and SHN enrolled in secondary vocational education programs. Unlike those who live without clear goals, students who feel in control of their destiny, set objectives, and actively strive to achieve them report significantly higher levels of happiness and well-being. Therefore, support for students in vocational education programs should include assistance in finding meaning, fostering conscious choice, and strengthening personal resilience (Petukhov, 2020). Most researchers emphasize organizational and methodological work with students with disabilities and SHN. Particular attention is paid to social rehabilitation and professional orientation (Gallyamov, 2021), the development of volunteer activities and the formation of inclusion-related values, as well as the development of students' communicative and practical competencies (Kazimirova, 2020). Another essential focus is the training of qualified educators who possess the necessary competencies to work effectively with students with disabilities and SHN (Glazunova, 2024). The authors note the insufficient adaptation of teaching methods to the individual capabilities of students and the lack of accessibility in vocational education (Glazunova, Yesina, & Meremyanina, 2024), as well as the absence of adaptive educational resources and professionally oriented educational technologies (Prikhodko, Pavlova, & Mironova, 2022).

Effective organization of vocational education in colleges requires considering not only educational standards but also the requirements of potential employers. Unfortunately, this aspect of inclusive vocational education has been under-researched, although the issue is not new. Interestingly, the idea of providing vocational training for individuals with disabilities in industrial settings was raised as early as the early 20th century in the United States; this experiment was successfully implemented in New York City across several industries (Monthly Labor Review, 1919), but for economic reasons, it was not widely adopted.

Bricout and Bentley, summarizing the results of studies conducted in various countries by various authors (Nordstrom, Huffaker, & Williams; Bordieri, Drehmer, & Taricone; Drehmer & Bordieri; Millington, Szymanski, & Hanley-Maxwell), come to the disappointing conclusion that employers view applicants with disabilities as less suitable candidates, regardless of the position they are applying for. That is why, for the high-quality organization of the educational process at college, it is crucial for us to understand the position and requirements of employers for applicants for IT specialists in order to take this into account during training, including with students with disabilities (Bricout, Bentley, 2000). Pamela Luft, using the example of working with deaf and hearing-impaired young people, draws conclusions about the need for a "transition period" from the educational process to professional activity, and proposes a system of tutoring support during the adaptation period in the workplace (Luft, 2015). We are confident that Russian employers will support this practice if it is legally enshrined and financially supported; the economic effect of this form of support, in our opinion, is obvious. T. Bryce and W. Humes, describing the education system and support service for children with disabilities in Scotland, demonstrate how, already in senior classes, it is possible to integrate the interests of children and the needs of the labor market, including the requests of employers (Bryce, Humes, 2018). In our opinion, S. Dahmen's point of view is consistent with the need to legally enshrine the transition from school to vocational education, then any young person, including individuals with disabilities, will receive support from the state and potential employers (Dahmen, 2021). E. Pearman, T. Elliott, and L. Aborn, describing successful examples of the socialization of students with disabilities, consider the experience of a college in Los Angeles, in which

vocational training for individuals with disabilities was combined with special education and was focused on local (municipal) needs as a basis for future employment (Pearman, Elliott, Aborn, 2004). Their article describes a local special education plan, reflecting an alliance between a school district and a local college, as well as activities and services related to the subsequent employment of individuals with disabilities. Thus, there are isolated examples of successful cooperation between the vocational education system and employers, but this experience has not been analyzed or understood scientifically.

Analysis of scientific literature, the experience of implementing inclusive education in the secondary vocational education system, and the training of IT specialists revealed the following contradictions:

- between the need to develop professional competencies in students with disabilities in the IT field and the insufficient development of pedagogical conditions and methodological approaches to organizing this process in the secondary vocational education system.
- between the acknowledgement of mandatory employer participation in organizing the educational process and the formal (or insufficient) consideration of the requirements and expectations of IT employers themselves for future specialists.

These contradictions allowed us to identify the research problem, which consists of a comparative analysis of employer requirements for the level of proficiency in job functions and the actual level of development of job functions in students studying IT specialties. The purpose of the study is to analyze employers' expectations regarding the level of professional competence of students with disabilities in IT fields. Successfully developing professional competencies in IT-related students with disabilities in secondary vocational education is possible if professional competency assessment criteria are developed that consider the specific needs of students, are coordinated, and consider employers' requirements for relevant specialists. Implementing these criteria will ensure high-quality professional training for students with disabilities in the IT field and their successful integration into the professional community.

