PEDAGOGICAL CONDITIONS FOR DEVELOPING COMPETENCE IN OPERATING DIGITALLY CONTROLLED MACHINE TOOLS IN VOCATIONAL EDUCATION

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Abstract. This thesis examines the pedagogical conditions for developing students' competencies in operating digitally controlled machine tools within vocational education. The digitalization of modern production processes requires the content of vocational education to be aligned with the new requirements of production technologies. Effective operation of digitally controlled machine tools requires students not only to possess technological knowledge, but also to develop skills in using digital tools, planning technological processes, implementing program-based control, identifying technical problems, and making independent decisions. The study analyzes the content-related, methodological, practical, and organizational-pedagogical conditions for developing these competencies.

Keywords: vocational education, digitalization, digitally controlled machine tools, professional competence, practical competence, technological competence, pedagogical conditions, industrial training, digital technologies.

Аннотация. В тезисе освещаются педагогические условия формирования у обучающихся профессиональных компетенций работы на станках с цифровым управлением в процессе профессионального образования. Цифровизация современных производственных процессов обусловливает необходимость согласования содержания профессионального образования с новыми требованиями производственных технологий. Эффективная работа на станках с цифровым управлением требует от обучающихся не только технологических знаний, но и навыков использования цифровых инструментов, планирования технологического процесса, осуществления программного управления, выявления технических проблем и принятия самостоятельных решений. В исследовании анализируются содержательные, методические, практические и организационно-педагогические условия формирования данных компетенций.

Ключевые слова: профессиональное образование, цифровизация, станки с цифровым управлением, профессиональная компетентность, практическая компетентность, технологическая компетентность, педагогические условия, производственное обучение, цифровые технологии.

Annotatsiya. Mazkur tezisda kasbiy ta'lim jarayonida o'quvchilarning raqamli boshqariladigan dastgohlarda ishlash kompetensiyasini shakllantirishning pedagogik

shartlari yoritilgan. Zamonaviy ishlab chiqarish jarayonlarining raqamlashtirilishi kasbiy ta’lim mazmunini ishlab chiqarish texnologiyalarining yangi talablari bilan uyg‘unlashtirishni taqozo etmoqda. Raqamli boshqariladigan dastgohlardan samarali foydalanish o‘quvchidan texnologik bilimlar bilan bir qatorda raqamli vositalardan foydalanish, texnologik jarayonni rejalashtirish, dasturiy boshqaruvni amalga oshirish, texnik muammolarni aniqlash va mustaqil qaror qabul qilish ko‘nikmalarini talab etadi. Tadqiqotda mazkur kompetensiyani shakllantirishning mazmuniy, metodik, amaliy va tashkiliy-pedagogik shartlari tahlil qilinadi.

Kalit so‘zlar: kasbiy ta’lim, raqamlashtirish, raqamli boshqariladigan dastgoh, kasbiy kompetensiya, amaliy kompetensiya, texnologik kompetensiya, pedagogik shartlar, ishlab chiqarish ta’limi, raqamli texnologiyalar.

Today, the digitalization of production processes is leading to changes in the requirements placed on specialists working in the labor market. The widespread use of automated and digitally controlled machine tools in production has made the preparation of students in vocational education institutions for modern technological processes one of the pressing tasks of contemporary vocational education.

While traditional production processes require specialists to possess practical skills related to understanding the structure of machine tools, using equipment, and performing technological operations, working with digitally controlled machine tools additionally requires competencies in digital control, understanding program commands, determining technological parameters, and monitoring production processes.

From this perspective, preparing students to operate digitally controlled machine tools in vocational education cannot be limited to providing technical knowledge alone. It is necessary to organize the educational content, teaching methods, practical training, and assessment mechanisms in an interconnected and integrated manner.

Competence in operating digitally controlled machine tools encompasses students’ ability to understand technological processes, use digital control tools, organize machine tool operations in accordance with established technological requirements, and independently solve problems that may arise during the production process.

Competence Component	Content
Technological Component	Knowledge of metalworking processes, the sequence of operations, and technological requirements
Digital Component	Ability to use digital control systems and software tools
Practical Component	Setting up machine tools, performing technological operations, and monitoring the results
Problem-Solving Component	Identifying and resolving technical and technological problems that arise during the process

Reflective Component	Analyzing the results of completed work, identifying errors, and evaluating one's own activities

Thus, competence in operating digitally controlled machine tools should not be regarded as an individual skill, but rather as an integrated outcome of knowledge, practical actions, digital literacy, independent decision-making, and self-assessment.

A number of pedagogical conditions need to be ensured for the effective development of this competence among students.

The first condition is aligning the educational content with the requirements of modern production. Educational programs should consistently incorporate not only traditional metalworking technologies, but also knowledge related to digital control, automated production, technological software, and digital monitoring tools.

The second condition is the integration of theoretical and practical training. Students should not only understand the operating principles of digitally controlled machine tools theoretically but also be able to apply this knowledge in practical situations. Therefore, it is advisable to reinforce the knowledge acquired during theoretical lessons through practical tasks.

The third condition is the gradual increase in the complexity of vocational tasks. Initially, students may be introduced to the structure of machine tools and their control elements. Subsequently, they can perform operations based on predefined algorithms and then proceed to independently planning technological processes.

The fourth condition is the use of problem-based and practical situations. Along with performing predefined algorithms, students should be given tasks aimed at identifying potential problems arising during technological processes and finding appropriate solutions. This contributes to the development of independent professional thinking.

The fifth condition is the implementation of a competency-based assessment system. Such assessment should not be limited to testing theoretical knowledge; it should also take into account students' practical actions, their ability to make technological decisions, use digital tools, and evaluate the final results.

Educational content → theoretical preparation → practical task → independent technological activity → problem-based situation → outcome assessment → reflection

This sequence enables students to progress from acquiring basic knowledge to applying it independently in professional activities.

In developing competence in operating digitally controlled machine tools, it is advisable to rely on the integration of competency-based, practice-oriented, and technological approaches.

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In developing competence in operating digitally controlled machine tools, it is advisable to rely on the integration of competency-based, practice-oriented, and technological approaches.

Such tasks help students connect their technological knowledge with practical activities, develop the ability to make independent decisions, and develop a sense of responsibility for production outcomes.

Developing competence in operating digitally controlled machine tools in vocational education is one of the important conditions for preparing specialists who meet the requirements of modern production. This competence is not limited to the ability to operate a digital program or a machine tool; rather, it involves the integration of technological knowledge, digital literacy, practical activity, decision-making in problem-based situations, and reflective assessment.

To develop this competence among students, several important pedagogical conditions should be established, including adapting educational content to the requirements of digital production, integrating theoretical and practical training, gradually increasing the complexity

of vocational tasks, using problem-based situations, and implementing a competency-based assessment system.

As a result, vocational education should be oriented not merely toward teaching students to operate a particular machine tool, but toward preparing them for independent, technologically grounded, and responsible professional activity in a digital production environment.

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