# 5.2. PECULIARITIES OF USING DIGITAL PLATFORMS FOR PROFESSIONAL TRAINING OF SKILLED WORKERS IN THE ENGINEERING INDUSTRY

**Andrii Hurzhii**
**Doctor of Technical Sciences, Professor, Full Member (Academician) of the NAES of Ukraine, Chief Researcher of the Department of Digital Educational Resources of the Institute of Vocational Education of the NAES of Ukraine,**
**https://orcid.ore/0000-0001-6923-0830**
**a.m.hurzhii@gmail.com**

**Mykola Pryhodii**
**Doctor of Sciences in Education, Professor, Corresponding members of the NAES of Ukraine, Deputy Director for Research of the Institute of Vocational Education of the NAES of Ukraine,**
**https://orcid.org/0000-0001-5351-0002**
**prygodii@ukr.net**

*The benefits of digitalisation, including personalised learning, integration of SMART technologies and adaptive educational solutions, are analysed. The key challenges are identified, including industry-specific adaptation of platforms, lack of specialised learning resources, and the need for virtual simulators. The prospects for introducing artificial intelligence, gamification and the Internet of Things into the educational process are considered. Possibilities for improving the training of specialists through cooperation between educational institutions and industrial enterprises are outlined.*

***Keywords:*** *digital platforms, vocational education, mechanical engineering, adaptive learning, digital technologies.*

# 5.2. ОСОБЛИВОСТІ ВИКОРИСТАННЯ ЦИФРОВИХ ПЛАТФОРМ ПРОФЕСІЙНОЇ ПІДГОТОВКИ КВАЛІФІКОВАНИХ РОБІТНИКІВ МАШИНОБУДІВНОЇ ГАЛУЗІ

**Андрій Гуржій**
**доктор технічних наук, професор, дійсний член (академік) НАПН України, головний науковий співробітник відділу цифрових освітніх ресурсів Інституту професійної освіти НАПН України,**
**https://orcid.org/0000-0001-6923-0830**
**a.m.hurzhii@gmail.com**

**Микола Пригодій**
**доктор педагогічних наук, професор, член-кореспондент НАПН України, заступник директора з наукової роботи Інституту професійної освіти НАПН України,**
**https://orcid.org/0000-0001-5351-0002**
**prygodii@ukr.net**

*Проаналізовано переваги цифровізації, включаючи персоналізоване навчання, інтеграцію SMART-технологій та адаптивні освітні рішення. Визначено ключові виклики, зокрема галузеву адаптацію платформ, недостатність спеціалізованих навчальних ресурсів та потребу у віртуальних симуляторах. Розглянуто перспективи впровадження штучного інтелекту, гейміфікації та Інтернету речей у навчальний процес. Окреслено можливості покращення підготовки фахівців через співпрацю освітніх закладів із промисловими підприємствами.*

***Ключові слова:*** *цифрові платформи, професійна освіта, машинобудування, адаптивне навчання, цифрові технології.*

Since the 20s of the 21st century, digital technologies have become the basis for the transformation of most areas of human life around the world. As digitalisation covers all areas of human activity, it has inevitably affected educational institutions, including the vocational training system. The introduction of digital platforms in education provides access to quality training that meets the requirements of the times. In the context of current global changes (economic, political, technological), the vocational education system should respond to these challenges by adapting and introducing new teaching methods, including through the use of digital platforms (Pryhodii, 2024b).

In the context of the digital transformation of the engineering industry, there is a need to work with big data, artificial intelligence, automation of production processes, and the use of the latest technologies for the development and maintenance of machinery. In order to train specialists capable of working with such technologies, the education system should actively integrate digital platforms to create conditions for the development of new competencies and ensure a high level of qualification (Hurzhii & Pryhodii, 2024).

The future of digital platforms for skilled worker training looks promising. Every year, the number of tools that allow creating interactive, adaptive courses, using artificial intelligence to personalise learning, and conducting real-time knowledge assessment is growing (Radkevych et al., 2025). Given the rapid development of technology and the needs of the engineering industry, digital platforms are becoming an essential tool for improving training.

Traditional approaches to worker training, especially in the engineering industry, often do not meet the requirements of the modern labour market. This is due to a lack of flexibility in the educational process, limited opportunities for personalised learning, and a lack of quick access to new knowledge. At the same time, digital platforms are able to provide continuous updating of educational materials, interactivity, and individualised approaches to each vocational education student, which allows for effective training of skilled workers (Pryhodii, 2025).