2 MATERIALS AND METHODS

The study involved 98 participants, including 30 females and 68 males, 10% of whom were students with various disabilities (sensory impairments, musculoskeletal disorders, somatic diseases, attention deficit disorder, and severe speech impairments). All students were in their second year of study. In addition, employers from seven organizations participated in our study, three of which were public sector. It is important to note that the number of IT specialists at these companies ranges from 2 to 6,000. All employers surveyed consider employing employees with disabilities and disabilities, and all agreed that candidates for IT positions are selected based on their professional skills.

To assess the students, we used an expert assessment method, which allows us to obtain quantitative data on the frequency of demonstration of work-related skills, the degree of independence in problem solving, and the level of development of students' cross-professional skills. The experts were instructors of specialized disciplines and modules, which allowed for an objective assessment. The scale we developed consists of 7 ratings, where 0 represents a lack of skills in performing work tasks; 1 represents partial performance under instructor guidance; 2 represents performance based on a model, with errors; 3 represents performance of work tasks requiring verification and correction; 4 represents independent performance of work tasks in familiar conditions; 5 represents performance of work tasks optimized for various processes; and 6 represents performance of work tasks in various ways, including the creation of innovative solutions. This scale allows for a detailed analysis of the development of work skills. Using the same 7-point scale, employers were asked to rate the criticality of an IT specialist's proficiency in this job function for their organization (company). The job functions for assessment were selected from the IT specialist professional standard. Job function A, Software Code Development and Debugging, was selected for analysis in this study. It includes a number of subfunctions that are broken down into the following work activities:

A 1. Formalization and algorithmization of assigned tasks for developing software code.

A 1.1. Creating formalized descriptions of solutions and assigned tasks in accordance with the requirements of the technical specifications or the organization's internal documents.

A 1.2. Developing algorithms for solving assigned tasks in accordance with the requirements of the technical specifications or the organization's internal documents

A 1.3. Verifying the correctness of the algorithms for solving assigned tasks

A 1.4. Estimating and agreeing on deadlines for completing assigned tasks

A 2. Writing software code using programming languages for defining and manipulating data in databases

A 2.1. Creating software code in accordance with the technical specifications (ready-made specifications)

A 2.2 Optimizing software code using specialized software tools.

A 2.3. Estimating and agreeing on deadlines for completing assigned tasks

A 3. Formatting software code in accordance with established requirements

A 3.1. Bringing the names of variables, functions, classes, data structures, and files into conformity with regulatory and technical documents (standards and regulations) defining the requirements for the formatting of software code

A 3.2. Structuring source code in accordance with regulatory and technical documents (standards and regulations) defining requirements for program code formatting.

A 3.3. Commenting and marking up program code in accordance with regulatory and technical documents (standards and regulations) defining requirements for program code formatting

A 3.4. Formatting source code in accordance with regulatory and technical documents (standards and regulations) defining requirements for program code formatting.

A 3.5. Preparing technical documentation for computer software according to a specified standard or template

A 4. Working with a program code version control system

A 4.1. Registering changes to the program code source text in the version control system

A 4.2 Merging, splitting, and comparing program code source texts.

A 4.3 Saving changes to the program code in accordance with version control regulations

A 5. Checking and debugging program code

A 5.1. Analysis and verification of the program code

A 5.2. Debugging software code at the module level

A 5.3. Debugging software code at the level of intermodular interactions and interactions with the environment

A 5.4 Evaluating and agreeing on deadlines for completing assigned tasks.

3 RESULTS AND DISCUSSION

The summarized results and their comparative analysis are presented in Tables 1-3.

Table 1: Comparative analysis of employer requirements and the intermediate level of proficiency in job function A among second-year students. Job Function A. Program Code Development and Debugging.

