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Continuous Training of Teachers for Civil Engineering Education

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Abstract

The relevance of the problem lies in the need for providing civil engineering educational institutions with minor and major subject teachers within the context of the scientific and educational cluster. Teachers of these organizations are graduates of pedagogical or technical universities. The disadvantages in organizing the work of students in the former are the lack of industry competencies, and in the latter, pedagogical ones. There is some experience in the training of such teachers within the framework of the specialty vocational training (by industry). However, there is no data on their continuous training within the framework of the scientific and educational cluster. The objective of this article is to develop a lifelong teacher's training framework for construction vocational school teachers. The methodological basis of the training lies in principles of continuity and flexibility. The following continuity components are considered: objective, substantial, technological, psychological and managerial. Rapid adaptation of curricula is achieved by their flexibility. The article analyses ten bachelor's, four master's and one doctoral (PhD in Education) degrees curricula. The following techniques of research are applied: didactic analysis and generalization of pedagogical experience; analysis of Federal State Educational Standards (FSES) of educational and technical programs and professional standards (PS). They allow the continuity-oriented design of teachers' training curricula at all degrees, i.e. bachelor, master, doctoral. The stages of flexible learning content designing are developed. The system of continuous training of teachers, composed of continual educational programs for undergraduate, graduate and doctorate degrees is given. The article may be useful for the teacher's continuous training in technical institutions.

Keywords: educational standard, professional standard, vocational education, continual education.

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Introduction

The construction industry maintains a leading role in the economy of the Republic of Tatarstan. This is due to highly qualified personnel (workers and engineers) trained at educational institutions, and the scientific and the fact that the educational cluster, created at Kazan State University of Architecture and Engineering (KSUAE), makes a significant contribution to that (Korchagin et al., 2014; Safin & Korchagin, 2015 a, 2015 b; Akhmetov et al., 2016; Korchagin et al., 2017). The cluster consists of KSUAE itself and five construction secondary vocational schools.

The basis of any cluster lies in the following principles: 1) innovation, that provides qualitative growth in the organizational and managerial innovations and intellectual capital and high-tech products demanded by the market; 2) subsidiarity, that contributes to the creation of mechanisms for the voluntary and committed participation of companies and businesses to increase the intensity of research activities by key direction of cluster development of and the quality of professional training of future specialists; 3) autonomy, that defines equal partnership and balance of socio-economic interests of all entities within the cluster, the synergy of their goals and non-additivity of their interests (Akhmetov et al., 2016; Safin & Korchagin, 2013).

Scientific and educational cluster is successfully operating in the social partnership of different levels of education and production. The development of a strategy for the construction of scientific and educational cluster determines the pedagogical factors that allow designing the education content, professional competencies together with employers. In addition, interaction with organizations in the construction industry provides a more practical orientation of training and remains a place of internships of students and training of teachers. The training of graduates and postgraduates is reviewed in our previous papers (Safin & Korchagin, 2015 a). They are devoted to mechanisms of creation, operation, management, engineering, entrepreneurial training within the scientific and educational clusters, the features and the possibility of designing flexible learning content were given in other papers (Safin & Korchagin, 2015 b; Khairutdinov et al., 2019). Thus, it can be argued that the scientific and educational cluster created the conditions for the training of civil engineers.

In the system of tertiary education, new educational standards (FSES) were introduced (2015, 2019) and they are result-oriented ones. In the course learning at a tertiary educational institution, building skills are aimed to solve professional problems according to the areas specified in FSES and perform labor functions specified in State Professional Standards (PS) (professional standard 16.01.004, 2015). FSES contains a list of relevant professional standards. The possibility of incorporating the requirements of professional stand-

ards and their interface in the design of educational standards in technical universities was shown in the following papers (Safin & Korchagin, 2015 a; 2015 b).

Foreign research papers contain reviews of mutual influence and interaction of educational and professional standards. They argue that those standards called forth the industrial revolution. It is noted that the relationship between the standards and the modern economy demands from educational institutions paying more attention to the professional education standards (Safin & Korchagin, 2013; Borraz, 2007; Botzem & Dobusch, 2012; Brady & Bates, 2016; Lipset, 2018).

