Challenges and Opportunities for Vocational Education Teachers in the Context of Social and Technological Change

Dáša Porubčanová[1], Silvia Jakabová[2], Katarzyna Frączewska-Wójt[3]

Abstract

This article analyses the challenges and opportunities faced by vocational education teachers in secondary schools within the context of ongoing social and technological transformation. It focuses on the impact of pedagogical innovation, digital tools, and organisational mechanisms on teacher professionalism and the quality of practical training. The theoretical and empirical sections of the study intersect current trends in vocational education with the everyday realities of teachers, culminating in recommendations aimed at increasing the effectiveness and relevance of practical teaching in secondary schools.

Keywords: Innovation; Competences; Modern Technologies; Professional Development; Vocational Education Teacher; Vocational Education

1   Introduction

Practical training represents a crucial component of vocational education - one highly dependent on technological developments, material conditions, and the teacher's didactic preparedness. Current social and technological shifts are transforming not only the nature of professional activities but also the qualification requirements expected of secondary vocational school students. The vocational education teacher thus enters the instructional environment as a professional who must ensure the acquisition of technological processes while simultaneously supporting the development of competences aligned with contemporary trends in industry and services. Their work is therefore shaped by the need for

---

[1] DTI University, Sládkovičova 533/20, Dubnica nad Váhom, Slovakia.
E-Mail: porubcanova@dti.sk
[2] DTI University, Sládkovičova 533/20, Dubnica nad Váhom, Slovakia.
E-Mail: jakabova@dti.sk
[3] DTI University, Sládkovičova 533/20, Dubnica nad Váhom, Slovakia.
E-Mail: wojt@dti.sk

flexible reactions to change, the adaptation of teaching methods, and the integration of digital solutions into traditionally manual settings (Lobotková, et al., 2025).

2 Theoretical Background

Modern didactic concepts of vocational education Wyszynska and Andersson (2024), Szőköl and Gabrhelová (2024), emphasise a multidisciplinary connection between theory and practice, supporting students' adaptability in technologically adjusted working environments. Pecina and Krištofiaková (2021) define the vocational education teacher as a key professional and didactic 'element', integrating technological processes, work procedures, and situational learning into a coherent system of professional preparation. Their model highlights three crucial determinants of effective practical instruction:

1. the quality of material conditions,
2. the organisational structure of teaching, and
3. the teacher's didactic competence.

Among these, the teacher's ability to manage instruction under variable and technologically evolving conditions is currently the most exposed to external pressures.

Technological innovation, especially within the frameworks of Industry 4.0 and 5.0, is increasingly influential, reshaping manual activities, work processes, and labour market expectations. Research presented at technical conferences (Vulic et al., 2024) shows that digitalisation, sensor-based systems, automation, and virtual simulation environments demand a reconceptualisation of practical training, shifting emphasis from procedural memorisation toward analytical, diagnostic, and process-oriented thinking. The authors Barnová et al. (2024), Tamášová and Matušová (2021) also notes that digital environments heighten cognitive load, necessitating well-designed feedback mechanisms and differentiated tasks.

Theoretical models such as those by Timiras et al. (2024) demonstrate that technological transformation is not isolated; new soft skills have emerged as essential prerequisites for professional adaptation. Employer studies identify key competences needed at labour market entry: communication, teamwork, learning ability, analytical thinking, problem solving, and adaptability. These competences evolve in workplaces and thus must be embedded in practical instruction, where teachers address real or simulated problem scenarios. The observed disparity between employer expectations and student mastery, the so-called competence mismatch, adds further urgency to modernising vocational education.

Scholarship on vocational and technical education also references pedagogical adaptability, wherein traditional craft methods merge with digital technologies. IEEE research (2024) reports that augmented reality (AR), virtual reality (VR), digitisation, visualisation, and AI supported tools fundamentally change how students acquire workshop-based and vocational skills (Šimek, et al., 2024). Such technologies allow teachers to model risk situations that would

be unsafe in real life while enhancing the precision and safety of training. Consequently, the teacher's role evolves, from instructor of manual procedures to curator of a digital learning environment who manages stimuli, directs attention, and regulates interaction with technology.

