Hevko Ihor, Turchyn Rostyslav. Pedagogical conditions for the implementation of the integrative approach in the professional training of future bachelors of vocational education in the field of digital technologies. Journal of Education, Health and Sport. 2026;93:75302. eISSN 2391-8306.
https://dx.doi.org/10.12775/JEHS.2026.93.75302
https://apcz.umk.pl/JEHS/article/view/75302
https://zenodo.org/records/21917177

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences). Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).
Received: 07.06.2026. Revised: 10.06.2026. Accepted: 20.06.2026. Published:30.06.2026.

PEDAGOGICAL CONDITIONS FOR THE IMPLEMENTATION OF THE INTEGRATIVE APPROACH IN THE PROFESSIONAL TRAINING OF FUTURE BACHELORS OF VOCATIONAL EDUCATION IN THE FIELD OF DIGITAL TECHNOLOGIES

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Abstract

Introduction and purpose. The digital transformation of vocational education and the human-centred priorities of Industry 5.0 require that the pedagogical and the digital-technological components of teacher training cease to be delivered in parallel and become genuinely interpenetrating. Theoretical substantiation of the integrative approach does not by itself guarantee an educational result: it becomes operational only when supported by a controllable set of pedagogical conditions. The purpose is to substantiate and structurally describe such a set for the training of future bachelors of vocational education specialising in digital technologies.

Brief description of the state of knowledge. Pedagogical conditions are most often presented in the literature as unordered lists, without an explicit derivation procedure and without showing which component of competence each condition supports and which educational barrier it neutralises. Here five conditions were derived from three complementary sources: the seven-component structure of professional competence, the methodological triad of the systems, competence and activity approaches, and the educational barriers identified in the analysis of the state of the problem. A conditions-components matrix was constructed and two analytical indices were computed from it.

Summary. The set comprises content integration; a human-centred integrative digital learning environment; practice-oriented and project technologies; readiness of the teaching staff; and the subject position of students. Readiness of the teaching staff possesses the highest integrative capacity and is system-forming, whereas the cognitive-content and reflective-evaluative components receive the weakest support and form the principal risk zone of the design.

Keywords: education; professional; competency-based education; educational technology; digital technology; curriculum; faculty

1. Introduction and purpose

The training of teachers of vocational education specialising in digital technologies occupies a structurally unusual position. Such a specialist is simultaneously a pedagogue and a technologist: the object of the professional activity is another person's learning, while its content is a technological domain that renews itself faster than any curriculum revision cycle. In the practice of Ukrainian higher education institutions this tension is most often resolved by placing the two components side by side rather than bringing them together – the psycho-pedagogical and the branch-technological cycles are delivered in parallel, by different departments, with independently formulated learning outcomes, and the task of synthesising them is implicitly delegated to the student.

The integrative approach offers a way out of this configuration, and its theoretical potential has been demonstrated repeatedly. Didactic integration has been substantiated as a system-forming principle of vocational education [41], the concept and the distinctive features of the approach in higher education have been clarified [8, 9], and it has been described as a factor of the development of European higher education [10]; its productivity has been confirmed in fields as distant from one another as medicine [12], civil aviation [13], the artistic and pedagogical profile [14] and rehabilitation [15]. Within the speciality considered here, the training of bachelors of vocational education in digital technologies has been modelled for the design of interfaces [17], and strategies for the development of digital competence at higher vocational colleges have been analysed [5]. Studies of interdisciplinary educational ecosystems confirm an association between the systemic organisation of interdisciplinary training and the interdisciplinary competence of students [29], while the model of integrative pedagogy develops generic and social competences in teacher education [31].

The transition from theoretical substantiation to practical realisation nevertheless remains the weak link: the approach is described convincingly at the level of principles and far less convincingly at the level of the conditions under which those principles yield a measurable result. The gap is particularly consequential for the digital-technological specialisation, where the objects of integration are themselves unstable – generative artificial intelligence, immersive environments and cloud platforms enter the educational process faster than the pedagogical rules for their use are formulated [18, 19, 20, 38].

