The New Educational Review

DOI: 10.15804/tner.2023.72.2.05

Iryna Androshchuk
The Maria Grzegorzewska University in Warsaw, Poland

Larysa Sergeieva
University of Educational Management, Ukraine

Tetiana Stoychik
Kryvyi Rih Professional Mining and Technology Lyceum, Ukraine

Liubov Kravchenko
Communal Institution of Higher Education «Dnipro Academy of Continuing Education» of Dnipropetrovsk Region Council", Ukraine

Kateryna Martynenko
Kryvyi Rih Professional Mining and Technology Lyceum, Ukraine

Quality Control Modelling of Competitive Professionals' Training at Vocational Education Institutions

Abstract

The most important condition that provides the opportunity for the professionalism of professionals is their competitiveness. The current task of institutions of professional (vocational technical) education (IP(VT)E) is to prepare a qualified and competitive specialist who not only has a certain level of knowledge, skills and abilities but can practically apply them in their professional activities. Future specialists' training quality is based on the ability to adapt to rapidly changing production conditions. It is due both to the prospect of Ukraine's accession to the European Union and to the internal situation in the country, where a large number of applicants in IP(VT)E and institutions of professional higher education (IPHE) do not always meet the requirements of the labour market. It requires resetting educational goals and objectives of vocational education, considering global changes in society, production, and technology. This article aims to substantiate the quality management model of training competitive specialists in IP(VT)E, considering the factors affecting the quality of training and contradictions that need to be resolved in the training process and experimental verification of its effectiveness. A set of theoretical and empirical

methods was used to create a model and test its effectiveness, identifying the components that have become key in creating a model of quality management training for future competitive professionals in vocational education institutions. To determine the effectiveness, a set of questionnaires was developed, and within the framework of the pedagogical experiment, a section was conducted among entrants, applicants, graduates, pedagogical workers, heads of IP(VT)E regions of Ukraine, and employers, the results were analysed.

Introduction

The economic field undergoes an intense transformation which defines trends and directions for improving sectors of the national economy. Nowadays, competition in spheres associated with technical, investment, and mineral resources is a main criterion of the socio-economic efficiency of companies on the world stage. The introduction of new methods of modern ICT application to control production processes has brought up important issues of developing measures for enhancing the potential of human resources.

In solving this problem, the role of the institutions of professional (vocational technical) education (IP(VT)E), which acts as a locomotive of the structural components of the labour market and should become an effective marketing tool for production development, increases. The determining factor of the studied issue is updating the vocational education content, which sets new requirements for the methods of students' training at IP(VT)E in compliance with the demands of employers to the level of graduates' qualification and competitiveness. Changes in the system of education and industry links accentuate this problem. The demand for a competitive production force adapted to systemic changes in professional activity and on the labour market is increasing. The education management system results from complex pedagogical modelling and facilitates the mentioned issue.

Modelling is a basic field of scientific educational research (Rost et al., 2022). After all, the model is a substitute for the original object. It is used to prove a hypothesis or explain a phenomenon and obtain data about the original object (Reith & Nehring, 2020) and generate new knowledge (Belzen et al., 2021).

For the most part, the concept of "model" is considered by scientists as a conceptual image that concretely represents many physical systems, demonstrating a consistent regularity. It reflects the possibilities of differentiation of a physical system and also distinguishes the following pedagogical conceptualisations:

research modelling, expressive modelling, experimental modelling, evaluation modelling and cyclic modelling (Halloun, 2018).

However, on the other hand, models are considered instances of theories, narrower in scope and often more specific. Usually, they are applied to a certain aspect of a given theory, providing a more local description or understanding of a phenomenon (Fried, 2020). Each model is placed in the appropriate scientific plane and differs from others in terms of scale and other aspects of structure and performance, including conceptual complexity and cognitive requirements (Halloun, 2018). The practical aspects of modelling are epistemic and involve the implementation of the process of improving the existing reality to achieve certain goals, which includes the following vectors: the selection of an appropriate form on which the model is based, the selection of appropriate components or variables to include in the model, and the organisation of interacting components in such a way that to present the key characteristics of a phenomenon or system (Sadler et al., 2021). So, the modelling mechanism, as a sequence of observed actions, can be divided into three stages, namely: research – data generation and detection of regularities in these data; design – an initial model is developed based on analogies and experience, variable elements are identified and considered in it, they are relevant to the research phenomenon; verification (Göhner & Krell, 2021). Considering that scientific models act as objects and are not the kind of things that can be true or false, testing specific assumptions can be done by establishing the adequacy of the model for the intended purpose. In this case, the quality of the model depends only on how accurately and completely the model represents the target, where the ideal limit is its ideal and complete representation (Parker, 2020).

While applying the modelling method, it is suggested to create an adequate model of the quality control system of competitive professionals' training at IP(VT)E. The structural elements of the model are conceptual, functional and technological. Its components include "input", "process", and "output", while interdependent possibilities and results characterise its content.

Research Methodology

The research's leading idea was to develop a scientifically based quality control model for training competitive specialists in P(VT)E, following the needs of employers based on modern methodological approaches and requirements for the professional competence of specialists. The research subject is the theoretical

and methodical principles of quality management of the training of competitive specialists in P(VT)E in the conditions of the modern labour market.

According to the research goal, a set of interrelated research methods is used.