However, digital tools alone do not guarantee enhanced learning outcomes. Wyszynska and Andersson (2024), stress that their benefits manifest only when embedded within a clearly structured pedagogical design. Without such grounding, instruction risks becoming fragmented, cognitively overwhelming, and demotivating.

In the context of rapid societal change, the professional identity of the vocational education teacher becomes especially significant. Research (Sorensen, 2022; OECD, 2022) emphasises the teacher's role as mediator between technology and the world of work, requiring competences in digital didactics, technological integration, pedagogical reflection, inclusive teaching, and safe learning environments.

According to Bilčík and Bilčíková (2023), employers increasingly value 'green skills', competences related to sustainability, reflecting a shift toward circular, environmentally conscious economies. Their integration into practical training introduces new didactic challenges, particularly in engineering, electrical engineering, and gastronomy.

Recent research (Vochozka et al., 2023 a, 2023b) has shown suggest that vocational education must cultivate adaptive experts capable of addressing unpredictable problems and learning in technologically evolving environments. The teacher's role thus extends beyond transmitting skills. They must design learning situations that foster creativity, autonomy, responsibility, and safety.

Increasingly, didactic personalisation is also expected. According to IEEE (2024), AI enables the real-time identification of individual learning needs, adaptive pacing, precise error diagnosis, and personalised assignments. Teachers therefore influence not only *what* students learn, but also *how deeply* learning is internalised and transferred to practice.

Overall, contemporary vocational teachers face an interconnected set of didactic, technological, organisational, and value-oriented challenges (Voráč, Kopecký, 2021; Gawrych, 2022). Simultaneously, trends such as digitalisation, automation, sustainability, and labour market restructuring provide new opportunities for modernising practical training, improving its quality, and aligning education with current economic needs.

3   Methods

The methodological framework of this study combined content and comparative analysis of scholarly sources with the synthesis of data from recent empirical studies on practical training in Slovak and Polish vocational schools. The aim was to identify common determinants influencing the effectiveness of practical training in the context of social and technological change.

The quantitative sample consisted of 112 vocational education teachers from Slovakia and Poland, selected based on a minimum of three years' teaching experience, representation of diverse vocational fields (technical, service area, economic), and regional diversity. Data were collected through an electronic questionnaire. The qualitative component included nine semi-structured interviews with teachers from both countries, enabling deeper interpretation of their experiences, needs, and suggestions for improving pedagogical practice.

4 Results

The analysis of sources and empirical data highlighted several key determinants shaping the quality of practical training today.

1. **Didactic preparedness of teachers**

Several of the authors mentioned above stress the need for continuous updating of pedagogical and technological competences in response to the changing nature of work. In the research carried out, teachers reported that their ability to integrate new technologies directly influences instructional effectiveness.

2. **Quality of material and technical equipment**

Functional workspaces, access to modern tools, and digital simulation environments enhance skill acquisition and improve safety. Schools that invest systematically in workshop modernisation demonstrate significantly higher student success rates.

3. **Organisational mechanisms within schools**

School culture, staff collaboration, and communication between management and teachers strongly affect the implementation of innovations. Teachers emphasised that management support is crucial for adopting new methods and digital tools.