The category through which pedagogy describes this transition is that of pedagogical conditions, and it is used unevenly. In a considerable number of publications the set of conditions is an enumeration whose composition is neither derived from an explicit procedure nor justified with respect to the expected result. Where the derivation procedure is made explicit – as in the study of the graphic competence of future engineers-teachers of the computer profile, in which the conditions were established through expert evaluation [6] – the resulting set becomes both defensible and reproducible. The present study follows that second line.

The purpose of the article is to substantiate a set of pedagogical conditions for the implementation of the integrative approach in the professional training of future bachelors of vocational education in the field of digital technologies, and to describe the internal structure of that set: the derivation of each condition from an identified educational barrier, the correspondence between the conditions and the components of professional competence, and the functional relationships that make the set a subsystem rather than an enumeration.

Three questions follow: on what basis should the composition of the set be determined, so that its necessity and sufficiency can be argued rather than asserted; how is each condition related to the components of professional competence; and which condition is system-forming within the resulting architecture.

2. Materials and methods

The study is theoretical and analytical in design. It does not report empirical data on students or teaching staff; its object is the conceptual construction of a set of pedagogical conditions, and its result is a structural description of that set together with the analytical instruments needed to verify it empirically at a subsequent stage.

The source base comprises the publications listed in the References, selected for thematic relevance to the integrative approach in vocational teacher education or to its digital component, publication within the period 2016–2026 (foundational works on didactic integration being retained for conceptual continuity), availability of a persistent identifier, and representation of both the Ukrainian and the international research context. Normative and framework documents were analysed as a separate group: the Standard of Higher Education for speciality 015 Vocational Education [39], the Digital Education Action Plan 2021–2027 [37], the UNESCO AI competency framework for teachers [38] and the national Strategy for the digital development of innovation activity until 2030 [40].

Four methods were applied: theoretical analysis and systematisation, to establish the meaning of the category of pedagogical conditions and to identify the educational barriers that a set of conditions must neutralise; comparative analysis of normative frameworks, to align the conditions with national and European requirements; structural and logical modelling, to represent the derivation of the conditions and the architecture of the resulting subsystem; and matrix analysis, to quantify the correspondence between the conditions and the components of professional competence.

The matrix procedure requires description, since the two indices reported below are computed from it. Each cell records the relationship between one condition and one component on a three-point ordinal scale: 2 denotes a direct, target influence, the component being named in the substantiation of the condition as the principal object of its action; 1 denotes a mediated influence, exerted through the mechanisms of another condition or as a secondary effect; 0 denotes the absence of a substantiated direct link. The assignment of values was performed by the authors and follows the substantiation presented in Section 3.4, and is therefore reproducible from the text. Two indices are derived by summation: the integrative capacity index of a condition is its row sum (theoretical range 0–14) and expresses the breadth and the directness of its action on the result; the support index of a component is its column sum (range 0–10) and expresses the extent to which the component is provided for by the set as a whole. Both are analytical constructs computed from the matrix rather than measures of empirical effect, and their function is diagnostic – to expose imbalances in the design before it is implemented.

3. Description of the state of knowledge

3.1. The category of pedagogical conditions in vocational teacher education

Pedagogical conditions are understood here as a set of purposefully created circumstances of the educational process that ensure the effectiveness of the implementation of the integrative approach and the attainment of the predicted level of professional competence. Content answers the question of what is taught and technologies the question of how; conditions answer neither, describing instead the environment and the factors under which the integration of the pedagogical and the digital-technological components occurs effectively. A condition is thus neither an element of the content nor a method, but a characteristic of the circumstances in which content and methods operate.

Two properties follow and are used below as selection criteria. A condition must be manageable – capable of being created, maintained and withdrawn by the institution, which distinguishes it from an external circumstance such as the state of the labour market; and it must be observable – its presence establishable through documented indicators, which distinguishes it from a declaration of intent.

The literature offers three established ways of arriving at a set of conditions. The most frequent is derivation from the structure of the expected result, in which each component of the competence to be formed generates the condition that supports it; the analysis of integral competence in future specialists of vocational education [11], the systematisation of the relation between the systems and the integrative approaches in education [44] and the models of the formation of professional competence of future teachers of technology [45] follow this logic. A second is expert evaluation, in which a preliminary list is reduced by a panel of specialists [6]. A third, less common but methodologically productive, is derivation from identified obstacles, each condition being formulated as the removal of a documented barrier. The design adopted here combines the first and the third, and reserves the second for the empirical stage of the research.