Theoretical methods: systematic analysis of pedagogical and methodological literature aimed at studying the modelling process. Based on the study of various models, including the model of developmental education (V. D. Davydov, V. V. Flyakov, etc.); the traditional model of education (J. Majo, L. Crowe, J. Kraplya, D. Ravych, C. Finn, etc.); the rationalist model of education (P. Bloom, R. Ganier, B. Skinner, etc.); the phenomenological model of education (A. Maslow, A. Combs, K. Rogers, etc.); the non-institutional model of education (P. Goodman, I. Ilyich, J. Goodled, F. Klein, J. Holt, L. Bernard, etc.), the author's structural-functional quality control model of competitive professionals' training at vocational education institutions (IP(VT)E) is developed.

Empirical methods: the comparative experiment assumes that in one group (experimental), the training was carried out using a new method, and in the other (control) – it took place according to the generally accepted method; a survey (questionnaire, interview); an expert opinion; an interview, self-assessment, an analysis of documents and statistical data by groups of indicators: I – "The content of vocational training and its comprehensive and methodological support"; II – "Motivation and accessibility of IP(VT)E"; III – "Professional success of graduates"; IV – "Human capacity of an educational institution"; V – "Material and technical facilities". The questionnaires are developed by the authors.

Methods of mathematical statistics: in order to verify the reliability of the data, quantitative and qualitative processing of the results was carried out using computer equipment, methods of statistical data processing, graphical display of results, qualitative evaluation of results, pairwise comparisons of Saati were used to determine the relative importance of the components of a specialist's competitiveness according to the results of a survey of employers; criterion for testing statistical hypotheses (Pearson's $\chi 2$ criterion) – for checking the reliability of coincidences and discrepancies in experimental data; indicator-instrumental assessment.

The sample's representativeness was achieved due to the sufficient number of respondents and the probable way of forming the sample through clusters. In other words, a number of clusters – focus groups (students, graduates, teachers and employers) were involved in the research, but not individual people. The members of the focus groups were randomly selected.

The following were interviewed: 14 IP(VT)E (7 – control group, 7 – experimental group), of which 9 IP(VT)E (5 – control group, 4 – experimental group),

and 5 institutions of vocational pre-higher education (colleges, technical schools) (3 – control group, 2 – experimental group); 175 entrants (87 – control group, 86 – experimental group); 175 students (87 – control group, 86 – experimental group); 86 employers (43 – control group, 43 – experimental group); 84 managers (42 – control group, 42 – experimental group) and 280 teachers (140 – control group, 140 – experimental group); 548 graduates of IP(VT)E (274 – control group, 274 – experimental group) from ten regions of Ukraine.

IP(VT)E include Kryvyi Rih Professional Mining and Technological Lyceum, Dnipropetrovsk region; SPTEI "Pershotravensk Mining Lyceum", Dnipropetrovsk region; Ternivsky Professional Mining Lyceum, Dnipropetrovsk region; SPTEI "Interregional Center for Jewelry Art", Kyiv; Bilopil Higher Vocational School, Sumy region; SEI "Odessa Center of Vocational Education", Odessa region; SEI "Professional Lyceum of Ukrainka town", Kyiv region; Dniprorudne Vocational Lyceum, Zaporizhia region; Higher Vocational Mining School (Horishni Plavni), Poltava region.

Institutions of professional pre-higher education – Lviv State Food and Processing Industry College of the National Food Technologies University, Ivano-Frankivsk Restaurant Service and Tourism College of the National Food Technologies University, Technical College of Ternopil National Technical University named after Ivan Pol', Zhytomyr Trade and Economics College of Kyiv National Trade and Economics University, Kyiv Information Technology and Land Management College of the National Aviation University).

At the enterprises which were selected for the inquiry, there are 7,280 employees (58.8% of the total number of employees in selected economic activities) of Dnipropetrovsk, Zaporizhia, Zhytomyr, Ivano-Frankivsk, Kyiv, Lviv, Odessa, Poltava, Sumy, Ternopil regions, and the city of Kyiv.

There are some stages to gain the aim and the goal: preparatory – to set the aim and the goal, the confirmation of experimental educational institutions; basic – to work out and fix the experimental management model of quality training of future competitive professionals in IP(VT)E; final – the resulting diagnostics of the level of future professionals' competitiveness.

Results and Discussion

The monitoring of the present state of vocational training at IP(VT)E indicates imperfection of mechanisms of competitive workforce generation primarily because of low motivation and irresponsible career choice; low quality of stu-

dents' training, insufficient qualification of teachers, inconsistency of the content of vocational training to modern changes in production technology (Sergeeva & Stoychik, 2020).

It necessitated the creation of modern/up-to-date tools for modelling and implementing innovations to solve these problems.

The research aims to develop graduates' competitiveness reflected in the structural and functional model. This model type differs from others as it simulates the internal arrangement of the process. Its functions are stable and common to this system.

The proposed model is simulative. By type of activity, it is conceptual (It is of a conceptual type); by modelling aim – structural; by structure – schematic; by form – informational; by the detail degree – detailed; by temporal development – relevant; by approximation degree to the application of quantitative indicators – structural and functional; by research object – a model of educational tasks related to the creation of a quality control system of competitive professionals' training at IP(VT)E.

The flowchart of the quality control model of competitive professionals' training at IP(VT)E comprises a set of processes, the proper implementation of which is to ensure its effective introduction.

The practical value of the model is determined by its identity to the studied aspects of the object. At all stages of model design, the following principles are considered:

- clear visual character – obvious distinctiveness of the model: constructive, symbolic, visual, functional;
- precision – clear identification of significant and insignificant aspects of the research object;
- impartiality – independence of conclusions from the personal beliefs of a researcher (Vitvytska, 2019).

Modelling graduates' competitiveness development is based on replacing the research object with similar ones. The research results were transferred to the object, and the model became the final result of the forecast. The system-based approach was prioritised while modelling. It involved considering graduates' competitiveness as a holistic system of improving training efficiency through managerial and pedagogical functions in relationships and interactions of elements (Figure 1).