According to the Ministry of Labor and Social Security of the Republic of Tatarstan, the most popular in-demand profession is a construction worker, although employers have questions about the quality of their training. It is acknowledged that the quality of their training is determined by vocational teachers. They train students in their specialties at secondary vocational, tertiary and additional vocational education institutions (Korchagin & Safin, 2017).

However, in recent years no institution has such programs. These courses are no longer financed by the government and as a result, there are no students of that major anymore. Whereas hardly any university teaching staff member has received any kind of pedagogical training.

The lack of research work, devoted to the training of technical university teaching staff, determines the relevance of the article. A possible solution to this problem was presented in (Safin, Korchagin & Abitov, 2019), which developed variable models of teacher's training for secondary vocational and higher education. The work describes the principles of designing the training content.

We will show the continuous training of teachers of vocational and higher education institutions within the context of the scientific and educational cluster. This training can be accomplished on the basis of such bachelor programs as "Civil engineering", "Vocational training" and "Housing and communal services". Within the context of the preparation process, the integration of corporate and pedagogy training is carried out.

Purpose and objectives of the study

The purpose of the study is to develop ways of implementing variable models in the process of training teachers of vocational training on the basis of the scientific and educational cluster.

Literature review

The problem of continuity in education has been addressed by researchers for many years. The essence of continuity, its place, and role in a holistic educational process are revealed in the works of Moroz (1983), Godnik (1981), Kustov, Gushchin and Statsuk (2015), Batrakova and Tryapitsyn (2014), Batrakova, Gladkaya and Tryapitsyn (2014), Dendeber (2002), Sitdikova (1985); Mamus and Pinajeva (2011) and others.

In pedagogy, the term of continuity is understood differently. It is treated as a methodological principle of organization of the pedagogical process at different levels of study (Godnik, 1981); as a pedagogical pattern which is manifested in the unity of the pedagogical process (Sitdikova, 1985); as a general pedagogical principle of ensuring continuous communication between the different parties, parts, stages of learning and education (Moroz, 1983; Kustov, Gushchin and Statsuk, 2015); as a system, including structural components the main components of the learning process; as a requirement for educational organizations which provides interrelation of all its sides (Dentener, 2002); as a system of educational work in which each subsequent link of the ongoing consolidation, the expansion and deepening of knowledge, abilities and skills form the content of the training activities in the preceding step; as the realization of connections between the components the learning process (Kustov, Gushchin and Statsuk, 2015); as a link in the system classes. All of these approaches to the definition of continuity in the education and identification of its nature testify to the complexity and versatility of this phenomenon.

Methodology

Methodological framework lies in didactic analysis and generalization of pedagogical experience; the principles of continuity, flexibility; theoretical analysis of psychological and pedagogical scientific publications on the issues of professionalism of teachers; evaluation of educational and professional standards of work activities of graduates with pedagogical and technical areas of training; analysis of the methodological basis of training teachers.

Results

Let us show that the principle of continuity can act as the methodological basis of continuous pedagogical training in undergraduate, graduate and doctoral courses. This category creates the conditions for the transition to a higher level, i.e. the transition from the level of vocational education from undergraduate to graduate, from graduate and doctorate courses is ensured (vertical transition: secondary vocational school teacher – university teacher – university teacher with PhD degree). Novikov (2000) argues that

the principle of continuity allows the movement of a person vertically as well as horizontally in the space of education.

Depending on what specific components of a training program is researched, the continuity is considered both horizontally (between individual parties, parts, stages of the pedagogical process within the same education level) and vertically (between different levels (degrees) of the education system).

The researchers of Novosibirsk identified target, substantial, technological, psychological, managerial as the most important aspects of the continuity problem (Pedagogical review, 2015). Let us get a closer look at them.

The target continuity ensures consistency between the goals and objectives of undergraduate, graduate and doctoral systems of continuous vocational education. Then the whole pedagogical process at different levels will focus on the formation and development of the professional-pedagogical competence of a future teacher of construction educational institutions.

Content continuity is taken into account when designing educational programs. This process precedes the analysis of professional standards for vocational teachers and "Housing communal services" programs, where employment functions and operation, the requirements for knowledge and skills are given. The work activity needs to be transferred to the contents of their training.