3.2. Sources and criteria for determining the composition of the set

The composition of the set was determined from three complementary sources, none of which is sufficient in isolation. The first is the structure of the expected result – the seven-component structure of professional competence, comprising the motivational-value, cognitive-content, methodical-design, practical-activity, communicative-organisational, digital-technological and reflective-evaluative components. This source orients the set towards the result and makes it possible to check that no component is left unsupported.

The second source is the methodological triad of the systems, competence and activity approaches, substantiated as the methodological core of the integrative approach at the preceding stage of this research [1]. It constrains the form the conditions may take: the systems approach requires that they constitute a subsystem with internal relationships rather than a list, the competence approach that each be traceable to a component of the result, and the activity approach that they be formulated as characteristics of activity rather than of resources.

The third source is the set of educational barriers established in the analysis of the state of the problem. It is what turns the set from a theoretically desirable configuration into a practically necessary one, since a condition that removes no documented obstacle is redundant however attractive it may appear.

Five criteria were applied to the resulting pool: necessity, meaning that removal of the condition demonstrably degrades the result; sufficiency, meaning that the set covers every component of the expected result; controllability; non-redundancy, meaning that no condition duplicates the function of another; and compatibility with the structural and functional model. The derivation procedure is presented in Figure 1.

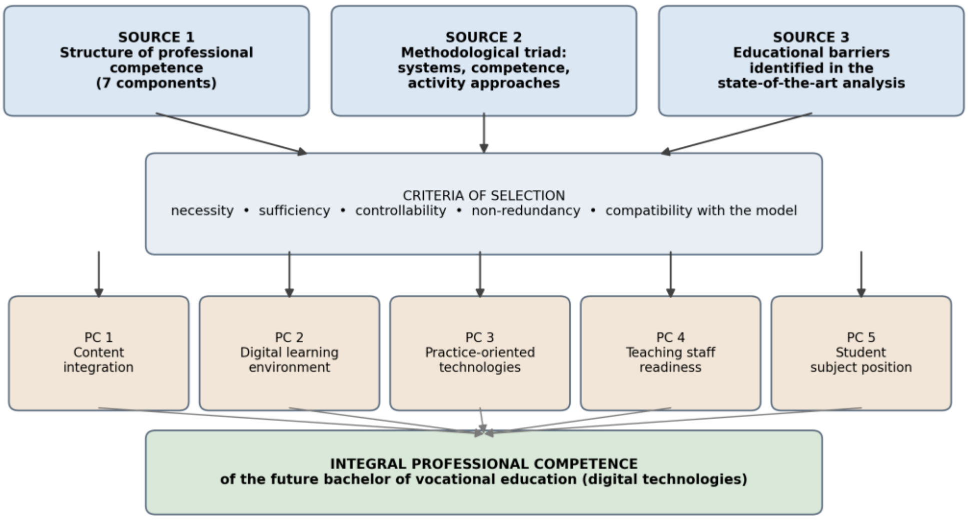

Fig. 1. Derivation of the set of pedagogical conditions from three complementary sources

3.3. Educational barriers as the empirical basis of the set

Five barriers were identified in the analysis of the state of the problem; each is documented in the literature, manageable at the institutional level, and corresponds to exactly one condition in the set proposed below. The insufficient readiness of teaching staff to use digital tools in a didactically meaningful way is reported consistently across national contexts

[24, 28]; the fragmentation of curricula and learning content, expressed in the parallel delivery of the two cycles, is documented in studies of the preparation of teachers for the integrative approach [7]; the ethical, security and academic-integrity risks of digitalisation have intensified with the diffusion of generative artificial intelligence [19, 38]; the mismatch between labour-market requirements and the pace of curriculum renewal is analysed in studies of higher education strategy in digital transformation [25]; and the predominantly reproductive position of students, in which digital resources are consumed rather than designed, is implied by studies of student engagement with digital technologies [26, 27]. Table 1 relates each barrier to its observable indicators and to the condition that neutralises it.