At the same time, three successive stages of competitiveness development among graduates were singled out.

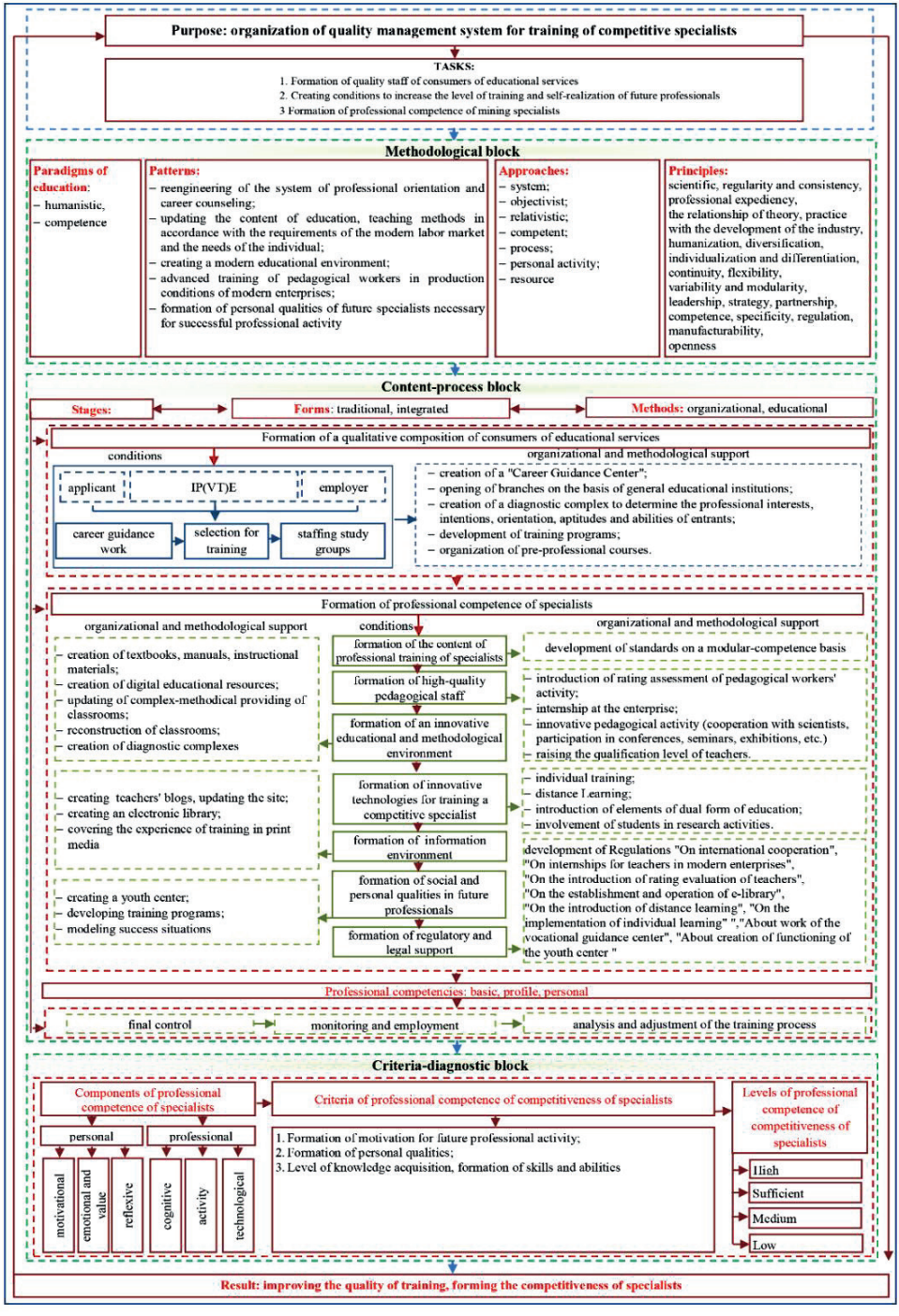

Figure 1. Quality control model of competitive professionals' training at IP(VT)E

The first stage is students' staff formation. A triad of components represents it: entrant – IP(VT)E – employer. At this stage, it is recommended to group students by selecting and assessing applicants' ability to carry out training, coordinate their professional ambitions, and plan with enterprises' plans.

The second stage is competence development when pedagogical preconditions of students' competitiveness development are introduced. Within this stage, special attention is paid to selecting forms and methods that ensure the effective implementation of each precondition.

The third stage involves completing vocational training, including final testing, monitoring and employment.

According to the results of introducing the model in the training system and assessing certain groups of indicators, some dynamics were identified.

After assessing the level of students' motivation (according to the method of professionals' motivation study (Currie, 2018)), the following dynamics were observed: in the control group, the number of people with unsatisfactory (-3.6%) and low (-7.2%) levels of motivation decreased, at the same time the number of students with the average level (+7.2%) increased; the sufficient and high levels remained unchanged. In the experimental group, there are few students with the unsatisfactory level of motivation; the number of people with low (-23.2%) and medium (-23.1%) levels decreased; the number of students with sufficient (+15.5%) and high (+46.2%) levels of motivation increased. The obtained intermediate results show that the creation of the career development centre and its educational and methodological support helped to coordinate applicants' professional ambitions and plans with those of enterprises and increase the motivational component of professional activity, respectively (Table 1).

