Trans-perspective technologies in the formation of the vocational and educational space of students

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Abstract. Digital economy in professional standards sets high requirements for the competencies of specialists, necessity of acceleration and continuation of professional development, introduction of modes of distance learning. Students have contradictions and chronological gaps between the new virtual educational content and previously obtained real experience, modern styles of professional activity and traditional patterns of performance of labor functions, between current information from Internet sources and well-known fundamental knowledge in the subject area. As a result, it becomes difficult to implement educational strategies and trajectories, as well as to develop professional competencies. To solve this problem, it is suggested to distinguish a class of trans-perspective pedagogical technologies. Their pedagogical impact is based on the creation of spatial and temporal relationships (trans-perspectives) between various educationally significant events. The trans-perspective reverse-methodologies identified by the authors have these opportunities and are based on case studies, professionally-oriented complex projects, end-to-end design based on reverse-engineering and prototyping, the “Swing of Time” methodology based on visualization. Diagnostics of the results of the experiment with students of various training areas proves an increase in the level of formation of the continuous professional and educational space of the student due to the reduction of educational risks and the creation of a professional and educational trans-perspective as a purposeful combination of the multidimensional experience of the past, knowledge of the present and forecasts of the future in the educational process.

1 Introduction

Socio-economic transformations and digital economy in professional standards set high requirements for the competencies of specialists, necessity of acceleration and continuation of professional development, introduction of modes of distance learning. A system of

complicated interrelations of an individual with the world of professions and vocational education is characterized in psychological and pedagogical studies as the phenomenon of the "professional and educational space of an individual" [1]. The success of its formation depends on continuity of space-time continuum created by the process of training, education and development of an individual. The continuity of the space is ensured by the interaction between the processes of personal development, continuing education and the leading professionally oriented activity of the student [1, p. 23]. The continuity is created by the presence of time trans-perspective as a set of interrelationships between past, present and future professional and educational events, while identifying the internal value-semantic dimensions of their comprehension [2], [3], [4]. Absence of time trans-perspective leads to risks of stagnation of self-development of an individual, decrease in the level of educational motivation and professional incompetence.

The term ″time trans-perspective″ means an individual's review of the flow of time in his or her own life in any direction, on any part of its duration [5]. Informatization and Internet technologies significantly expand pedagogical resources of formation of professional and educational space but they can not fully ensure its continuity, since they don't purposefully create time trans-perspective [6].

Surveys and questionnaires, conducted during the mass transition to distance learning during the pandemic in 2020, showed that there is a need of new pedagogical technologies in order to provide opportunities for creating a student's trans-perspective. These technologies integratively contribute to the successful prediction of the professional future, the creation of realized educational trajectories, the ability to evaluate professional situations on the basis of innovations and fundamental principles of labor relations, motivate for an in-depth critical study of professional experience [7].

The study justifies the allocation of a class of trans-perspective pedagogical technologies, defines the options and limits of their use in the educational process in order to form professional and educational space for students.

2 Materials and methods

Presentation of trans-perspective technologies of formation of professional and educational space for students is briefly given in Table 1.

Table 1. Brief review of the study of trans-perspective technologies in the educational practice

Name of the technology in pedagogical discourse	Educational specifics, testing trans-perspective opportunities	Authors-researchers of trans-perspective opportunities of technologies
Reverse-Methodology	engineering education	O.F. Piralova, V.V. Kolga
	talent management	L.P. Repyakh, I.D. Belonovskaya
Case Study	talent management	L.P. Repyakh, I.D. Belonovskaya
	upgrade training of teachers	D.F. Ilyasov
	upgrade training of managers	M.A. Drobot
Visualisation	Pedagogical education and upgrade training	D.F. Ilyasov
	Legal education	A.V. Kiryakova, A.P. Lopanova
	Economic education	M.A. Drobot, I.D. Belonovskaya
Project technologies	engineering education	I.N. Charikova
Engineering	engineering education	A.N. Polyakov, A.I. Serdyuk
"Swing of Time"	General education	S.V. Tetersky
"Swing of Time" Visualisation	medical education	V.V. Nevolina

In Table 1, we highlight the studies that clearly define the limits of the use of technologies in the educational practice:

- trans-perspective reverse-methodologies and case studies in upgrade training of the personnel;
- trans-perspective professionally-oriented integrated design technologies in education in construction;
- trans-perspective engineering in the training of future machine builders;
- trans-perspective visualisation in professional self-development of a future medical worker.