There are a number of advantages to using digital platforms for skilled worker training. One of the main ones is access to training materials in any convenient way, which allows you to study at your own pace and time. Digital platforms also provide ample opportunities for integration with other information systems, including production systems, which allows training to

be organised on-site or off-site. The use of virtual laboratories, simulators and training simulators allows students to practice in real-world conditions without risking safety. From this perspective, digital platforms can significantly improve the quality of skilled worker training (Pryhodii et al., 2023).

The introduction of digital platforms in vocational education is actively developing in many countries around the world. For example, countries in the European Union (CEDEFOP, n.d.), the United States (Neendoor, 2024), and Japan (Slashdot, 2025) have long been implementing such technologies, which not only improve the effectiveness of training but also ensure the mobility of workers in the international labour market. Studying the experience of these countries can help adapt their achievements to Ukrainian realities. At the same time, Ukraine is also making powerful steps in introducing digital platforms in vocational education, but the process requires further research and adaptation to the specifics of the Ukrainian education system and industry (Ministerstvo osvity i nauky Ukrayiny, n.d.).

In the scientific and pedagogical literature, there is a variety of approaches to defining the concepts of ‘digital educational platforms’, ‘digital learning platforms’ and ‘digital vocational training platforms’ (Ministry of Education and Science of Ukraine, n.d.). The absence of a single established terminology can complicate the research, practical implementation and effective use of these platforms in the vocational education system. A clear distinction and analysis of different variations of definitions contributes to a deeper understanding of their functionality, scope and potential impact on the training of future professionals. Therefore, it is important to study the specifics of each of these concepts, their interrelationships and differences, which will allow for more effective strategies for the digitalisation of vocational training.

Digital learning platforms are integrated environments that provide access to learning content, facilitate interaction between teachers and learners, and offer learning management tools (Josue et al., 2023).

These platforms typically support a variety of learning methodologies, including blended learning, self-paced learning, and interactive content delivery. Key features of digital learning platforms include (Pryhodii, 2025):

- Learning management system (LMS) capabilities that provide structured course management and tracking of learners' progress;
- integration of multimedia content, including video lectures, interactive simulations and virtual laboratories;

- collaboration tools such as discussion forums, chat functions and virtual classrooms for communication between students and teachers;
- assessment and analytics, including automated testing, progress monitoring and personalised feedback.

The main focus of digital learning platforms is on the transfer of theoretical knowledge and broad subject coverage. Although they are used for vocational training, their universal nature may require additional customisation to meet the specific training needs of skilled workers in the engineering industry.

Digital learning platforms share many similarities with digital education platforms, but emphasise flexibility, adaptive learning, and personalised learning experiences (Blyzniuk, 2021). These platforms typically use artificial intelligence and machine learning algorithms to adapt content based on learners' progress and preferences. The distinctive features of digital learning platforms are:

- adaptive learning paths that dynamically adjust the curriculum to the individual skills and knowledge levels of learners;
- gamification elements such as badges, leaderboards and interactive tasks that increase motivation to learn;
- support for mobile learning, which provides access to learning content from any device;
- cloud accessibility, which ensures seamless integration with various third-party tools and resources.

Digital learning platforms are particularly effective for organising self-directed learning based on competence development. In vocational training, they can complement practical classes with digital resources, bridging the gap between theory and practical application.

In contrast to digital education and training platforms, digital vocational training platforms are specifically designed to support the acquisition of practical skills in professional fields. These platforms integrate advanced technologies such as augmented reality (AR), virtual reality (VR) and digital twins to simulate real industrial processes. The key characteristics of digital vocational training platforms are aimed at (Hurzhii & Pryhodii, 2024):

- task-based learning, where learners engage in interactive practical exercises directly related to industry needs;
- simulation tools that allow users to practice equipment handling, assembly processes and troubleshooting in a virtual environment;

- competency-based assessment, which ensures that users are qualified to industry standard through skills testing and certification;
- integration with Industry 4.0 technologies, enabling real-time data exchange, remote monitoring and training using the Internet of Things.

These platforms are closely aligned with the needs of the engineering industry, providing immersive, hands-on learning experiences. They facilitate the acquisition of skills in a controlled and cost-effective manner, reducing the need for physical resources and minimising the risks associated with on-the-job training.