Table 1. Comparative analysis of quantitative diagnostics of students' professional activity motivation in the control and experimental groups

Motivational complexes (levels)	Ascertaining stage		Formation stage		Generalisation stage	
	Article I. control group/ CG,%	Article II. experimental group/ EG,%	Article III. control group/ CG,%	Article IV. experimental group/ EG,%	control group/ CG,%	experimental group/ EG,%
Unsatisfactory	7,1	15,4	3,5	0	3,5	0
low	60,8	34,7	57,2	15,4	53,6	11,5
medium	7,1	38,5	14,3	19,2	14,3	15,4
sufficient	10,7	7,6	7,1	23,1	10,7	23,1
High	14,3	3,8	17,9	42,3	17,9	50

Analysis of the level of acquired knowledge and skills revealed a decrease in the low level in the control group (-7.1%), an increase in the medium (+0.2%) and sufficient levels (+7.3%), the high level remained unchanged and was equal to 3.6%; in the experimental group, there is a decrease in indicators of the low (-30.8%) and medium levels (-11.5%), and an increase in indicators of the sufficient (+30.8%) and high levels (+11.5%), respectively (Figures 2 and 3).

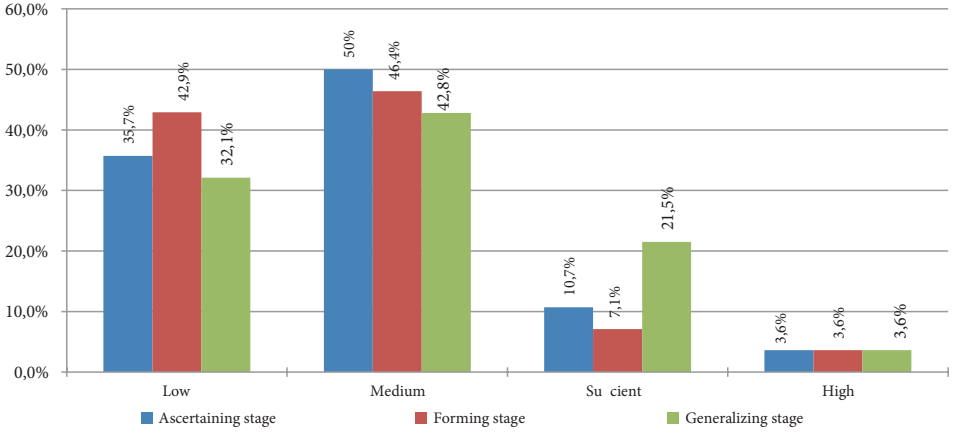

Figure 2. Relationship between the levels of acquired knowledge and skills of theoretic and applied subjects (control group)

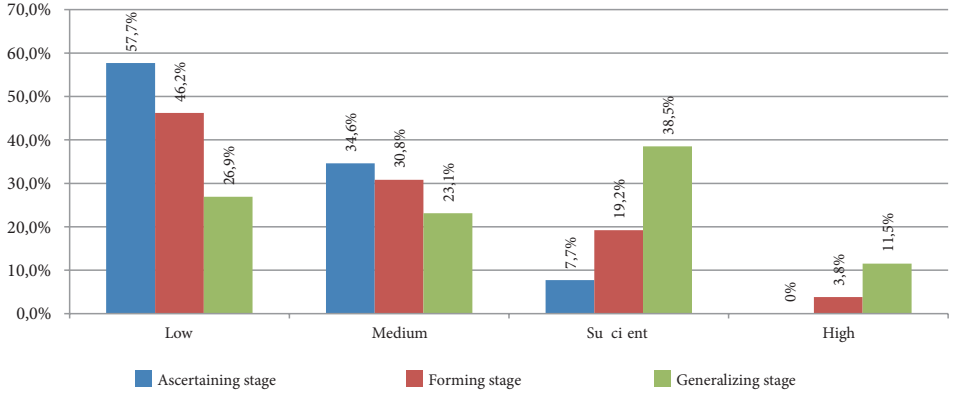

Figure 3. Relationship between the levels of acquired knowledge and skills of theoretic and applied subjects (experimental group)

The dynamics of the level of acquiring knowledge and skills of theoretic and applied subjects before and after the experiment indicate positive changes, which confirms the results of a survey on the state of vocational training within the experimental group. Apart from that, the survey showed a higher level of multimedia use (+47%), and update of disciplines content (+63%). The Respondents also noted a greater involvement in developing features necessary for self-realisation in professional activity (+70%). At the same time, among the representatives of the control group, there is a need to expand multimedia application (52%), upgrade the subject content (57%), and develop features necessary for self-realisation in professional activity (73%), thus substantiating the need to introduce the technology (Figures 4 and 5).

The survey of teachers on the level of professional competence, self-education and students' training revealed: an increase in the number of teachers introducing innovations in training and the production process by 48%; the innovation potential is considered 19% higher; the number of information technology users increased by 9%; the level of teachers' readiness for independent learning

