Specifics of training specialists in the field of water resources logistics

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Abstract. The article defines the problem of training specialists who manage water resources logistics. The problems of water logistics are related to peculiarities of transportation of water resources in order to preserve their quality characteristics, operation of hydraulic structures, preservation of coastal territories and their corresponding ecosystems. Effective implementation of the processes related to the above features requires constant analysis of a multitude of parameters and processes, which in most cases are random in nature. The development of operational management solutions requires the use of specialized intelligent software tools. Their effective use requires professional training. The study developed a model of the educational process that uses technologies of digital twins of real natural objects, which allowed forming professional competencies in the field of water resources logistics in an interactive form.

1 Introduction

Continuous growth of the world population, development of human economic activity and industrial production increases the level of water consumption, while forming water deficit not uniformly [1]. At present, there are regional crises of water consumption, hindering sustainable development of human settlements, provoking various problems (e.g., uncontrolled migration processes, slowdown of agricultural development) [2].

The organization of interregional redistribution of water resources is based on the principle of moving large volumes of water, which are commodity products. Such specificity determines economic, environmental and geopolitical processes, ensuring the development and observance of rules and methods of their management in order to create ways of large-scale interregional transportation of water resources, while maintaining a favorable environmental situation in the implementation of these activities [1].

The process of water resources logistics is complex, requiring a comprehensive approach and not only ensuring water safety during transportation, but also including works on organizing and carrying out regulation of river flows and reservoir levels, reclamation of

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water protection zones, supporting the state of hydraulic engineering systems, ensuring environmental safety, etc.

Methods of transportation of water resources should be distinguished. They can be carried out through the system of trunk pipelines, getting there from storage and distribution networks, or by means of vehicles in a special container, ensuring the integrity and safety of its properties [3, 4]. Depending on the nature of labor functions of a specialist who provides water resources logistics processes, the profile on which the corresponding professional education should be obtained is determined

If a specialist carries out resource logistics using transport (e.g., delivery of extracted mineral water from the source to the plant for its processing and packaging), then educational programs related to management are used in its training. Namely the training of specialists in the field of logistics with professional theoretical and practical skills of designing the life cycle of goods from production or purchase, processing, warehousing to its subsequent transportation with the use of specialized software that provides information-analytical modeling technologies (High School of Economics and Business of the I. Razzakov Kyrgyz State Technical University: https://kstu.kg/fakultety/inzhenerno-ehkonomicheskii-fakultet/menedzhment; Logistics and Supply Chain Management. NRU Higher School of Economics: https://spb.hse.ru/ba/log/passport).

If human activity is aimed at solving complex problems related to the design, construction, operation and reconstruction of water supply and drainage systems of industrial, agricultural, civil and environmental facilities, then it is required to train a specialist in an educational program related to water supply and drainage (Moscow State Construction University. Department of Water Supply and Drainage: https://mgsu.ru/universityabout/Struktura/Kafedri/Vodosnab_i_vodootved/about-the-directi ons-and-specialties). The object of professional activity of such a specialist is the development of design, survey, specification and estimate documentation, providing the above tasks (Department of Water Supply and Drainage of the Kyrgyz State Technical University named after I. Razzakov: https://kstu.kg/bokovoe-menju/instituty/kyrgyzskii-inzhenerno-stroitelnyi-institut-im-n-isan ova/vodosnabzhenie-i-vodootvedenie/istorija-kafedry).

Thus, the *aim of the study* is to create a practice-oriented training model that implements the concept of training specialists who use an integrated approach to the transportation of water resources regardless of ways and means. This requires performing the *tasks* of formalizing the problem domain and developing an educational concept based on the results obtained.

The *object of the study* is the educational process, and the subject of the study is the system of control over the mastering of professional competencies.

The *theoretical significance of the study* lies in the creation of a model for the integration of intelligent digital technologies in the educational process.

The *practical significance of the study* lies in the creation of a digital ecosystem of an educational organization

2 Materials and methods

The creation of an effective learning model requires a complete picture of the educational process, namely all its participants, available resources and the way their interaction is organized. The *method of structural analysis* was used for this purpose. It made establishing the hierarchical structure of the processes that make up the educational activities carried out in the training of professionals related to water resources logistics possible. Such a method is used in studies where it is required to create a formal model of a

problem area or any object of research [5-7]. To refine the results, researchers use methods of step-*by-step refinement* (to move from one level of the hierarchy to another), *abstraction* (setting insignificant elements that do not influence the change of states of the studied objects or processes), *grouping* (combining similar behavior, quantitative or qualitative characteristics of objects) and *synthesis* (processing of the obtained results to create an idea of the studied area) [8-10].