All three types of digital platforms serve educational purposes and share common features: online access to educational resources; tools for interaction and collaboration; assessment and tracking of learners' progress; and integration with external content and tools. However, their main functions and applications differ:

- digital learning platforms focus on structured, theoretical learning with a broad curriculum;
- digital learning platforms emphasise flexibility, personalised learning and gamification;
- digital vocational training platforms provide practical skill development through simulations and problem-based learning.

The development of digital platforms has transformed vocational training in various industries, including engineering. These platforms offer innovative solutions that improve the acquisition of skills, increase the efficiency of learning, and meet the current requirements of the industry. The following analyses the features of digital platforms in the professional training of skilled workers in the engineering industry (Pryhodii, 2024b).

Digital platforms developed for the engineering industry include industry-specific tools, simulations, and real-world applications that enhance learning. They integrate computer-aided design (CAD) and computer-aided manufacturing (CAM) software, allowing students to design, test, and optimise machine components before production. In addition, computer numerical control (CNC) programming simulators allow students to gain experience with automated manufacturing processes without the risks and costs associated with actually operating machines (Pryhodii, 2024a).

Moreover, these platforms often include digital twins that create virtual representations of real machines and systems. Learners can interact with these models to simulate work scenarios and troubleshoot in a controlled environment. This *industry-specific adaptation* ensures that the

training materials and simulations are in line with the latest developments and trends in the engineering sector, preparing workers for real-world challenges (Profosvita, n.d.).

*Blended learning* combines online learning with hands-on training to optimise skill development. Digital platforms offer e-learning modules, training videos and interactive exercises that facilitate the learning and testing of theoretical concepts. This self-paced learning allows trainees to acquire fundamental knowledge before embarking on an apprenticeship (European Commission, n.d.).

In addition, virtual and augmented reality (VR/AR) technologies are integrated into training programmes, providing an immersive experience where employees can interact with machinery in a virtual space. VR-based training reduces the risk of accidents and improves understanding by allowing learners to perform complex tasks in a simulated environment before operating real equipment.

The blended approach also includes remote access to laboratories where vocational trainees can control physical machines through cloud-based systems, bridging the gap between theoretical learning and practical application. This hybrid model ensures that workers develop both the cognitive and technical competencies required by the engineering industry.

The emergence of Industry 4.0 has brought new technologies to the manufacturing sector, requiring corresponding changes in vocational training to *integrate learning with SMART manufacturing technologies* (Pryhodii et al., 2022).

Digital platforms integrate Internet of Things (IoT) sensors, artificial intelligence (AI) and big data analytics to expose vocational learners to the modern manufacturing environment.

Through IoT integration, students can analyse machine data in real time, monitor performance and predict maintenance needs. AI-based tools support decision-making by identifying patterns and recommending process optimisation. These features prepare skilled workers for smart factories, where automation and data analytics play a crucial role in increasing productivity and efficiency.

In addition, the robotics modules allow vocational students to program and operate robotic systems used in processing and assembly lines. The integration of SMART technologies into the curriculum ensures that employees acquire the competencies necessary for career development in the modern manufacturing environment.

Digital platforms enable *remote access and flexibility*, making vocational training more accessible to learners regardless of their location. Online courses, webinars, and virtual laboratories allow learners to participate in skill development without the need to be physically present at educational institutions (Josue et al., 2023).

Flexibility is particularly useful for learners in remote areas, people with busy work schedules, and those seeking to upgrade their skills while maintaining their jobs. Mobile-compatible learning platforms further increase accessibility by allowing learners to access content on smartphones and tablets.

In addition, cloud-based learning solutions facilitate collaborative learning, where vocational learners can interact with teachers and colleagues through discussion forums, video conferencing, and real-time project collaboration. This flexibility ensures that learners can study at their own pace while maintaining a work-life balance.

Modern digital platforms include *adaptive learning technologies based on artificial intelligence* that personalise the educational process. Artificial intelligence algorithms analyse the user's progress, identify their strengths and weaknesses, and adapt the educational process accordingly (Radkevych et al., 2025).

Intelligent learning systems provide instant feedback, offer additional resources, and adjust the complexity of exercises according to the level of training of students. Gamification elements, such as quizzes, tasks and achievement badges, increase engagement and motivation.

Additionally, AI-powered virtual assistants and chatbots support learners by answering questions, guiding them through complex procedures, and offering real-time help to resolve complications. Adaptive learning ensures that each vocational trainee receives an individualised learning experience, optimising knowledge retention and skill acquisition.