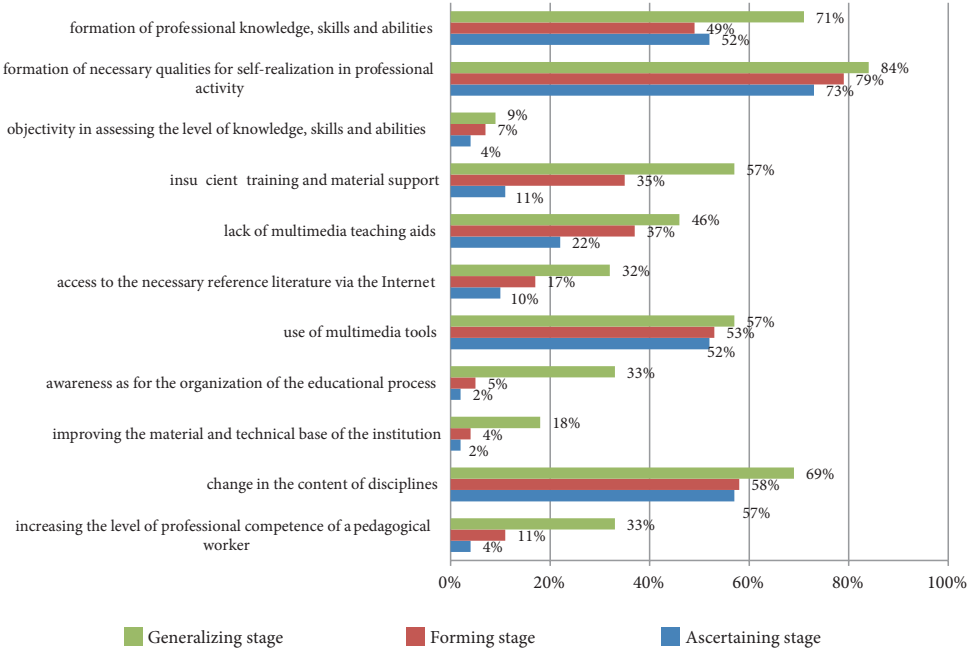

Figure 4. Results of the survey of students on the state of vocational training (control group)

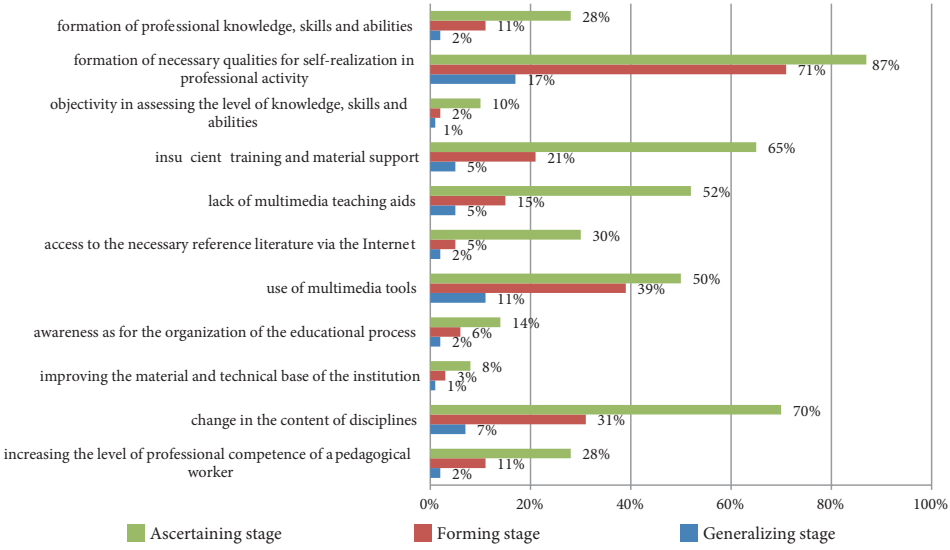

Figure 5. Results of the students' survey on the state of vocational training (the experimental group)

increased by 18%. The percentage of teachers informed about innovations also increased (+13%). However, the percentage of teachers who occasionally conduct professional development activities decreased by 71% (Figure 6).

The study of students' personality development indicates an increase in indices after the experiment in the control and experimental groups. Thus, the teachers provided the following assessment of personality development of students according to the criteria: sociability – the high level is 5% CG; 11% EG (+3%; +8%), sufficient – 8% CG; 28% EG (-1; +21%), medium – 31% CG; 37% EG (+6%; -3%), low – 50% CG; 27% EG (-8%; -26%); discipline – high level is 10% CG; 19% EG (0%; +8%), sufficient – 7% CG; 23% EG (+2%; +17%), medium (38% CG; 34% EG (+1%; -1%), low – 45% CG; 52% EG (-3%; -27%); intellectual development – high level is 3% CG; 19% EG (+1%; +17%), sufficient – 16% CG; 27% EG (-3%; +17%), medium – 37% CG; 36% EG (-1%; +1%), low – 46% CG; 43% EG (-1%; -10%); initiative – high level is 6% CG, 21% EG (+1%; +18%), sufficient – 12% CG; 29% EG (+1%; +20%), medium – 53% CG; 30% EG (+1%; -22%), low – 28% CG; 20% EG (-3%; -16%); ability to learn – high level is 15% CG, 29% EG (+2%; +19%), sufficient – 9% CG; 24% EG (+2%; +19%), medium – 23% CG; 25% EG (0%; +1%), low – 53% CG; 60% EG (-4%; -39%); creative potential high level is 9% CG, 21% EG (+1%; +15%), sufficient – 13% CG; 23% EG (+1%; +12%), average – 36% CG;