4. **Generational differences in digital tool adoption**

The youngest teachers (under 40) reported the highest usage of digital tools (92%). Usage declined among teachers aged 40–49 (85%) and was lowest in the 50+ group (66%).
These findings align with European studies indicating a generational gap in digital readiness (Vulic et al., 2024).
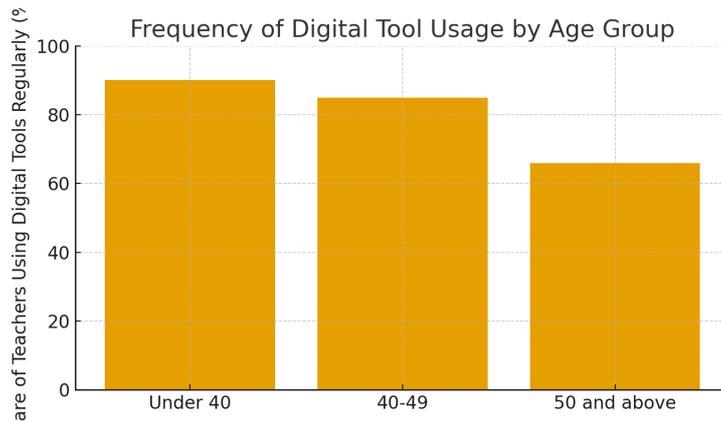
Graph 1: Frequency of Digital Tool Usage by Age Group.

5. Insufficient professional training in digital competence

Only 38% of teachers considered school provided digitalisation training adequate. A majority (55%) requested more targeted, practice based, and subject specific training. The remaining 7% were undecided. These results mirror findings from Timiras (2024), which stress the need for systemic and field-specific professional development.
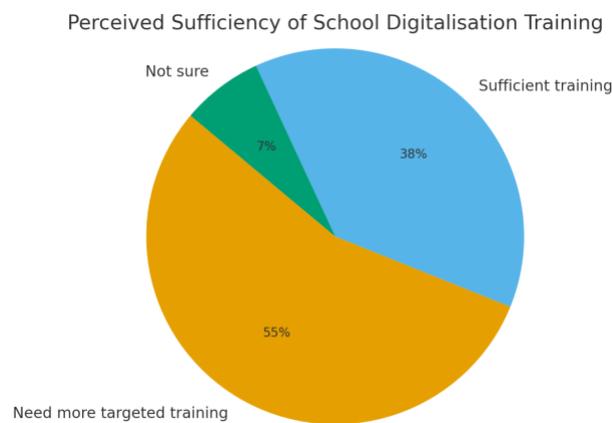
Graph 2: Perceived Sufficiency of School Digitalisation Training.

5   Discussion

The findings indicate that practical training in vocational education is undergoing fundamental transformation. Technological innovation must be integrated into pedagogy in ways that reflect student needs and instructional goals. Successful innovation depends on the teacher's willingness to adapt, their ability to work with digital tools, and the availability of methodological guidance and reflective professional spaces.

A major theme concerns balancing manual and digital learning components. While practical, hands-on experience remains irreplaceable, digitalisation offers enhanced opportunities for safe, repeatable, and detailed simulations that cannot be executed in real conditions. Vocational teachers thus gain opportunities to enrich traditional instruction with technological solutions, improving precision, engagement, and safety.

6   Conclusion

Practical training is increasingly shaped by rapid technological and social change. The vocational education teacher serves as expert, coordinator, and facilitator within this evolving landscape.

The findings show that effective practical training requires a combination of didactic preparedness, quality material resources, supportive school management, and the thoughtful integration of new technologies aligned with student needs.

The study highlights the pressing necessity for systematic professional development and the continuous modernisation of practical classrooms, ensuring that vocational education remains responsive to changing labour market demands.

References

Barnová, S., Duda, M., Matulčíková, M., Gabrhelová, G., & Hrivíková, T. (2022). Further professional on-the-job training of employees in the digital era. *International Journal of Engineering Pedagogy, 12*(5), 54–67. https://doi.org/10.3991/ijep.v12i5.32523

Bilčík, A., & Bilčíková, J. (2023). Edukácia k environmentálne zodpovednému správaniu. In L. Zapletal, A. Lobotková, I. Szőköl, & B. Švábová (Eds.), *Didakticko-odborové súvislosti pregraduálnej prípravy učiteľov 1 (I)* (pp. 66–71).