Effective vocational training requires cooperation between educational institutions, training centres and leading companies in the machine building industry. Digital platforms facilitate partnerships by enabling direct interaction between students and industry professionals.

*Cooperation with industry partners* provides access to real-life cases, expert lectures and mentoring programmes, helping vocational students gain insight into current trends and challenges. Companies can offer virtual internships where students work on real industrial projects under the supervision of experts (Evans et al., 2023).

In addition, corporate learning portals allow companies to customise training modules to meet their specific workforce needs. Such collaboration ensures that the curricula remain relevant, in line with industry needs and technological advances in the engineering sector.

Digital platforms support competency-based learning, where vocational learners progress based on the acquisition of skills rather than time spent studying. *Competency-based certification and assessment* ensures that each learner meets professional standards before progressing to the next level (Europass, n.d.).

Automated assessments, including simulation-based assessments, measure practical skills by requiring vocational learners to complete tasks in a virtual environment. Artificial intelligence-based assessment systems provide objective assessments, highlighting areas for improvement.

Upon successful completion of the training, vocational learners receive digital certificates that serve as verifiable proof of their competencies. These digital certificates increase the chances of employment and career development as they meet industry-recognised standards.

One of the important advantages of digital learning platforms is *cost-effectiveness and resource optimisation.* Traditional teaching methods require significant investment in physical infrastructure, equipment and learning materials. Digital solutions reduce these costs (per student by 25-30%) through virtual simulations and cloud-based learning environments (Shah, 2024).

In addition, distance learning eliminates the need for travel costs and minimises equipment downtime, as employees can practice in a simulated environment before using real equipment. Digital platforms also enable the reuse of training materials, reducing the cost of developing new training programmes.

By optimising resource allocation and reducing operational costs, digital platforms make high-quality training more accessible and sustainable. Companies benefit from a well-trained workforce without the burden of excessive training costs.

Thus, the peculiarities of using digital platforms for professional training of skilled workers in the mechanical engineering industry include: industry adaptation; blended learning; integration of learning with SMART production technologies; remote access and flexibility; adaptive learning technologies based on artificial intelligence; cooperation with industry

partners; competency-based certification and assessment; cost-effectiveness and resource optimisation.

To identify the current state of use of digital platforms for the professional training of skilled workers in the mechanical engineering industry, a survey of 76 teachers of vocational education and training institutions in the mechanical engineering sector was conducted. The respondents evaluated various aspects of the use of digital platforms on a four-level scale ('sufficient', 'medium', 'low', 'insufficient').

In general, the survey was conducted in a mixed format - both in the form of an online survey and through individual interviews with teachers. The survey participants represented different regions of Ukraine and had different levels of experience in using digital technologies in the educational process. This made it possible to obtain a variety of opinions on the effectiveness of digital platforms and their relevance to the needs of modern vocational education in the engineering industry.

The survey revealed significant differences in the levels of sectoral adaptation of digital platforms (Figure 5.1).

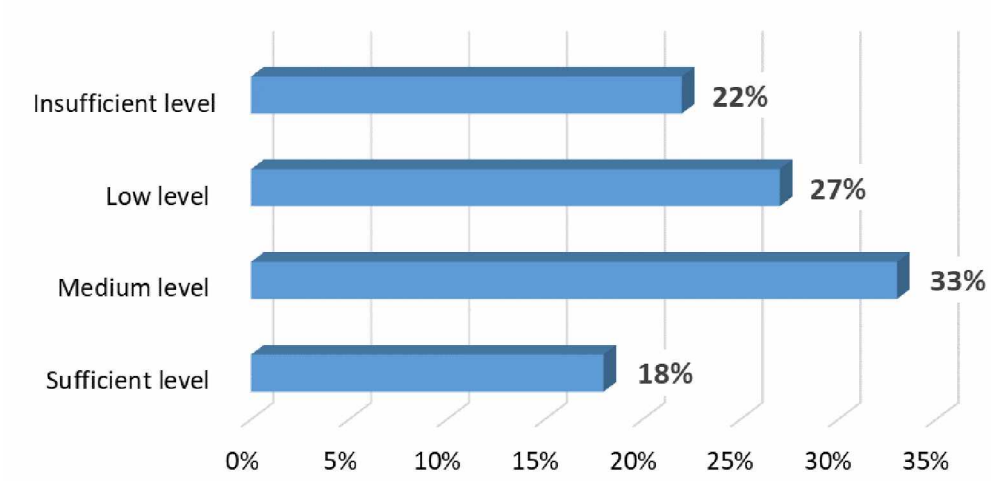


*Figure 5.1*
Level of industry-specific adaptation of digital platforms.
Note. Created by the author.