It should be borne in mind that the learning content may not reflect the content of all professional teaching or construction work activities, and reflects only the part related to the regulations that are the most important ones. In addition, any professional activity is integrative in nature and it is infused by knowledge and skills from various fields of science, technology, and production. Integrative nature and interdisciplinarity, as well as the fundamentality and practical orientation also should be taken into consideration.

Thus, the substantial continuity of training teachers of vocational training provides the list of pedagogical courses like "Vocational training", "Psychology of social interaction," "Leadership," "Work with citizens", "Corporate social responsibility", etc. A number of courses directly shape pedagogical competence (vocational education, psychology, social interaction, leadership, etc.) while others do it otherwise (corporate social responsibility, communications management, etc.). Their content at each level of training provides the study material at a higher level. For example general and vocational education (undergraduate level);

practice-oriented curricula design of vocational courses (graduate level) – theory and methodology of vocational education (doctoral level).

The elements of pedagogical component for doctoral programs are discussed in detail and presented in the following work (Korchagin & Safin, 2019). It has a model of educational component for the designing of technologies, techniques, appropriate educational-methodological, scientific and methodological support for postgraduate training.

As you might know, the education environment of scientific and educational cluster acts as a medium for professional and personal development of graduates. We believe that pedagogical internship acts like this environment and it exists at secondary and tertiary schools within one educational cluster where students are introduced to methodological equipment of the offices, teachers of special construction disciplines and thus learn the structure of lessons of theoretical and practical training. The familiarity with the lessons in resource centers was very effective for undergraduates. The latter was created during the preparation of the students for WorldSkills both at the level of educational institutions, and at the regional and national levels. Undergraduates are also involved in this process. The participation of our students in the qualifying WorldSkills-compliant exams at secondary vocational schools as trainee experts is also becoming increasingly more commonplace.

Teaching internship for postgraduates is aimed at the preparation of educational and didactic documents, participation in the planning and organization of extracurricular activities with the students in the colleges and carrying out final WorldSkills-compliant examinations as a stand-in lecturer.

The curriculum of the doctoral students also provides a teaching internship. At this level, the graduate students develop curricula for special courses and develop didactic material for conducting workshops, carry out a pedagogical experiment to identify the effectiveness of the training sessions and participate in the final WorldSkills compliant examinations as experts.

The effectiveness of a pedagogical internship is determined by the psychological and pedagogical competences acquired during the course of studying disciplines described above. In the course of the internship, undergraduates act as an alternate teacher of special disciplines, postgraduates as a teacher of major disciplines.

Technological continuity is also provided by the selection of common training and approaches to the organization of the educational process in the environment of scientific and educational cluster. For example,

undergraduates solve teaching situations, postgraduates – case studies, role-playing, doctoral students – design methods and training. Increasing the level of training as technology learning include: problem-based learning – contextual learning – active learning methods. All of the presented ensures continuity in the education and development of professional qualities of the teacher (Borraz, 2007).

Psychological continuity is achieved by the improvement of the educational process and teaching methods with the age traits of a typical undergraduate, postgraduate, and doctoral student. The creation of a comfortable psychological environment for students is achieved by the designing and creation of classrooms of active learning, scientific and educational centers, ergonomic learning technologies (Safin, 2001).

The continuity of cluster management of the educational system in tertiary schools includes the designing, organization, regulation, and development of mechanisms to ensure the continuity of training of vocational and higher education teaching staff, standardization of education (so far a general structure of educational programs of bachelor, master and doctoral study is created).

Let us note that the implementation of the continuity principle allows for a flexible designing of the training content, allowing us to quickly respond to changing requirements for pedagogical and methodological competence of the teacher of vocational education. Flexibility appears here as the principle used to design this learning content, which enables fast adaptation to the changing requirements of the customer and to the personal needs and interests of students (Korchagin & Safin, 2017).

Indeed, the educational process includes the selection of learning content, its didactic processing, distribution of educational material on the courses, and also on the main organizational forms of teaching. As the contents, forms of organization and methods of the educational process are interconnected with the development of the specific content of training, in accordance with the principle of relationship (training information or set of tasks, assignments and exercises), requires appropriate organizational forms, appropriate methods and learning tools. The interrelation between the content and teaching methods is due to the fact that the implementation of the contents is carried out using these methods (Korchagin & Safin, 2017).