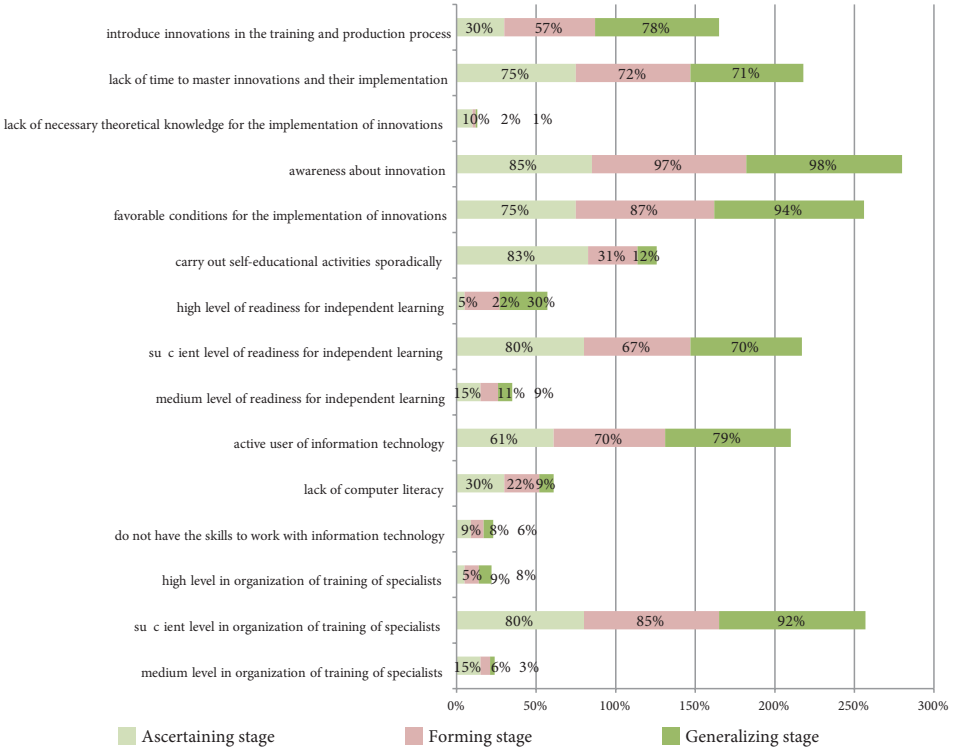

Figure 6. Survey of teachers on the level of professional competence, self-education and level of students' training

31% EG (-2%; 0%), low -42% CG; 25% EG (-4%; -27%); leadership qualities – high level is 12% CG, 23% EG (+1%; +15%), sufficient -13% CG; 27% EG (+4%; +19%), medium – 43% CG; 47% EG (+1%; -16%), low – 31% CG; 19% EG (+6%; -20%) (Figures 7, 8, and 9).

There is a positive dynamic of changing vocational training efficiency according to the results of the employers' survey: the high level – 12% CG; 33% EG (+2%; +4%), the sufficient level – 34% CG; 37% EG (-1%; +7%), the medium level – 39 CG; 40% EG (-1%; +3%), the low level – 15% CG; 5% EG (0%; -3%) (Figure 10).

During the scientific search, the performance of educational institutions was measured according to the main indicators of activity. They testify to the expediency of the conducted scientific search, formative experiment since the average indicator of the quality of activity is 1.5 times more compared to the results of the ascertaining experiment.

[78]

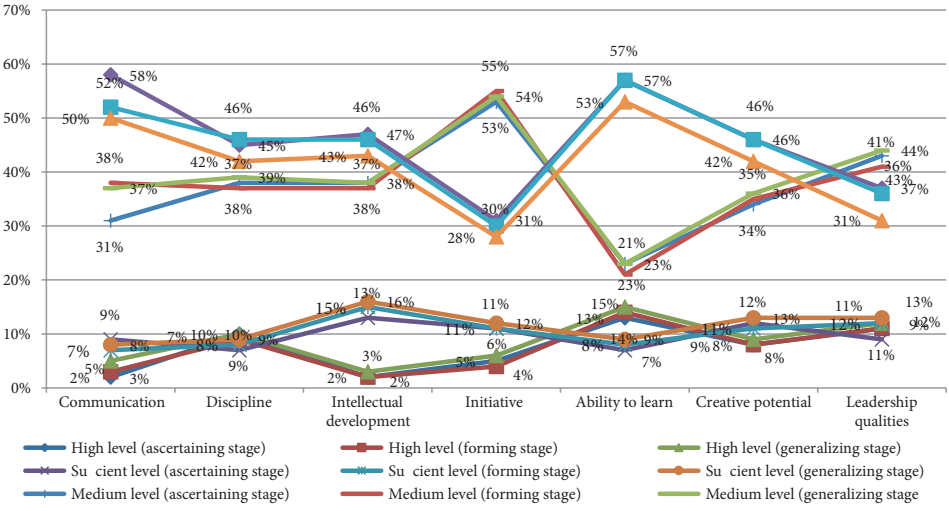

Figure 7. Intermediate results of students' personality development (the control group)

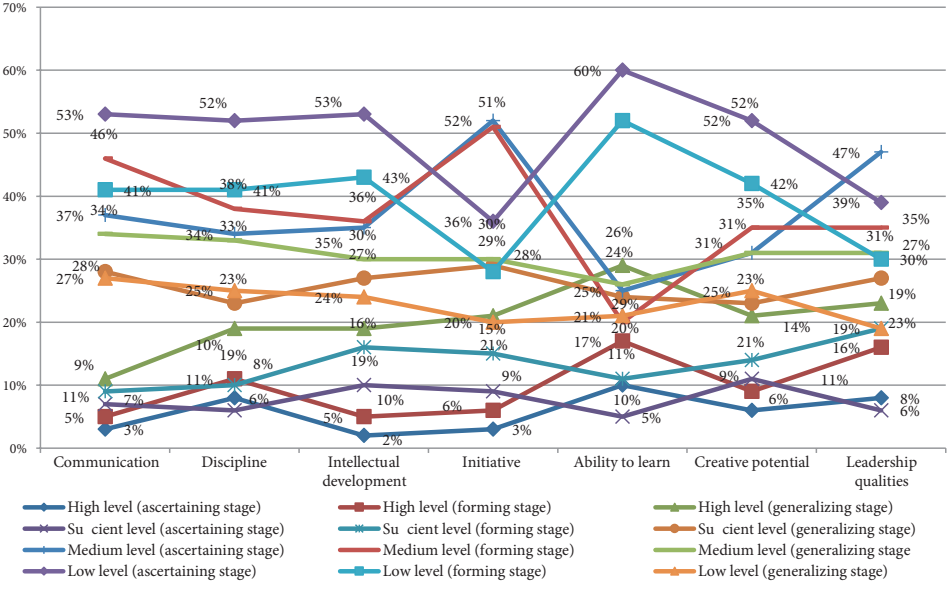

Figure 8. Intermediate results of students' personality development of (the experimental group)