We present the basic organizational and pedagogical conditions of implementation of these technologies in educational practice.

2.1 Trans-perspective reverse-methodologies and case studies in upgrade training of the personnel

Mass distance learning revealed the effect of "virtual oversaturation" of the professional and educational space of students. Filling the content of distance learning with virtual objects led to the displacement of real ideas, growing isolation from reality [8], reduced the level of credibility in evaluation of eventfulness of the profession [9]. Surveys among students showed that distance learning significantly complicated the understanding of the professional context of academic disciplines. So, for example, the specifics of the engineering profession became less comprehensible since production facilities were replaced with their diagrams and images during the educational process [10]. At the same time, it happened to be effective to refer to the life experience of a student, creation of chronological (tempor**al**) links and associations between the existing industrial (everyday) experience and positions of new knowledge [11],[12]

In works of O.F. Piralova [13] and V.V. Kolga [14], a methodology of returning to past educational events is proposed. Thus, O.F. Piralova characterizes the reverse-component of educational process of students. It consists in a periodic return to the studied issue (topic) for the conscious application of well-known theoretical provisions in real and future academic and practical activities by students. The method is effectively used for students of engineering and technical areas of training.

We offer additional trans-perspective opportunities of reverse-methodology with case study technology. Description of past situations given in the cases is analyzed by the student from the perspective of the present and is aimed at creating pragmatic, cognitive and axiological resources for solving the issue [15] transferring experience to the future professional activity [16].

In the studies of L.P. Repyakh and I.D. Belonovskaya, an option of integration of reverse-methodology and case study in the upgrade training of engineering and technical personnel to form their preparedness for various production hazards was developed [17]. The methodology included three stages.

First stage - exchange of experience and information and situations of production hazards. On the assignment of the teacher, according to the proposed scheme, the students made a description of the situation known to them in the form of a mini-case. The structure of the case included mandatory positions on the logic of engineering situational analysis. The volume of description was 1-2 pages. Then, there was a short exchange of information messages and a joint discussion of actions of the engineering and technical personnel. The author-listener briefly recorded the summary-assessment of actions in his or her mini-case. The result assumed the actualization and systematization of their own risk experience.

Second stage - analysis and solution of cases given by the teacher. The decision was carried out independently or with the help of the advisory support of the teacher. The decision

was based on norms, regulations and current industry methodologies that were studied during upgrade training.

Third stage - search and discussion of innovative approaches to reducing the level of production hazards, return (reverse) to discussion of previously studied cases in order to determine the possibility for application of new ways to reduce production hazards, re-evaluation of case solutions from the student's experience, joint discussion. The most typical risk-based cases were discussed together with leading specialists of Rostechnadzor. It was proposed to document the results of expert assessments in free form to preserve experience, as well as in the form of risk cards or regulated documents.

2.2 Trans-perspective professionally-oriented integrated design technologies in education in construction

An important aspect of the problem of the formation of a student's professional educational space is the unsystematic and uncritical use of information resources, which leads to the incorrect use of new knowledge, to possible voluntary decisions and professional incompetence. The student actively uses the available, rapidly updated Internet sources but does not receive reliable "live knowledge", feels the separation of new information from fundamental scientific positions in the subject area. Long-term experience in the development of the profession is compressed and stored in knowledge databases, but in a formalized form it loses its subjectivity, authorship, emotional saturation, becomes less valuable for the student and less in demand [18]. In order to establish the relationship between the available traditional knowledge and innovative information, researchers of the Orenburg State University proposed trans-perspective technologies that recreate the formation of the scientific foundations of the profession in educational and real projects. The project technology "retro-real-prognosis" [19] is implemented through the participation of students-future builders in the implementation of a triad of projects. The first stage of design "Retro-projects" is carried out as analytical abstract studies of classic examples of engineering thought, autobiographies of famous figures. Students perform real-projects in order to get modern technical solutions with the use of revitalisation. Variants of such projects were term papers, final qualification papers, articles and essays addressing the integration of tradition and innovation of an engineering project. Prognosis-projects had a conceptual nature of predicting the future, a "probabilistic image of an artifact", were created within the framework of competitions at the request of regional employers.