As an example, we present the stages of designing flexible learning content in bachelor's degree (FSES code: 44.03.04) "Vocational training". Designing flexible content of professional training of University students includes the following steps:

- The development of pedagogical models for flexible learning content. It, in turn, involves the following components: analysis of the requirements of the bachelor's degree program titled "Vocational

training" (FSES code: 44.03.04); analysis of work functions, job functions, labor actions and skills of the professional standard (PS) titled "Vocational teacher, vocational education and additional vocational education"; the identification of the requirements to a teacher in secondary schools; defining the strategic goals of designing learning content.

- At this stage, a pedagogical model of flexible learning content is designed. In order to do this, one must follow the instructions: we need to build hierarchical structure of goals and the target analysis of actions. It is necessary to address the objectives providing the principal activities of a teacher; define the content of academic courses in the structure of teacher's training; identify the structure of each academic course content required for the solution of objectives principal teacher's work activities; select of the identified content, its structuring and systematization; form the content of each course in a logical sequence of research themes and topics; identify the logical sequence of the location of the disciplines in the curriculum, their place and role in the structure of training of teachers and the establishment of the relationship between disciplines; draft the flexible content of the educational program of a teacher.
- The quality of the pedagogical designing of a flexible learning content check is done. The stage consists of operations on definition of criteria and indicators for assessing the quality of the project flexible learning content; conducting an expert evaluation of the quality of the project flexible learning content; projecting adjustment of flexible learning content based on the results of an expert's assessment: the decision-making on the implementation of the project of flexible learning content in educational process of a tertiary educational institution.

The implementation of these stages of designing a flexible content of educational programs at a technical university allows (Korchagin & Safin, 2017):

- implementing new FSES in educational practice at technical universities, creating flexible content of educational programs, defining a set of academic disciplines involved in the formation of the employment functions of teachers of vocational training, identifying the role and place of each subject in the solution of problems in various types of professional activities;
- providing pairing of FSES and PS when designing a flexible content of the educational program at the University;
- creating flexible learning content for university students based on the changing requirements of the enterprises of the region and of the labor market;
- creating a flexible training and methodological support of the educational process in a university, selecting the relevant content, optimal forms, methods and technologies of training;

- developing flexible content of assessment tools for intermediate and final certification of students taking into account the requirements of industry and employers.

Quality assessment of the teacher's training project, based on the principle of continuity by means of the method of expert assessment and diagnostic maps is determined by the criteria of learning content conformity of employment functions of a specialist (Korchagin et al., 2004; Suchkov, Safin & Korchagin, 2007).

Over 80 teachers of vocational education are trained by these programs. 15 people were trained at all three levels of higher education. 10 of them defended their PhD theses and work in the universities of Kazan.

Discussion

The current status of research on this issue is determined by the degree of elaboration of the pedagogical category of continuity and flexibility. The relevance of this category is due to the fact that in conditions of dynamic changes in the socio-economic and public life of Russia, informatization of all parties, expansion of business, scientific and cultural cooperation have significantly changed the requirements of the level of preparation of specialists, and, consequently, of the education system. Currently, an important property of education is flexibility, i.e. the ability to respond quickly to changing requirements of a customer, which is not only the employer but every level of education in relation to the previous one. The leading element, providing the flexibility of the system and interaction of its components acts as continuity between the degrees.

Conclusion

Revealing the current status of the research, the fragmentation of theoretical approaches to the problem of continuity of education should be taken into account. This is expressed in an ambiguous approach to the definition of continuity (it is defined as a pedagogical pattern as a general pedagogical principle, as a condition of the effectiveness of the pedagogical process) and in the absence of a common psycho-pedagogical concept of continuity.

Recommendations

The technology of designing the content of lifelong pedagogical training can be applied in technical universities. This will improve scientific and methodological support of the educational process in technical

and special departments. Continuous training of vocational teachers in the scientific and educational cluster on the basis of the principle of continuity is offered.

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