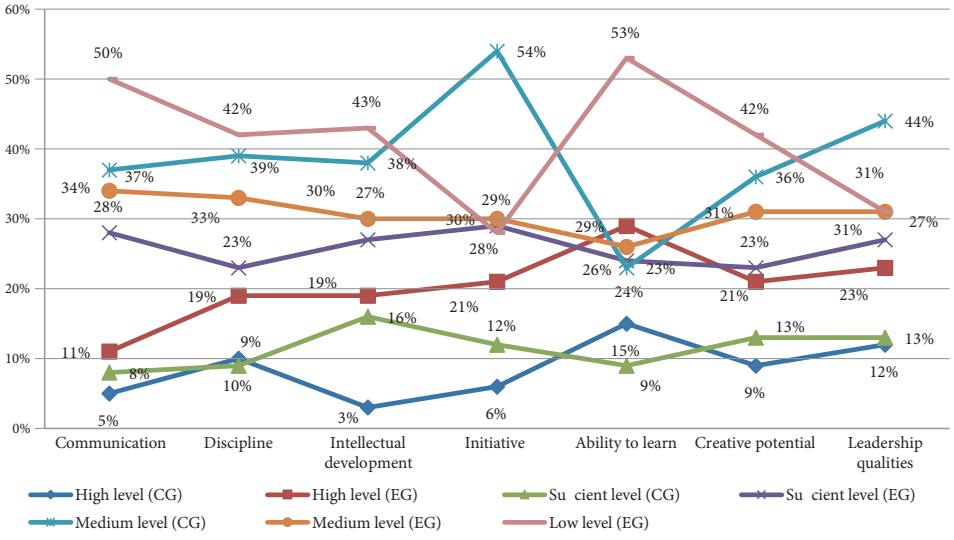

Figure 9. Comparative analysis of intermediate results of personality development of students in the control and experimental groups

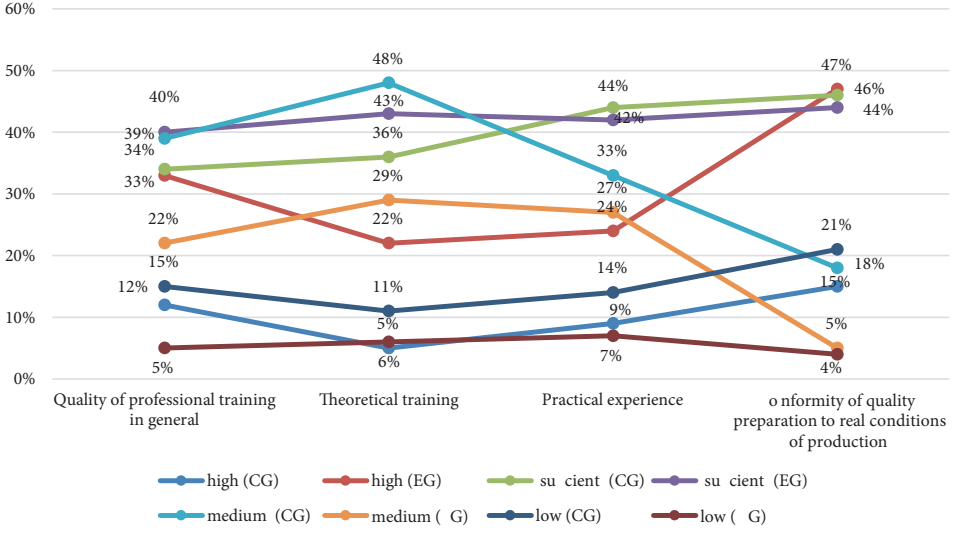

Figure 10. Comparative analysis of assessing the quality of professional training of future specialists in control and experimental groups based on the results of a survey of employers

The results of the calculations of the empirical chi-square value of the survey of pedagogical workers (regarding the determination of their level of professional competence and self-education, determination of the level of formation of the personal qualities of students of education) of the survey of students of education regarding their motivation for professional activity give grounds for asserting the heterogeneity of the sample and the effectiveness of the experiment with a reliability of 0.95, which confirms the effectiveness of the experiment.

According to the results of the survey of employers, the components of specialist competence have the greatest importance: "Professional competence" (weight coefficient – 0.343926), "Discipline, independence, creativity (ability to solve tasks in a non-standard way)" (weight coefficient – 0.189863), "Communication, the ability to work in a team" (weight coefficient – 0.18389), it confirms the effectiveness of the developed quality management model for training competitive specialists in vocational training IP(VT)E.

Conclusions and Prospects

When introducing the quality control model of competitive professionals' training at IP(VT)E and testing its effectiveness, it was concluded that vocational training is effective only if scientifically substantiated pedagogical conditions are observed.