2.3 Trans-perspective engineering in the training of future machine builders

In computer-aided design, a student independently configures and optimizes a construct, but does not master innovative approaches deeply enough, since he uses standard procedures and standard database solutions [20]. In order to overcome innovative gaps in the professional and educational space of the student, the technology of end-to-end trans-prospective design based on the reverse engineering methodology was elaborated and implemented. Reverse engineering in modern scientific research is a return to the initial stage of the product life cycle, which at the moment is already a popular commercial product. The study is carried out to find out those features of the construction, which defines success of sales or exploitation of technical object. An attempt is made to understand the principles of operation for later playback with additional options or functions. The ethical problem of borrowing original ideas is not raised in this case, since direct copying of know-how is not assumed.

Trans-perspective engineering was elaborated and used for the training of engineering students [21]. This technology consisted of three stages.

Initially, in the first and second years, students studied well-known design solutions of mechanical systems and converted them into digital models based on their own drawings or scanning method.

Then, in the senior years, the created models were used for prototyping on a 3D printer in the training laboratory. Solid-state prototype models were fairly accurate copies of the studied objects.

In the final qualification works and in the magistracy, those prototypes served as a means for students to critically evaluate technical solutions, search for directions for their modernization and develop advanced manufacturing technologies.

Trans-perspective engineering combined the stages of the product life cycle and the stages of professional actions in the field of design, established the time sequence of engineering procedures, the relationship of research, modeling, design, construction and production in the professional and educational continuum of the student.

2.4 Trans-perspective visualisation in professional self-development of a future medical worker

The sphere of professional education effectively includes a variety of foresight technologies and visualization [22]. Foresight represents a technology for managing positive changes in the future through its knowledge in modeling, determining management resources and stakeholders. The initial purpose of Foresight to create relationships between a real event and a promising future indicates the broad possibilities of technology in the formation of the professional and educational space of students. We will distinguish in this spectrum the methodology - "Swing of time" [23], suitable for implementation in a mode of distance learning and taking into account the peculiarities of the clip perception of "space-time" among modern youth. This methodology was adapted to the conditions of distance learning of junior students of a medical university by V.V. Nevolina [24]. The basis of the methodology is the visualization by the student of the idea of his or her future as an effectively managed positive phenomenon. According to the teacher's instructions, students reflect their positive life and professional goals, methods of their progressive achievement and methods of effective management of movement towards the future in several chronologically connected images.

Pedagogical support, aimed at emphasizing the value-semantic and ethical priorities of the professional and educational space of a medical worker, is of a high importance in the implementation of this methodology. The specifics of the professional values of future medical workers must reflect in visualisation of the values of health, central position of a healthy life style, bright and rich visual representation of the concept of "life".

The brightness of the color gamut of images should characterize energy, resilience, focus on results and confidence in the correct professional choice.

It is important to help students to visualize the symbols of their profession, the instrumentarium of their specialization.

In internal mode of studies, the technology of "Swing of Time" was implemented in stages:

- the student was asked to mentally move to the desired future (with a help of a video clip, music; counting hours, days or years; moving from one place to another; changing the position) and accept it as reality.
- the student answered to questions that reinforce what he saw in the created future.
- the student came back to present (using the same techniques that were used to go to future) where the answers from future were analyzed, objectives and goals were defined.

The process of sequential image or "quasi-living" of the stages of the life path of the future medical worker (action) also includes the independent construction or selection of images, video clips, photographs, diagrams and other graphic objects. In the classroom meetings, the statics and dynamics of positions, changes in styles, directions and rates of movement were used, which provided a clearer understanding of the goals of self-development, the concretization of the means and trajectories of its achievement, the strategy and tactics of managing positive changes.