Table 1. Educational barriers, their observable indicators and the corresponding pedagogical conditions

Educational barrier	**Observable indicators**	**Pedagogical condition**
Insufficient readiness of teaching staff for integrative digital didactics	Digital tools used for demonstration rather than for design; low uptake of collaborative instruments; no methodological support or mentoring	PC 4 – Readiness of the teaching staff
Fragmentation of curricula and learning content	Parallel delivery of the two cycles; learning outcomes of separate components not aligned; no cross-cutting content lines	PC 1 – Content integration
Ethical, security and academic-integrity risks of digitalisation	No institutional rules for generative AI and student data; unregulated tool selection; integrity incidents in coursework	PC 2 – Integrative digital learning environment
Mismatch between labour-market requirements and the pace of curriculum renewal	Long content update cycles; no modular or micro-credential mechanisms; course content lagging behind industry practice	PC 3 – Practice-oriented and project technologies
Predominantly reproductive position of students	Digital resources consumed rather than designed; episodic reflection; assessment reduced to summative testing	PC 5 – Subject position of students

3.4. Substantiation of the five pedagogical conditions

The first condition is the content integration of the pedagogical and the digital-technological components. Its realisation replaces parallel delivery by three mechanisms: interdisciplinary integrated modules in which pedagogical and technological content are united by a common professionally significant task [7, 32]; cross-cutting content lines –

algorithmisation and the methodology of teaching it, digital technologies and the didactics of their application, the ethics and human-centredness of digital education – running through a series of educational components [23], studies of education for sustainable development [22] and of curriculum innovation [34] confirming that a value-oriented line is a workable mechanism rather than a declarative addition; and the alignment of the learning outcomes of separate components with the target standard of competence. Comparative analysis of European higher education confirms that content integration is a leading tendency of the contemporary university [10], while the symbiotic relationship between educational robotics and computer science demonstrates the productivity of uniting technological and pedagogical content within shared tasks [23]. The condition acts primarily on the cognitive-content and the methodical-design components, since it is at the level of content that the capacity to establish interdisciplinary connections is laid down.

The second condition is an integrative digital learning environment founded on human-centredness and academic integrity: the systemic combination of learning management systems, cloud services, virtual laboratories, modelling tools and artificial intelligence instruments with explicit ethical, security and legal regulators of their use [38]. Research in digital pedagogy indicates that the effectiveness of such an environment depends not on the novelty of the instruments but on their alignment with pedagogical models and their orientation towards learner-centred instruction [26, 42], and reviews of the role of digital technologies in education point in the same direction [4]. The UNESCO framework for teacher competence in artificial intelligence [38] supplies its value and ethical contour, and anthropologically oriented analyses of interaction in the human-computer and human-artificial-intelligence systems [35, 36] supply its philosophical grounding, while the environmental model of interdisciplinary education [30] indicates that a learning space is itself a didactic factor and not a container for instruments. The condition acts directly on the digital-technological and the practical-activity components and, through its value regulation, on the motivational-value component.

The third condition is the application of practice-oriented and project technologies that model future professional activity: the systematic use of problem-based, project-based, blended, hybrid and student-centred learning, the case method, business games and STEM design, combined with flexible modular structures and micro-credentials [27, 43], the latter drawing on the mechanisms of non-formal education [21]. Their integrative potential lies in the fact that they simultaneously model professional activity and require the application of digital instruments, so that subject learning and the formation of transferable skills occur within a single process rather than in sequence. Studies of flexible hybrid formats [27] and of the influence of digital technologies on student engagement [26] confirm that such technologies bring theoretical knowledge and practical experience into contact, while research on the development of critical thinking through artificial intelligence tools [18] demonstrates their potential for forming the key skills associated with Industry 5.0 [33]. The instrumental support of this condition – the typology of digital didactic tools and the procedure of their design on integrative principles – was substantiated at an earlier stage of this research [2] and is treated here as a resource of the condition rather than as its object. The condition acts on the practical-activity, methodical-design and communicative-organisational components.