The analysis of the responses showed that the effectiveness of platforms largely depends on their compliance with the specifics of machine building production. The main challenges identified are the lack of

specialised training resources and the difficulty in setting up platforms for integration with production processes.

A detailed analysis also showed that most learning platforms contain general educational materials that do not take into account the specifics of mechanical engineering. This complicates learning, as teachers are forced to adapt the content manually, which takes a lot of time. In addition, the study identified the need to develop specialised modules for automated production control systems and material handling, which would significantly increase the level of adaptation of the educational process to the real conditions of the industry.

Evaluation of the implementation of blended learning based on digital platforms has demonstrated good results (Figure 5.2).

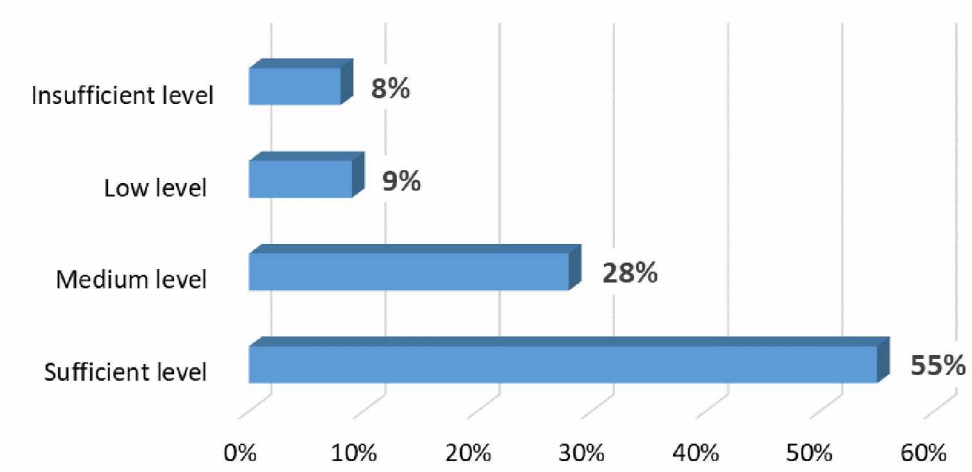


*Figure 5.2.*
Level of implementation of blended learning based on digital platforms.
Note. Created by the author.

On the positive side, most teachers use digital platforms to prepare theoretical materials and conduct tests. However, respondents point to difficulties in organising practical classes due to the lack of virtual laboratories and simulators.

The analysis of the responses showed that teachers often use blended learning for theoretical training, but face difficulties in delivering practical classes. The majority of respondents noted that it is necessary to expand the capabilities of digital platforms in terms of interactive simulations, which will allow vocational students to acquire practical skills in a virtual

environment. In addition, some teachers stressed the need to introduce cloud-based solutions for modelling production processes.

The survey results show that the level of integration of digital platforms with SMART technologies in production is insufficient (Figure 5.3).

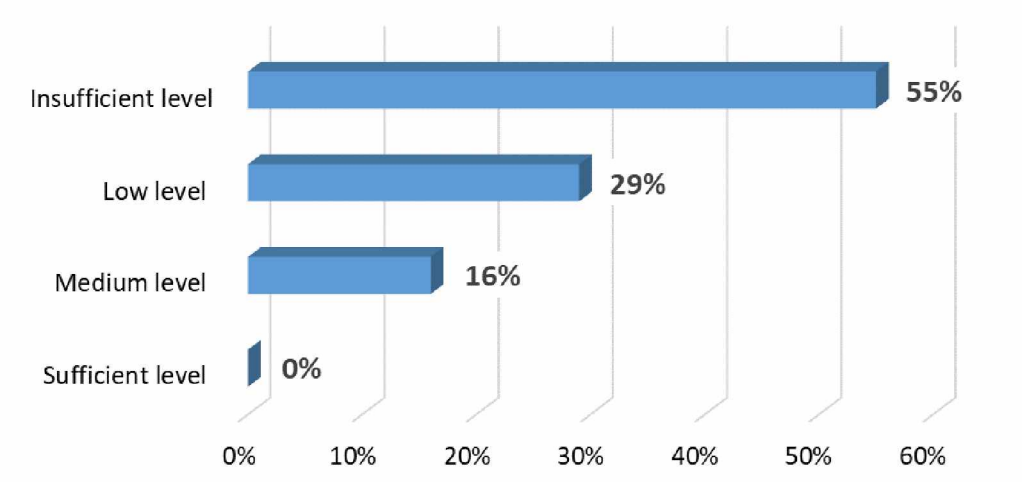


*Figure 5.3*

Level of integration of digital platforms with SMART technologies in production.