3 Results and discussion

The results of formation of professional and educational space may be characterised on the basis of the research of the process of development of its components - continuous education, developing types of leading activities, personal and professional development of the subject [1, p. 23]. For a comparative analysis of various studies, their results were evaluated according to identical criteria adopted in pedagogical diagnostics – epistemological, praxiological, axiological (Table 2).

Table 2. Criteria of formation of professional and educational space of students

Structural components of the professional and educational space	**Criteria of formation of professional and educational space of students**		
	Epistemological	**Praxiological**	**Axiological**
Continuous Education	knowledge of the resources and prospects of continuous professional education	ability to develop options for professional and educational trajectories	value of continuous professional education
Developing types of leading activity (professional and educational)	Knowledge of fundamentals, current positions and prospects for the development of professional activity	ability to master and implement promising professional activities	values of long-term professional development
personal and professional development of the subject	professional knowledge	professional skills	Value of professional and personal self-development

The following levels of formation of the professional and educational space of students were established: acceptable, normative and promising. The levels were assigned 3, 4, and 5 points. According to the principles of pedagogical diagnostics, the effectiveness of trans-perspective technologies was evaluated by comparing the initial and final state of the control and experimental groups of students. The results of the studies revealed significant differences in the state of the participants in the experimental group; statistical processing of the results was carried out according to the Wilcoxon-Mann-Whitney test. In the control groups where such technologies were not used, there were no significant positive changes in the formation of continuous professional and educational space.

A quantitative comparative assessment of the effectiveness of technologies was carried out on a 5-point scale using an integrative calculation with equal weight coefficients. Additionally, also according to the 5-point scale, the opinion of students about the significance of a particular technology for future professional activity was taken into account, the teachers assessed the labor intensity of developing methodological support for the proposed technologies in the logic of "higher score for reducing labor intensity". The results are given in Figure 1.

The experiment and diagnostics showed that for the development of the epistemological aspect of all components of the professional and educational space for students, technologies

based on referring to the previously known experience of professional activity are effective. So, reverse-methods on the basis of case-study provide the most complete mastering of actual knowledge and the transfer of such knowledge to the immediate future of work. Own experience is a prerequisite for the implementation of this trans-perspective technology, which determines its use in additional professional education.

Design technologies "retro-real-forecast" contribute to strengthening the relationship between fundamental knowledge and prospects for the development of professional activity, are more focused on the future of the profession and require a long time for the consistent implementation of all stages. In this regard, such technology can be applied in the system of secondary and higher professional education, as well as in the research activities of bachelors, undergraduates and postgraduates.

Reverse engineering as a pedagogical technology has limited application in engineering education, but it is this technology that allows the most intensive development of the ability to master and implement promising types of professional activities.

The technology of "Swing of Time" and visualization of a positive future arouse interest among students of all categories, but its use, as shown by the experiment, is advisable for the formation of motivational and value positions. In particular, it is this technology that ensures the assignment of the value of continuing professional education as the basis for self-development and self-improvement in the profession.

Turning to the problem of the complexity of creating software and methodological and pedagogical support, we note that the greatest labor costs of a teacher relate to reverse techniques, case studies and reverse engineering, relatively less costs are required for the preparation and implementation of the technology of "Swing of Time".

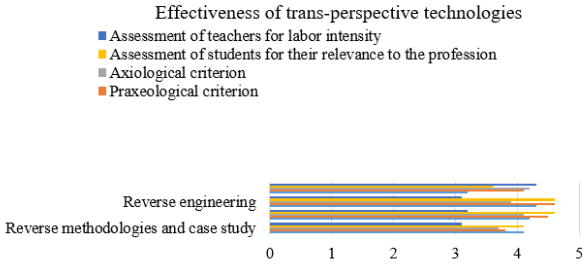

Fig. 1. Diagram for assessing the effectiveness of various trans-perspective pedagogical technologies

4. Conclusions

This study justifies the allocation of the class of trans-perspective pedagogical technologies. The demand for trans-perspective technologies is due to the requirements of the professional standard of specialists, which fixes the continuity of professional self-development, the ability to organize an independent search for knowledge and solve problems in the subject area. The basics for the allocation of the class of trans-perspective pedagogical technologies are opportunities to create a professional and education trans-perspective as a purposeful combination of the multidimensional experience of the past, knowledge of the present and forecasts of the future in the educational process. At the same time, the risks of breaking the relationship between new and traditional knowledge, approaches and principles of professional work are minimized. Information risks are reduced by redundant replacement of real phenomena in the profession with virtual objects and situations. The possibility of a fuzzy idea of the specifics and prospects of this profession, which can cause stagnation of professional self-development, is decreased.