The fourth condition is the readiness of the teaching staff for the implementation of the integrative approach and of digital didactics. It recognises the leading role of the teacher, established in the analysis of the state of the problem [24, 28] and in research on the foundations of professional pedagogical activity in the training of teachers of technology [46], and presupposes methodological support, the development of digital-didactic competence, mentoring practices and institutional support. The specialisation of teacher training for online engineering pedagogy [24] and the analysis of policies for the integration of information and communication technologies [28] confirm its system-forming character, since it directly determines the feasibility of every other condition. The condition is not reducible to instrumental training: what is required is the capacity to make didactic decisions about technology rather than familiarity with particular platforms, which is precisely the distinction drawn in the transition from digital literacy to technological culture [16].

The fifth condition is the formation of the subject position and the reflective-evaluative culture of students: their involvement in the independent design of learning trajectories and didactic tools, formative assessment, electronic portfolios, and self- and peer-assessment [2]. Research on the expediency of the classical approach to teaching programming in the era of generative artificial intelligence [19] makes explicit the need for a critical and reflective attitude towards digital instruments, since the availability of automated solutions makes the absence of such an attitude immediately consequential. The condition acts on the reflective-evaluative and the motivational-value components and constitutes the mechanism of continuous improvement that closes the system with feedback. The consolidated characteristics of the five conditions are presented in Table 2.

Table 2. Consolidated characteristics of the pedagogical conditions for the implementation of the integrative approach

№	Pedagogical condition	Mechanisms of realisation	Target components of competence
PC 1	Content integration of the pedagogical and digital-technological components	Interdisciplinary integrated modules; cross-cutting content lines; alignment of learning outcomes with the target standard	Cognitive-content; methodical-design
PC 2	Integrative digital learning environment on the basis of human-centredness and academic integrity	LMS, cloud services, virtual laboratories, modelling and AI tools; institutional ethical, security and legal regulators	Digital-technological; practical-activity; motivational-value
PC 3	Practice-oriented and project technologies modelling professional activity	Problem-based, project, blended, hybrid and student-centred learning; case method; business games; STEM design; modularity and micro-credentials	Practical-activity; methodical-design; communicative-organisational
PC 4	Readiness of the teaching staff for the integrative approach and digital didactics	Methodological support; development of digital-didactic competence; mentoring practices; institutional support	All components (system-forming influence)
PC 5	Subject position and reflective-evaluative culture of students	Student design of learning trajectories and didactic tools; formative assessment; e-portfolios; self- and peer-assessment	Reflective-evaluative; motivational-value

3.5. The conditions-components matrix and the derived indices

The substantiation above names, for each condition, the components on which it acts. Collecting these statements into a matrix converts a set of separate justifications into an object that can be inspected as a whole and makes visible two properties invisible in a list: whether every component of the result is provided for, and how unevenly the conditions differ in their breadth of action. The matrix is presented in Figure 2.

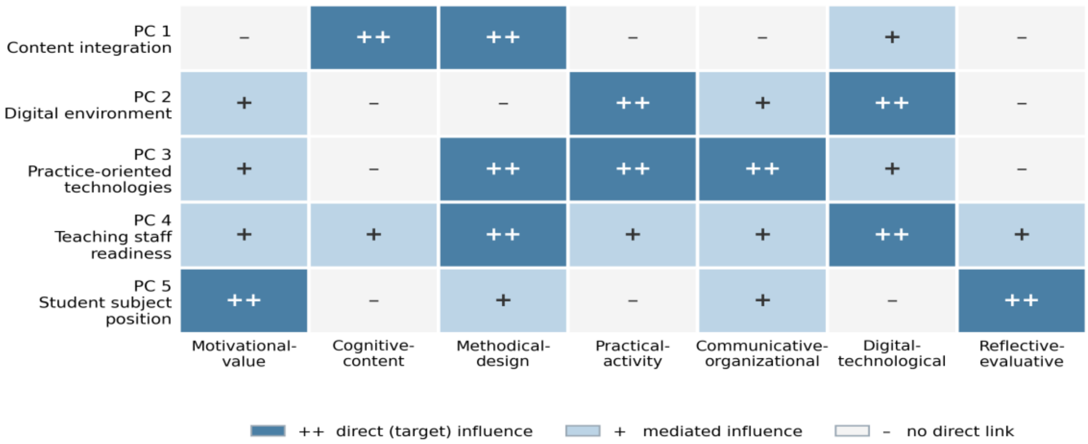

Fig. 2. Matrix of correspondence between the pedagogical conditions and the components of professional competence

Two observations follow directly. No column is empty: every component is supported by at least two conditions, which satisfies the criterion of sufficiency. And no two rows coincide: each condition possesses a distinct profile of action, which satisfies the criterion of non-redundancy. Neither property is self-evident in advance, and both would have remained unverified had the set been presented as an enumeration. Summation of the rows and the columns yields the two indices described in Section 2, presented in Figure 3.