Gawrych, R. (2022). *Czynniki motywujące uczniów do uczenia się* [In Polish]. Wyższa Szkoła Społeczno-Ekonomiczna w Gdańsku.

IEEE. (2024). Artificial Intelligence-Based Approaches for Enhancing Vocational Education and Training within Industry 4.0 Paradigm. *2024 19th International Conference on Computer Science & Education* (ICCSE). https://ieeexplore.ieee.org/abstract/document/10662998

Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development.* Prentice Hall, Englewood Cliffs.

Lobotková, A., Marks, I., & Doríčková, M. (2025). Psychologický faktor sebahodnotenia učiteľa a jeho vplyv na edukačnú realitu. In G. Kartawa-Maślakiewicz (Ed.), *Psychologia w edukacji i zarządzaniu: współczesne wyzwania i perspektywy* (pp. 139–147). Wydawnictwo PRYMAT.

OECD. (2019). *Measuring Innovation in Education 2019: What Has Changed in the Classroom?* OECD Publishing, Paris. https://doi.org/10.1787/9789264311671-en

OECD. (2022). *Teaching as a Profession: Lessons from Around the World.* OECD Publishing, Paris. https://doi.org/10.1787/5f7e8afc-en

Sorensen, N. (2022). *The Improvising Teacher: Reconceptualising Pedagogy, Expertise and Professionalism* (1st ed.). Routledge. doi.org/10.4324/9781003223207

Šimek, V., Gawrych, R., & Vojtášová Berová, S. (2024). Možnosti aplikace vizualizace v edukaci žáků středních odborných škol [In Czech]. In Z. Huľová & E. Bolčová (Eds.), *Trendy v technickom dištančnom, hybridnom a v prezenčnom vzdelávaní na základných a stredných školách* (pp. 47–57). VERBUM.

Pecina, P., & Krištofiaková, L. (2021). *Vybrané aspekty výuky odborných předmětů a praktického vyučování na středních odborných školách* [Electronic textbook]. Vysoká škola DTI. https://www.dti.sk/data/files/file-1634710379-616fb36bd3a6a.pdf

Szőköl, I., & Gabrhelová, G. (2024). The concept of competition in educational evaluation. *Ad Alta: Journal of Interdisciplinary Research, 14*(1), 247–251.

Tamášová, V., Matúšová, S., & Tandlich, R. (2022). Innovations in in-service training of university teachers in digital competencies. In J. Kříž & Z. Svobodová (Eds.), *Adult Education 2021 – In diverse learning environments: Proceedings from the 11th International Scientific Conference, Prague, 14–15 December 2021* (pp. 81–97).

Timiras, L. et.al (2024). Key Professional Competencies for Graduates in the Job Market: An Analysis of Employer Expectations in 2024. *Studies and Scientific Researches.* Economics Edition. 10.29358/sceco.v0i40.596.

Vochozka, M., Absolon, J., & Absolonová, J. (2023a). *Odborovo-didaktické súvislosti v didaktike profesijných predmetov I* [In Slovak].

Vochozka, M., Kloknerová, L., & Ščasná, J. (2023b). *Odborovo-didaktické súvislosti v didaktike profesijných predmetov II* [In Slovak].

Voráč, D., & Kopecký, K. (2021). Media education in the Czech Republic. In *Proceedings of the International Academic Conference on Education, Teaching and Learning* (pp. 56-64).

Vulic, J. et.al. (2024). Exploring Education as a Complex System: Computational Educational Research with Multi-Level Agent-Based Modeling. *Education Sciences, 14*(5), 551. https://doi.org/10.3390/educsci14050551 https://library.iated.org/view/VARADINOV2024ENH

Wyszynska Johansson, M., & Andersson, I. (2024). Vocational didactics: Mapping the terrain in Swedish upper secondary vocational education and training. *International Journal for Research in Vocational Education and Training, 11*(1), 76–95. https://doi.org/10.13152/IJRVET.11.1.4