Note. Created by the author.

It is noted that the key barriers are the lack of appropriate software packages and insufficient qualifications of teachers to use them. At the same time, institutions that actively cooperate with businesses demonstrate a higher level of integration of such technologies into the educational process.

The survey also showed that the best results are demonstrated by educational institutions that have established partnerships with industrial enterprises, which allows them to provide students with access to modern SMART technologies. At the same time, there is a need to expand the number of training courses focused on the use of automated production systems and digital twins, which will allow future professionals to better adapt to the conditions of modern production.

A significant number of respondents noted the convenience of digital platforms in providing remote access (Figure 5.4).

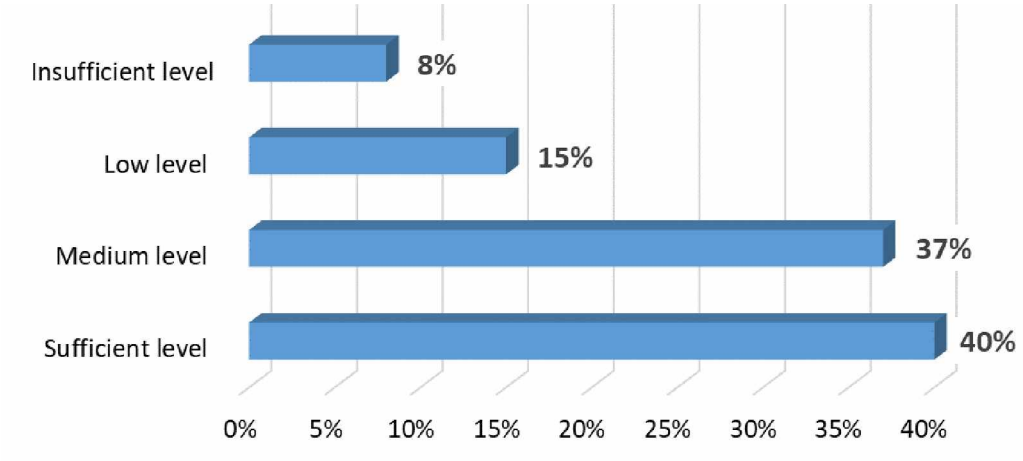


*Figure 5.4*
Level of provision of remote access.
Note. Created by the author.

The main advantage is the ability to access learning materials at any time and place, which contributes to the individualisation of the educational process. At the same time, challenges are associated with the quality of the Internet connection and the need for more effective methods of monitoring the learning activities of vocational education students. Some teachers also note the need to improve mechanisms for monitoring academic integrity in distance learning.

The level of use of adaptive learning technologies based on artificial intelligence is relatively low (Figure 5.5).

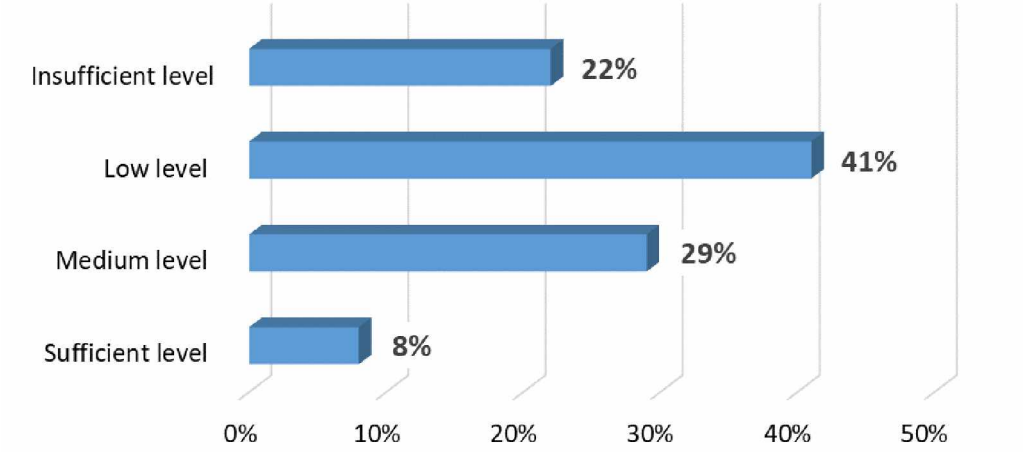


*Figure 5.5*
Level of use of adaptive learning technologies.
Note. Created by the author.