The study of the current state and prospects of development, analysis of problems of students' training at IP(VT)E, ways to solve them, as well as the results obtained allow substantiating recommendations for improving the training process, the introduction of which will promote students' competitiveness:

- creation of a regulatory framework at the level of the government and institution administration that meets the requirements of today to regulate: the processes of vocational guidance with synchronisation of IP(VT)E interests and those of general education institutions and employers; incentive mechanisms for teachers to achieve high academic results, professional development and introduction of innovative methods; cooperation of research institutions, employers and IP(VT)E to provide educational and methodological support of the educational process; financial support for the development of infrastructural and technical components of educational process;

- facilitation of the role of employers: in the development of educational and methodological support for vocational training (textbooks, manuals, teaching materials); organisation of dual training (by providing mentors, jobs, training and apprenticeship under the curricula); assistance in raising professional competen-

cies of teachers and students based on industrial enterprises; conducting training sessions on subjects of professional and theoretical training by experienced specialists; organisation and conduction of career guidance events and selection of applicants for training; development of motivation for future professional activity through nominal scholarship payments;

- at IP(VT)E: development of professional training content in accordance with the requirements of the labour market; improvement of vocational guidance by organising professional career centres based on general education institutions; creation of a diagnostic complex of students' professional interests, intentions, orientation, aptitudes and abilities; introduction of courses to master professional competencies; involvement of specialists from the enterprise in the development of educational and methodological support of professional training; development and implementation of digital educational resources as an effective tool for expanding the information space of students; implementation of the principles of continuity and accessibility of education through introduction of distance individual education and introduction of elements of dual training; promotion of dissemination of innovative experience in organising students' training through workshops, seminars, and webinar conferences.

The experimental search does not cover all the aspects of the problem of students' competitiveness. Further research is needed to solve: the problems of professional and pedagogical education of teachers at IP(VT)E, to study optimal conditions for stimulating self-development and self-improvement of teachers as well as constant professional development of students.

References

Currie, C. T. (2018). *Student Motivation Profiles as a Diagnostic Tool to Help Teachers Provide Targeted Support* [PDXScholar]. https://pdxscholar.library.pdx.edu/ open_access_etds/4229

Fried, E. I. (2020). Theories and Models: What They Are, What They Are for, and What They Are About. *Psychological Inquiry*, *31*(4), 336–344. https://doi.org/10.1080/1047840x.2020.1854011

Göhner, M., & Krell, M. (2021). Was ist schwierig am Modellieren? Identifikation und Beschreibung von Hindernissen in Modellierungsprozessen von Lehramtsstudierenden naturwissenschaftlicher Fächer. *Zeitschrift für Didaktik der Naturwissenschaften*, 155–180. https://doi.org/10.1007/s40573-021-00131-4

Halloun, I. A. (2018). *Scientific Models and Modeling in the Framework of Systemic Cognition and Education*.

Ke, L., Sadler, T. D., Zangori, L., & Friedrichsen, P. J. (2021). Developing and Using Multiple

Models to Promote Scientific Literacy in the Context of Socio-Scientific Issues. *Science & Education*, *30*(3), 589–607. https://doi.org/10.1007/s11191-021-00206-1

Parker, W. S. (2020). Model Evaluation: An Adequacy-for-Purpose View. *Philosophy of Science*, *87*(3), 457–477. https://doi.org/10.1086/708691

Reith, M., & Nehring, A. (2020). Scientific reasoning and views on the nature of scientific inquiry: testing a new framework to understand and model epistemic cognition in science. *International Journal of Science Education*, *42*(16), 2716–2741. https://doi.org/10.1080/09500693.2020.1834168

Rost, M., & Knuuttila, T. (2022). Models as Epistemic Artifacts for Scientific Reasoning in Science Education Research. *Education Sciences*, *12*(4), 276. https://doi.org/10.3390/educsci12040276

Sergeeva, L., & Stoychik, T. (2020). Managing the development of training of competitive professionals in vocational educational institutions. *SHS Web of Conferences*, *75*, 02004. https://doi.org/10.1051/shsconf/20207502004

Upmeier zu Belzen, A., Engelschalt, P., & Krüger, D. (2021). Modeling as Scientific Reasoning – The Role of Abductive Reasoning for Modeling Competence. *Education Sciences*, *11*(9), 495. https://doi.org/10.3390/educsci11090495

Vitvytska, S. S., Kolesnyk, N. Ye., Boichuk, I. D., Herasymchuk, O. L., Zaporozhtseva, Yu., S., Kovalchuk, O. A., & Usata, O. Yu. (2019). *Modeliuvannia profesiinoi pidhotovky fakhivtsiv v umovakh yevrointehratsiinykh protsesiv* [*Modeling professional training of specialists in the conditions of European integration processes*]. Yevenok O. O.

AUTHORS

IRYNA ANDROSHCHUK

The Maria Grzegorzewska University in Warsaw
Shcheslivicka Str., Warsaw, 02-353, Poland
E-mail: iandroshchuk@aps.edu.pl
ORCID: https://orcid.org/0000-0002-3557-793X

LARYSA SERGEIEVA

University of Educational Management
52-A Sichovykh Striltsiv Str., Kyiv, 04053, Ukraine
E-mail: lase2508@gmail.com
ORCID: https://orcid.org/0000-0002-7177-3014

TETIANA STOYCHIK

Kryvyi Rih Professional Mining and Technology Lyceum
1 Elistynska Str., Kryvyi Rih, 50053, Ukraine
E-mail: stoychyk_t@ukr.net
ORCID: https://orcid.org/0000-0002-6106-9007

LIUBOV KRAVCHENKO

Communal Institution of Higher Education «Dnipro Academy of Continuing Education» of Dnipropetrovsk Region Council"
Vladimir Antonovich St. 70, Dnipro, 49006, Ukraine
E-mail: doih_kravchenko@ukr.net
ORCID: https://orcid.org/0000-0002-8031-2252

KATERYNA MARTYNENKO

Kryvyi Rih Professional Mining and Technology Lyceum
1 Elistynska Str., Kryvyi Rih, 50053, Ukraine
E-mail: kat.martynenko@ukr.net
ORCID: https://orcid.org/0000-0003-0433-2929