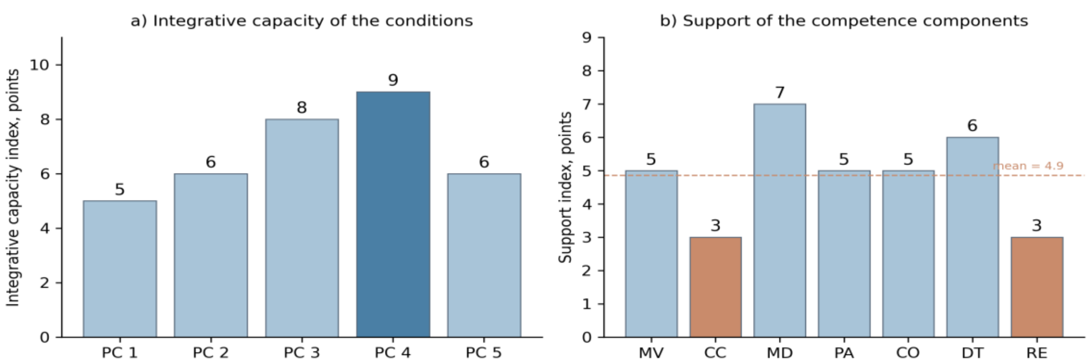

Fig. 3. Integrative capacity of the pedagogical conditions (a) and support of the components of professional competence (b), computed from the matrix in Figure 2

The distribution of the integrative capacity index confirms analytically what was argued substantively above. Readiness of the teaching staff attains the highest value (9 of a theoretical maximum of 14), followed by practice-oriented and project technologies (8). The result is not an artefact of the scale: readiness of the teaching staff is the only condition acting on all seven components, because it is the teacher who realises content integration, deploys the digital environment, selects the technologies and organises the reflective procedures.

Content integration attains the lowest value (5), which reflects its concentrated rather than diffuse character; a low index here indicates specialisation, not weakness.

The distribution of the support index is diagnostically more interesting, since it reveals an imbalance that the substantive argument did not make visible. The methodical-design component is the best supported (7 points), being addressed by four of the five conditions, consistently with its position at the intersection of the pedagogical and the technological. The cognitive-content and the reflective-evaluative components receive the weakest support (3 points each against an arithmetic mean of 4.9) and depend, in each case, on a single condition acting directly. This is the principal risk zone of the design: should content integration be realised formally, through the nominal renaming of existing courses as integrated modules, the cognitive-content component loses its only direct support, and the same applies to the reflective-evaluative component in the event of a formal realisation of the fifth condition. These two conditions therefore require the most rigorous monitoring.

3.6. The systemic architecture of the set

The five conditions do not act in isolation. Within their structure readiness of the teaching staff is system-forming, since its absence blocks the realisation of the remaining four; content integration constitutes the content basis; practice-oriented technologies the procedural core; the digital learning environment the environmental factor; and the subject position of students the regulatory mechanism that closes the system with feedback. This architecture is represented in Figure 4.