The main obstacles are the high cost of developing and implementing such solutions, as well as the limited availability of ready-made adaptive platforms focused on the machine-building industry. Nevertheless, respondents noted the prospects of introducing such technologies, in particular for automated knowledge assessment and personalised learning paths. Some educational institutions are already beginning to use elements of artificial intelligence to adapt curricula to the individual needs of vocational students.

The survey results show that cooperation with businesses in using digital platforms in education is uneven (Figure 5.6).

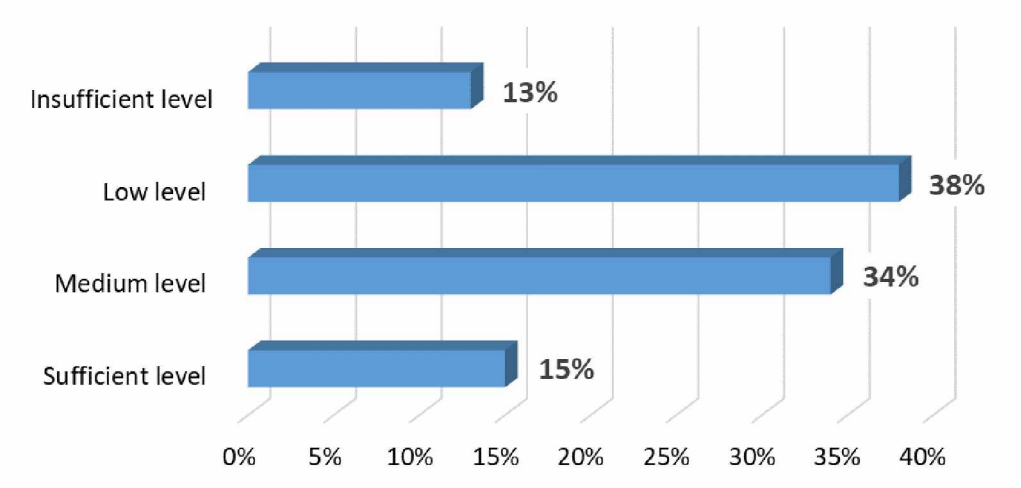


*Figure 5.6.*
Level of collaboration with enterprises within the digital platform.
Note. Created by the author.

The main difficulty is the lack of integrated programmes that would allow educational and production institutions to be connected in a single digital environment. At the same time, successful examples of such cooperation point to the effectiveness of dual education and the improvement of graduates' skills. A significant number of respondents emphasise the importance of expanding such partnerships through the joint creation of digital educational resources.

The assessment of digital platforms by the criterion of competence certification and assessment showed an average distribution (Figure 5.7).

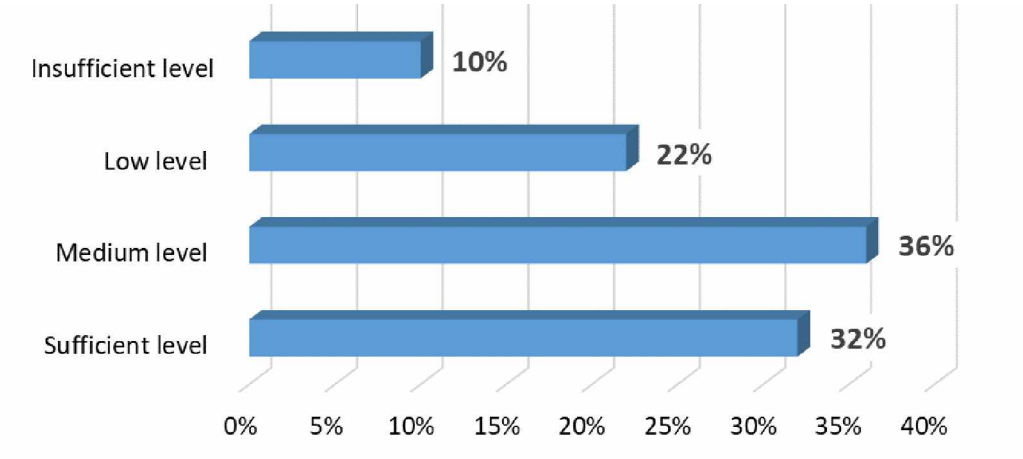


*Figure 5.7*
Level of certification and assessment based on competencies.
Note. Created by the author.

