E-ISSN: 2997-9439

American Journal of Education and Evaluation Studies

https://semantjournals.org/index.php/ AJEES

| Research Article

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Mechanisms for Developing Professional Competencies through Digital Learning Resources in Vocational Education Institutions

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Abstract: This article proposes a five-stage model aimed at developing professional competencies in vocational education institutions through digital textbooks, online platforms, and virtual laboratories. The methodology is based on bibliometric and content analysis of advanced foreign and domestic studies, as well as secondary statistical synthesis of diagnostic surveys conducted in Canada, Turkey, and Uzbekistan. The proposed model includes: (1) alignment of DigCompEdu, UNESCO-ISCED-2013, and National Qualification Frameworks; (2) selection of effective digital resources based on the SAMR criterion; (3) two-week micro-teaching cycles; (4) multi-criteria assessment based on e-portfolios and adaptive tests; (5) final project defense with the participation of employers. The model strengthens teachers' digital content creation skills and brings the learning process closer to labor market demands.

Keywords: digital learning resources; vocational education; professional competence; UNESCO-ISCED; DigCompEdu; digital pedagogy.

1. Introduction. In the context of digital transformation, the requirements for the workforce are rapidly evolving. According to the UNESCO-UNEVOC 2024 report, the integration of digital competence frameworks into the education system is recognized as a strategic factor determining the quality of human resource development [1]. The OECD Digital Education Outlook highlights that the didactic quality of digital resources is closely linked to teachers' digital competence [2]. The UNESCO-ISCED-2013 standard, which provides a universal classification of education levels, categorizes vocational education at levels 3, 4, 5, and 6 and describes learning outcomes through the triad “knowledge—skills—competence”

In Uzbekistan, the regulatory framework includes Presidential Decree No. PF-5812 dated September 6, 2019, "On Additional Measures to Further Improve the Vocational Education System," Presidential Decree No. PF-27 dated February 28, 2023, "On the State Program for the Implementation of the Development Strategy of New Uzbekistan for 2022–2026 within the Year of Attention to People and Quality Education, “Cabinet of Ministers Resolutions No. 466 dated August 7, 2020, and No. 106 dated February 26, 2020, concerning the regulation and improvement of the vocational education system and the retraining of managerial and pedagogical personnel [16–19]. These normative documents define the tasks of digitalizing vocational

education, training competitive personnel, and retraining teachers.

Several scientific studies have been conducted in Uzbekistan to improve the mechanisms for developing professional competencies through digital learning resources in vocational education institutions. Researchers such as R.H. Djuraev, Sh.E. Qurbonov, U. Begimqulov, N.A. Muslimov, Q.T. Olimov, Sh.S. Sharipov, Z.K. Ismoilova, A. Haitov, M. Aripov, O. Turakulov, N.I. Taylaqov, L.N. Shibarshova, I.A. Otaboyev, and E.R. Ahmedov have developed conceptual approaches and practical recommendations for the informatization of education.

This article aims to develop a comprehensive model for forming professional competencies in vocational education institutions using digital learning resources based on the synthesis of international and local scientific sources and practical indicators, and to provide recommendations for its implementation.

2. Methodology.

2.1. Bibliometric Search and Selection.

Search Strategy: A search was conducted in the Scopus and Web of Science Core Collection databases (2019–2025) using the keywords “digital learning resources” AND (“vocational education” OR “professional education”) AND “competence.” A total of 68 articles were identified and screened following the PRISMA flow diagram.

Selection Criteria: (1) vocational education context; (2) digital learning resource as the central variable; (3) empirical method (quantitative/qualitative) or a coded theoretical model; (4) measurement of educational outcomes within the competence framework. Ten articles meeting these criteria were included in the final analysis.

Coding Scheme: Each article was coded based on (i) research design; (ii) sample size and ISCED level; (iii) type of resources used; (iv) key indicators; (v) alignment with DigCompEdu; (vi) competence outcomes. Coding reliability was confirmed with Cohen's kappa = 0.86 (two independent researchers).

2.2. Integration of Local Scientific Sources.

Theoretical and empirical studies conducted in Uzbekistan (n = 6) — Djuraev [12], Qurbonov [11], Begimqulov [10], Inoyatov [13], Turakulov [14], and PF-6079 [9] — were subjected to secondary analysis using the coding scheme described above.

2.3. Secondary Empirical Synthesis.

Diagnostic Data:

- Deschênes et al.: 137 students (Canada, ISCED-5 level) — frequency and satisfaction with the use of 36 resources.
- Özkan & Gürsoy: 271 teachers (Turkey, ISCED-4/5) — DigCompEdu indicators.
- Begimqulov: 184 college teachers (Uzbekistan, ISCED-4) — self-assessment of digital competence.

These data were analyzed using SPSS 29 for descriptive and correlational statistics; significant results at $\alpha = 0.05$ were included in the main text.