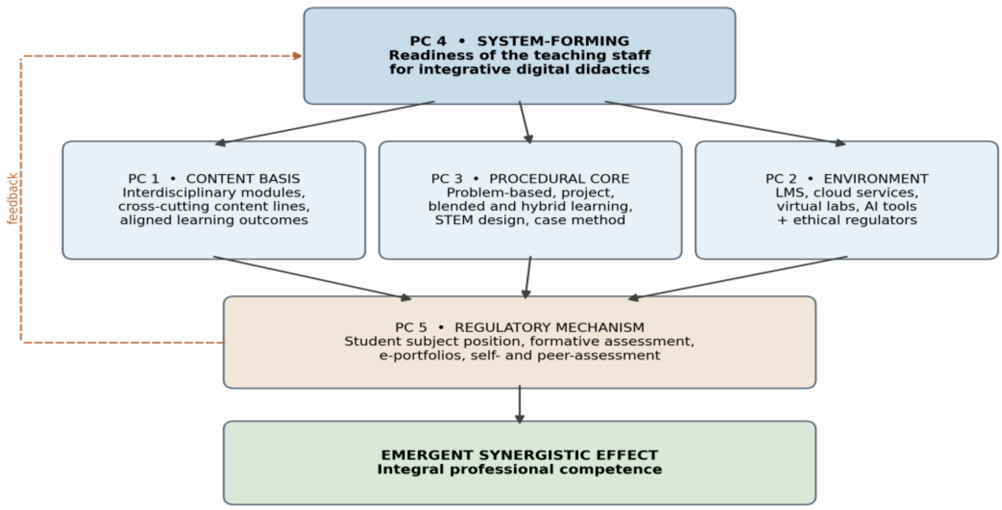

Fig. 4. Systemic architecture of the set of pedagogical conditions

The essential property of this architecture is that the effect it produces is emergent: it is the interaction of the conditions, not their separate action, that generates the synergistic effect for the sake of which the integrative approach is implemented [1]. A digital environment deployed without the readiness of teaching staff to use it didactically degrades into an electronic repository of files; content integration realised without practice-oriented technologies remains an administrative reorganisation invisible to students; project technologies applied without the reflective mechanism of the fifth condition produce artefacts without producing professional self-understanding. Partial implementation therefore does not yield a proportionally partial result, and the sequence matters: the system-forming condition must be realised first.

It follows that within the structural and functional model of the implementation of the integrative approach the conditions must be represented not as one block among others but as a cross-cutting block ensuring the quality of integration simultaneously at the content, the procedural and the resultative levels, as organisational and pedagogical conditions are treated in related research on the training of specialists in computer technologies [3].

3.7. Indicators for monitoring the realisation of the conditions

Table 3. Indicators for monitoring the realisation of the pedagogical conditions

№	Indicator	Data source	Method of collection
PC 1	Share of ECTS credits in interdisciplinary integrated modules; learning outcomes aligned across the two cycles; cross-cutting content lines implemented	Curricula, syllabi of educational components	Document analysis
PC 2	Functional completeness of the environment against a reference list of instrument classes; currency of the institutional policy on AI and student data	Audit of the digital environment; institutional regulations	Checklist-based audit
PC 3	Share of study time in project and practice-oriented formats; completed projects with a professional context per student per year	Syllabi; register of student projects	Document analysis
PC 4	Distribution of staff across DigCompEdu proficiency levels (self- and expert assessment); participation in methodological support and mentoring	Survey of teaching staff; expert review of teaching materials	Questionnaire; expert assessment
PC 5	Share of students maintaining an e-portfolio; frequency of self- and peer-assessment per component; share designing their own didactic artefacts	LMS analytics; portfolio audit	Analysis of LMS logs; document analysis

The requirement of observability obliges the researcher to specify how the presence of each condition is established. Without such specification a set of conditions remains a declaration and its experimental verification becomes impossible, since it will not be known whether an absent effect indicates the ineffectiveness of the conditions or their non-realisation. Table 3 proposes a minimal set of indicators, deliberately restricted to data that an institution already generates in the course of its ordinary operation.

4. Discussion

A demarcation with respect to the first author's previous publications is required. The synergy of the scientific ideas underlying the integrative approach and the methodological core of its realisation were substantiated in [1]; the design of digital didactic tools on integrative principles, including the structural and functional model of their design and the stepwise algorithm of their creation, in [2]. The present article addresses neither the methodological foundations of the approach nor the design of tools, but the conditions under which the approach yields an educational result: the methodology of [1] functions here only as a constraint on the form a condition may take and the tools of [2] only as a resource of the second and the third conditions, while the composition, the derivation and the internal architecture of the set have not been considered in either.

The set substantiated here converges, in its substantive part, with results obtained in adjacent professional fields. The conditions established for the formation of graphic competence of future engineers-teachers of the computer profile [6] include the integration of the pedagogical and the engineering components and the systematic monitoring of the formation of competence, corresponding closely to the first and, in its monitoring function, the fifth condition proposed here. Obtained through a different derivation procedure and in a different professional field, this convergence may be read as indirect evidence of the validity of the composition of the set.