Components of the labor function A	Labor actions (according to the standard)	Student assessment	Employer assessment (X-average meaning)	P is the probability of error
Formalization and algorithmization of tasks for software development	A.1.1.	2,38	4,50	0,04
	A.1.2	2,1	4,50	0,03
	A.1.3	1,33	4,33	0,01
	A.1.4	1,19	4,50	0,01
Writing software code using programming languages, defining and manipulating data in databases	A.2.1.	1,26	4,17	0,01
	A.2.2	1,05	4,33	0,01
	A.2.3	1,21	4,17	0,03
Designing software code in accordance with established requirements	A.3.1.	1,39	4,00	0,01
	A.3.2	1,22	4,00	0,01
	A.3.3	1,24	3,67	0,02
	A.3.4	1,13	3,83	0,02
	A.3.5.	1,08	4,33	0,01
Working with a software version control system	A.4.1.	0	3,17	0,01
	A.4.2	0	3,00	0,01
	A.4.3	0	3,00	0,01
5. Verifying and debugging software code	A.5.1.	0,83	3,83	0,02
	A.5.2	0	3,83	0,01
	A.5.3	0	3,50	0,01
	A.5.4	0	4,00	0,01
The significance of differences was evaluated using the Mann-Whitney test.				

A comparative study revealed a significant discrepancy between the current level of development of key job functions among second-year students and the requirements placed on them by IT employers. As

shown in Table 1, students' average scores for all tasks included in the "A. Software Code Development and Debugging" task are low (ranging from 0 to 2.38 points on a 7-point scale). However, employers' requirements are high (ranging from 3.00 to 4.50 points). Statistical analysis using the Mann-Whitney test confirmed that the identified differences are statistically significant ($p < 0.05$) for all tasks. The most problematic areas, where students' skills are practically undeveloped (scores close to 0), are:

- Working with a version control system (A.4). Students do not demonstrate skills in registering, merging, or saving code changes. This is a critical gap, as proficiency in version control is a mandatory basic skill for any developer today and a key element of teamwork.

- Debugging program code at the module and interaction levels (A.5.2, A.5.3). The inability to independently find and correct errors indicates a superficial understanding of program logic and a lack of practical problem-solving experience.

- Work activities related to the formalization and algorithmization of tasks (A.1) are in the initial stages of development (scores of 1.19–2.38). Students can work according to a model under the instructor's guidance but experience significant difficulties independently verifying the correctness of algorithms and estimating deadlines. Employers, however, rate the importance of these competencies extremely highly (4.33–4.50), as they underpin project planning and effective communication within a team.

- A similar picture is observed in the writing (A.2) and code formatting (A.3) blocks. Students demonstrate minimal skills, while employers critically value not only the ability to write code but also the ability to optimize it and format it in accordance with standards (employer ratings range from 3.67 to 4.33). This indicates a gap between academic assignments and industrial requirements for code quality and maintainability.

These data are fully consistent with the findings of researchers such as Bricout and Bentley regarding the existence of a "trust gap" between the potential of job seekers with disabilities and employer expectations (Bricout, Bentley, 2000). However, our study further elaborates on this gap, shifting it from general attitudes to an objective deficit in specific professional competencies. The identified gap is predictable and is due to objective factors:

- Stage of study: the second year is the initial stage of learning specialized disciplines.

- Lack of practical experience: the lack of real-world project experience in a production environment prevents students from testing and consolidating their theoretical knowledge. - a methodological gap: learning assignments are often academic and simplified in nature and do not replicate the full development lifecycle, including working with code versions, testing software code, etc.

Internships in secondary vocational education are a significant element of students' professional development. Thanks to them, students not only apply theoretical knowledge in real-world production settings and develop communication and adaptability skills but also master many job functions. For many students, internships help them find employment successfully, which is especially important for students with disabilities (Kharlamova, 2024), so the opinions and assessments of employers are extremely important to us.

This problem is particularly acute for students with disabilities, who, as Pamela Luft rightly notes, require an extended "transition period" to adapt to the workplace (Luft, 2015). Our analysis shows that without targeted development of these competencies already within the college, this adaptation period will be excessively prolonged or even unsuccessful, thus confirming the risks described in the literature. Table 2 presents a comparative analysis of the development of work function A. Software code development and debugging in neurotypical students and students with disabilities.

Table 2: Comparative analysis of the development of work actions in students with disabilities and neurotypical peers. Labor Function A. Program code development and debugging.