The respondents believe that digital platforms contribute to the objectivity of assessment through automated tests, but note the need to expand the forms of assessment, including integration with production projects. Another important aspect is the possibility of using digital platforms to certify specialists in accordance with international standards.

The study of the level of cost-effectiveness of digital platforms revealed the following results (Figure 5.8).

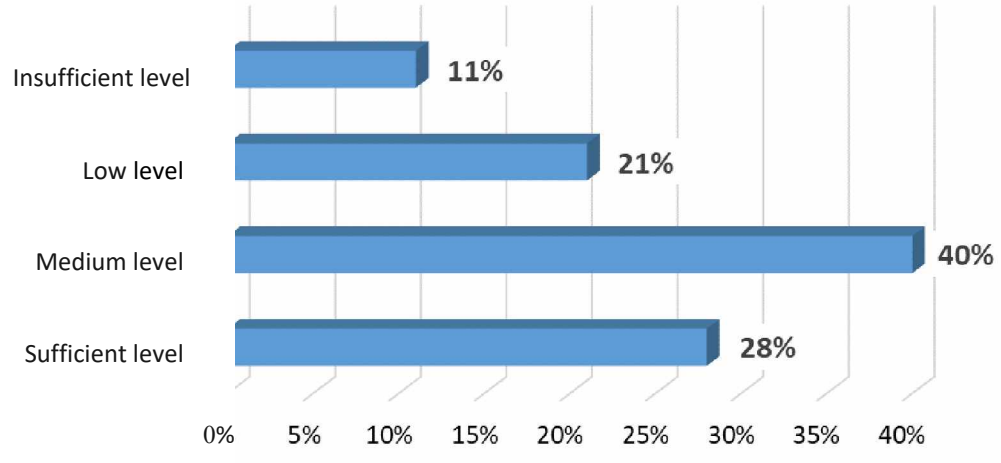


*Figure 5.8*
Level of economic efficiency of digital platforms.
Note. Created by the author.

A significant part of the respondents noted a reduction in the cost of printed materials and an increase in the efficiency of the educational process in its theoretical aspect, while in terms of professional and practical training, one third of the respondents noted the inadequacy of platforms to address this issue. Teachers also note that the cost of licences and technical support can be significant, requiring additional budgetary resources or grant programmes.

The survey results indicate that digital platforms are being actively introduced into the professional activities of mechanical engineering teachers, but the level of use of various aspects varies considerably. The main challenges remain industry-specific adaptation of platforms, integration with production technologies, expanding the possibilities of competency-based assessment, and the use of adaptive learning technologies. At the same time, the growing level of remote access, cooperation with enterprises and gradual optimisation of resources are positive trends.

As the machine building sector continues to evolve, digital learning solutions will play a crucial role in shaping the future workforce, driving innovation and increasing industrial efficiency.

The key features of an effective digital training platform for skilled workers in the mechanical engineering industry are task-based learning, simulation tools, competency-based assessment and integration with advanced industrial technologies. These features ensure that workers acquire practical skills in a safe and controlled digital environment before moving on to real-world applications in a production environment.

The integration of AI, augmented and virtual reality, and the Internet of Things into training platforms enhances the learning experience by making it more engaging and aligned with industry requirements. To maximise the benefits of digital vocational training, vocational education and training institutions and businesses should cooperate to ensure that the training content remains relevant and in line with technological advances in the engineering industry. This approach will help to prepare a workforce that is well equipped to meet the changing needs of modern manufacturing.

Thus, effective use of these features ensures the modernisation of the vocational education system, focused on the needs of the industry. The industry environment adapts learning to real-world conditions, and the blended learning approach increases flexibility and engagement. Integration with intelligent manufacturing technologies prepares students for digital transformation, and remote access ensures continuity of learning. Adaptive

learning with artificial intelligence personalises learning, improving results. Collaboration with industry partners enhances workforce readiness, and competency-based certification provides proof of skills. Finally, cost-effectiveness and resource optimisation increase accessibility and sustainability, making vocational education more efficient and effective.

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