The contribution of the present study lies less in the composition of the set than in the procedure by which it was obtained and the analytical instrument applied to it. Presenting the conditions in matrix form and computing the two indices makes it possible to detect a design defect – the weak support of the cognitive-content and the reflective-evaluative components – before the experiment rather than after it. Standard practice substantiates the conditions and proceeds directly to experimental verification, in which case an imbalance of this kind manifests itself as an unexplained low increment in one component and is attributed, retrospectively, to the specifics of the sample. The matrix converts a post hoc explanation into an a priori and falsifiable prediction: if the design is correct, the increments in these two components should be more sensitive to the quality of realisation of the first and the fifth conditions than the increments in the other components are to the quality of realisation of theirs.

Four limitations must be stated. The assignment of values in the matrix was performed by the authors on the basis of the substantiation of the conditions and, although reproducible from the text, has not been validated by an independent panel; expert validation is the natural next step, following the methodology applied in [6]. The three-point ordinal scale is coarse and the indices are unweighted sums, which presupposes that all components are of equal importance – an assumption that is convenient rather than substantiated. The set was substantiated for a single speciality within a single national system of higher education, and its transferability requires separate verification, all the more so because the rate of content renewal is unusually high in the digital-technological field. And the effectiveness of the set has not yet been verified experimentally: the study substantiates the design and supplies the instruments for its verification, but the verification itself constitutes a separate stage.

The practical implications are threefold. For those who design curricula, the matrix offers a procedure for checking the completeness of a set of conditions, since inspecting the columns reveals unsupported components of the expected result before implementation begins. For institutional management, the architecture in Figure 4 indicates the sequence of implementation, in which investment in the readiness of teaching staff precedes investment in the digital environment, the reverse order producing infrastructure that is not used didactically [24, 28]. For researchers, the indicators in Table 3 offer a starting point for the operationalisation of conditions, an aspect habitually left implicit.

Two directions of further research follow: the expert validation of the matrix by a panel of specialists in vocational teacher education and digital didactics, with the calculation of inter-rater agreement; and the experimental verification of the effectiveness of the set within the structural and functional model, with separate attention to the prediction formulated above.

5. Summary

The article substantiates a set of five pedagogical conditions for the implementation of the integrative approach in the professional training of future bachelors of vocational education in the field of digital technologies: content integration of the pedagogical and the digital-technological components; an integrative digital learning environment founded on human-centredness and academic integrity; practice-oriented and project technologies modelling professional activity; readiness of the teaching staff for the integrative approach and digital didactics; and the subject position and reflective-evaluative culture of students.

The composition was derived from three complementary sources – the seven-component structure of professional competence, the methodological triad of the systems, competence and activity approaches, and the educational barriers established in the analysis of the state of the problem – and each condition is related to a documented barrier that it neutralises and to the components of competence that it supports.

Matrix analysis established that every component of the expected result is supported by at least two conditions and that each condition possesses a distinct profile of action, satisfying the criteria of sufficiency and non-redundancy. Readiness of the teaching staff possesses the highest integrative capacity index (9 of 14) and is the only condition acting on all seven components, which confirms its system-forming character; content integration possesses the lowest index (5), reflecting its concentrated rather than diffuse character.

The cognitive-content and the reflective-evaluative components receive the weakest support (3 points each against a mean of 4.9) and each depends on a single condition acting directly, which identifies them as the principal risk zone of the design and requires the most rigorous monitoring of the first and the fifth conditions.

The five conditions form a subsystem in which the effect is emergent: partial realisation does not yield a proportionally partial result, and the system-forming condition must be realised first. Within the structural and functional model the conditions must accordingly be represented as a cross-cutting block ensuring the quality of integration at the content, the procedural and the resultative levels simultaneously. The proposed monitoring indicators and analytical instruments constitute the basis for the subsequent experimental verification of the effectiveness of the set.

Declaration of the Use of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the author used Gemini 3 (Google) for the purpose of for the purpose of language polishing, and stylistic refinement, preparation of figure layouts. After using this tool/service, the author reviewed and edited the content as needed and takes full responsibility for the substantive content of the publication.

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