Components of labor function A	Labor actions (according to the standard)	Neurotypical students	Students with disabilities	P - probability of error
Formalization and algorithmization of tasks for software development	A.1.1.	2,37	2	0,24
	A.1.2	2,15	1,5	0,15
	A.1.3	2,05	1,5	0,18
	A.1.4	1,81	1,5	0,26
Writing software code using programming languages, defining and	A.2.1.	2,36	2,5	0,31
	A.2.2	2,09	2	0,76
	A.2.3	1,82	1,5	0,26

manipulating data in databases				
Designing software code in accordance with established requirements	A.3.1.	2,76	2	0,09
	A.3.2	2,45	1,5	0,05
	A.3.3	2,47	1,5	0,05
	A.3.4	2,36	1,5	0,11
	A.3.5.	2,15	1,5	0,13
Working with a software version control system	A.4.1.	0	0	-
	A.4.2	0	0	-
	A.4.3	0	0	-
Verifying and debugging software code	A.5.1.	1,66	1,5	0,53
	A.5.2	0	0	-
	A.5.3	0	0	-
	A.5.4	0	0	-
The significance of differences was tested using the Mann-Whitney test				

Based on the diagnostic results, we observe that second-year students are not capable of performing most work tasks. Only sixteen students perform some work tasks independently, without errors. The work task "A. Developing and Debugging Software Code" has been mastered by students thanks to courses such as "Fundamentals of Algorithmization and Programming" and "Fundamentals of Design and Databases." In our opinion, the reasons for the insufficient mastery of work tasks may include a lack of practical experience in production, the initial stage of studying specialized disciplines and modules, and low student motivation.

According to the data obtained, students with disabilities demonstrate a lower level of mastery of work tasks compared to their neurotypical classmates, but these differences are in most cases statistically insignificant, with the exception of A3. Formatting Software Code in Accordance with Established Requirements. A number of work tasks were not mastered by either neurotypical students or students with disabilities. Currently, students do not meet employer requirements for any of the work tasks. This is a negative finding, as Labor function A should be primarily developed in the initial courses.

4 CONCLUSION

Based on the conducted analysis, a set of measures can be proposed to align educational outcomes with labor market requirements:

1. Changes in the content and methods of instruction

– Shifting the focus toward project-based learning: introducing cross-cutting academic projects from the first year of study that simulate real work processes—from receiving technical specifications to project delivery—with mandatory use of version control systems and proper documentation.

– Integrating practice-oriented tools into the educational process: including automated testing systems and static code analyzers (at least at a basic level) in the curriculum as early as possible.

– Elective courses on “soft” competencies or short modules/workshops on task formalization, workload estimation, and time management, based on real cases from partner companies.

2. Systematic involvement of employers

– Establishing expert councils within the college: engaging representatives of IT companies in updating course syllabi and instructional materials with a focus on work tasks deemed critical by employers.

– Internships: organizing regular internships at partner companies with the appointment of mentors or tutors from the enterprise. For students with disabilities, such internships may be arranged within a network-based or remote learning format.

– Real business project requests: enabling student teams to complete real, albeit small-scale, assignments for businesses.

3. Targeted support for students with disabilities

– Development of individualized educational trajectories and pathways: within the framework of personalized learning, placing special emphasis on developing competencies that show the greatest gaps, using adaptive and assistive educational technologies.

– Implementation of a tutoring support system: assigning tutors—senior students, alumni, or employees of partner companies—to students with disabilities to assist them in mastering theoretical and practical material and overcoming academic, professional, and social challenges.

– Psychological and pedagogical support: focused efforts to develop soft skills, overcome learned helplessness, and foster professional confidence.

The conducted study confirmed the existence of a substantial and statistically significant gap between the level of proficiency in Labor Function A “Software Development and Debugging” among second-year IT students (including students with disabilities) and employers’ requirements. The most critical discrepancies were identified in the areas of version control system use, software debugging, and skills in task formalization and time estimation. It was established that the current educational program does

not fully ensure the development of competencies that are considered critical from an industry perspective. This creates additional barriers to employment for graduates, particularly for students with disabilities, who require a longer and more structured adaptation period.

In conclusion, it can be stated that the successful professional integration of people with disabilities into the IT sector requires a transformation of the educational process within the system of secondary vocational education. It should aim at proactive training based on close integration with employers' needs and the implementation of practice-oriented educational technologies. The proposed recommendations outline concrete pathways for bridging the identified gap and creating an effective model for training competitive IT specialists that fully embodies the principles of inclusive education. Future research will focus on developing and testing specific methodologies for forming underdeveloped competencies in inclusive learning environments.

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