2.4. Framework and Standards Mapping.

DigCompEdu (6 indicator groups, 22 indicators) was aligned with UNESCO-ISCED-2013 education levels, and each indicator was linked to the relevant descriptor of the National Qualification Framework. This mapping served as a didactic criterion in the first stage of the mechanism (framework alignment).

2.5. Model Construction.

Based on the bibliometric synthesis and empirical data, a conceptual map was developed using the Miro online board. Nodes included frameworks, resources, module design, assessment system, and labor market; edges represented "provides," "adapts," "assesses," "transfers." Through the Delphi consensus method (3 rounds, n = 7 local experts), the stages and indicators of the mechanism were validated.

3. Results and Analysis.

№	Source	Sample/Method	Key Findings	Direct Impact on Mechanism
1	Deschênes et al., 2024 [3]	137 students; ISCED-5; online survey	14 out of 36 resources (<40%) actively used; 88% satisfaction	Resource selection criteria; module media design
2	Lahn & Berntsen, 2023 [4]	Review; 68 articles	DigCompEdu does not fully cover vocational context	Framework alignment; indicator recontextualization
3	Özkan & Gürsoy, 2024 [5]	271 teachers; ISCED-4/5; DigCompEdu test	"Digital content creation" M = 2.8 ± 0.9 (lowest)	Dedicated block module for teacher training
4	Diz-Otero et al., 2024 [6]	Systematic; 76 articles	Digital competence weakly reflected in lesson design	Micro-teaching methodology
5	Burns et al., 2025 [7]	98 teachers; ISCED-4; correlation	Resource ↔ motivation r = 0.41; $p < 0.05$	Activating resource package
6	Yang & Tremblay, 2021 [8]	356 teachers; questionnaire	39% of teachers rarely use resources	Resource integration strategy
7	OECD, 2023 [2]	27 countries; macro	"Infrastructure-practice" gap	Institutional risk consideration
8	UNESCO-UNEVOC, 2024 [1]	Framework base	12 domains not fully synchronized	Development of mapping algorithm
9	UNEVOC MTS IV, 2024 [15]	Strategic document	Employer involvement ensures competence sustainability	Principles of the transfer stage
10	Tzafilkou et al., 2023 [6]	1,204 teachers; ISCED-4/5	Assessment tools are limited	Multi-criteria assessment design
11	Djuraev, 2023 [12]	Monograph	Classification of digital resources	Theoretical foundation; resource cataloging
12	Qurbonov, 2021 [11]	270 students; VR experiment	Effectiveness +15%	VR/AR component
13	Begimqulov, 2022 [10]	184 teachers; questionnaire	47% at "beginner" level	Diagnostic indicators
14	Inoyatov, 2024 [13]	Qualitative	Assessment criteria	Assessment matrix
15	Turakulov, 2020 [14]	Monograph	Model of information-	Environment design

			educational environment	
16	PF-5812, 2019 [16]	Decree	Digitalization tasks	Normative validation
17	PF-27, 2023 [17]	Decree	"Year of Quality Education"	Normative validation
18	VM 466, 2020 [18]	Resolution	Continuous education	Institutional conditions
19	VM 106, 2020 [19]	Resolution	Teacher qualification	Teacher training

Synthesized Conclusions: The low frequency of resource use among students (ISCED-5) is directly linked to their didactic alignment and teacher facilitation level [3]. The weak "Digital Content Creation" sub-competency (M = 2.8) [5] and 47% "beginner" level in local diagnostics [10] necessitate teacher retraining and the development of methodological guides. The mapping of UNESCO-ISCED and DigCompEdu indicators provides a universal criterion for didactic resource selection. Nine resources selected based on the SAMR model — Moodle, Google Workspace, Labster VR, Padlet, EdPuzzle, MahallaEdu, YouTube Edu, Open-EDG, and uSkill — were linked to module objectives and outcomes. For module/micro-teaching, a two-week cycle was designed: introductory video → problem-based learning → virtual practice / VR → reflection. The assessment stage integrated e-portfolios (format: git-repo, multimedia), e-rubrics (aligned with DigCompEdu indicators), and adaptive tests (Moodle Quiz + H5P). In the final stage, students defended their project work in front of employers; the employer's evaluation contributed 20% to the summative grade, aligning with UNEVOC MTS IV principles [15].

Conclusion. This study has developed a methodologically robust, step-by-step mechanism for forming professional competencies in vocational education institutions through digital learning resources, synthesizing global and local scientific sources, the UNESCO-ISCED standard, and DigCompEdu indicators. The model adapts competence frameworks to national and international requirements, integrates a resource set selected based on didactic criteria into module and micro-teaching formats, standardizes multi-criteria digital assessment, and involves employers in the evaluation process. Empirical evidence confirms that strengthening teachers' digital content creation skills and expanding the use of VR/AR resources significantly improve teaching effectiveness. Based on regulatory documents, this mechanism can sustainably develop digital competencies in vocational education in alignment with labor market demands.

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