To date, the selected class of technologies includes four technologies developed, modernized and tested by the authors. Reverse-methods on the basis of case study are recommended in order to upgrade qualification of the personnel. Trans-perspective professionally-oriented complex design technologies "retro-real-forecast", invariant with respect to the areas of training, can be implemented in higher and secondary vocational education, in the research work of students. In engineering education, it is proposed to expand the use of reverse engineering in end-to-end design with prototyping of production facilities. For all age groups of students and areas of training, visualization in the "Swing of Time" method can be used, aimed at professional self-development and the development of strategies and tactics for creating a positive professional future.

Diagnostics of the results of testing in an experiment with students of various training areas proves an increase in the level of formation of the continuous professional and educational space of students.

References

1. D.P. Zavodchikov, *Innovative professional and educational space of an individual*, 154 (2014)
2. G.G. Chesmenskaya, Siberian psychological journal, **51,** 31 (2014)
3. V.E. Klochko, *Self-organization in psychological systems: issues of the formation of the mental space of the individual,* 174 (2005)
4. E.A. Kukuev, International scientific and research journal, **1-2(8),** 49 (2013)
5. V.P. Zinchenko, Questions of psychology, **6,** 37 (2001)
6. E. V. Lebedeva, D.P. Zavodchikov, Scientific dialogue, **12,** 452 (2018)
7. A. V. Kiryakova, N. A. Kargapoltseva, I. D. Belonovskay, Higher education in Russia, **8-9,** 155 (2020)
8. R. Kindley, The e-Learning Developers' Journal, **1** (2002) http://www.elearningguild.com
9. L. P. Repyakh, ESPACIOS. Sociacion de Profesionales y Tecnicos del CONICIT, **20(39),** 11 (2018)
10. T. A. Olkhovaya, E. V. Poyarkova, Higher education in Russia, **8-9,** 142 (2020)
11. A.V. Kiryakova, V.V. Kolga, A.S. Yumatov, V.P. Smorchkova, E.N. Romanova, Yu.N. Tuganov, V.I. Fedulov, Online Journal of Communication and Media Technologies, **10(3),** e202013 (2020)
12. A.V. Kiryakova, V.V. Kolga, E.N. Yalunina, A.D. Chudnovskiy, Yu.M. Korenko, A.V. Leifa, Man in India, **97(14),** 227 (2017)
13. O.F. Piralova, Higher education today, **4,** 27031 (2017)
14. V.V. Kolga, M.A. Shuvalova, Modern problems of science and education, **1(1),** 950 (2015)
15. A.V. Kiryakov, A.P. Lopanov, Modern problems of science and education, **2(1)** (2015) http://science-education.ru/ru
16. D.F. Ilyasov, E.A. Selovanova, A.A. Sevryukova, K.S. Burov, Scientific support of the personnel professional development system, **2(43),** 5 (2020)
17. L.P. Repyakh, OSU Bulletin, **1(224),** 94 (2020)
18. L. A. Mikeshina, Values and sense, **4(44),** 10 (2016)
19. I. Charikova, Eurasia J Biosci, **12,** 787 (2020)

20. I.D. Belonovskaya, A. N. Polyakov, Higher Education in Russia, **28(7),** 150 (2019)
21. A.N. Polyakov, Higher education in Russia, **7,** 150 (2019)
22. D.F. Ilyasov, K.S. Burov, A.A. Sevryukova, E.A. Selivanova, Modern pedagogical information, **4**, 123 (2020)
23. S.V. Tetersky, Values and meanings, **1(29),** 56 (2014)
24. V. V. Nevolina, Eurasian Journal of Analytical Chemistry, **12(7b),** 1117 (2017)