The formal model was created using a *graphical method* that allowed implementing the *methodology of functional modeling* (IDEF0). With its help, researchers display the structure and functions of a system of any complexity and subject area [7, 11, 12]. It is used to establish the requirements and functions of a model that integrates the interaction of specialists, resources and processes.

3 Results

The structural analysis has shown that in educational organizations related to the training of specialists in the field of water resources management, many software products used automate certain labor functions, but are not linked together in a single ecosystem. The use of such software, on the one hand, allows ensuring practice-oriented nature of the educational process, and on the other hand, does not allow creating and comprehensively managing the learning curve of students.

At the moment, many technologies and tools have been developed that allow simulating natural objects and processes of any complexity [9, 10, 13-15]. At the same time, such resources can become the basis for the tools used to perform practice-oriented tasks and to check the mastery of didactic units at each stage of the educational process. The model of such mastering is presented in Fig. 1.

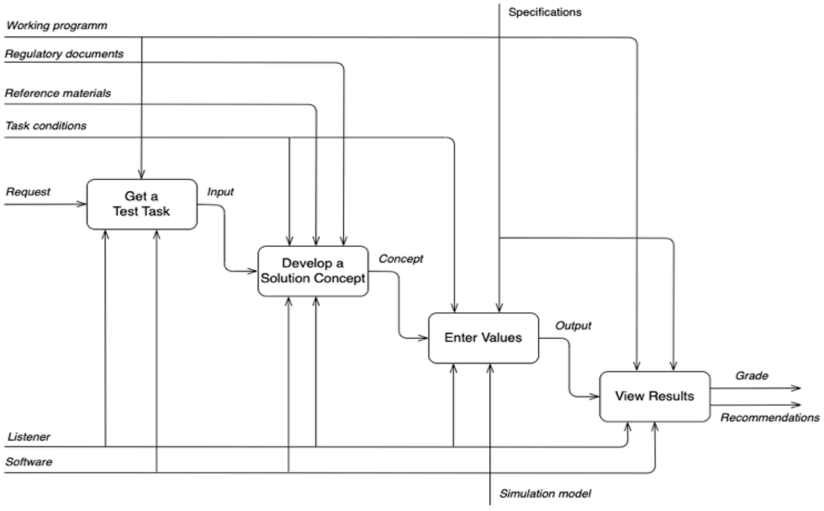

Fig. 1. Functional model of using educational models in the educational process

The developed educational model realizes the concept of sequential mastering of didactic units with the performance of practice-oriented task on the corresponding topic. The practice-oriented task in this case represents a model of a potentially real situation, which requires the development of a set of measures to ensure the safety of objects or the fulfillment of the required conditions. For example, it is required to create a water supply system of a settlement taking geological peculiarities, number of consumers and

development of the territory into account. In this case, the resources of the used simulation model allow forecasting changes in the created system over a long period of time in virtual space.

According to the results of the assignment, the student receives recommendations on the need to master additional educational content to improve the modeling performance, and will proceed to the next element only after mastering the previous one in full. In this case, the selection of recommended reference material is carried out individually depending on the results obtained.

The models on the basis of which the concepts are tested are customizable. This means that the complexity of the modeled process is determined by the teacher. In this case, the complexity is understood as the change of random external parameters in time. For example, these are weather conditions (dry summers, winters without snow, etc.), human economic activity (construction of roads, communication facilities, etc.), aggressiveness of fauna (damming of the area due to beavers' activity, destruction of flora due to the formation of habitat of herbivorous animals). All these and other characteristics have a random character, which in the long term is quite difficult to predict, but should be taken into account when developing water supply and wastewater disposal systems.

4 Discussion

The main trend in educational activities of the last decade is the active use of software tools. They ensure the functioning of an educational organization, support and control of the educational process [5, 7, 16]. A modern teacher actively uses digital educational resources in his activity. It allows not only to provide interaction with students to send assignments and receive completed works, or demonstrate any resources, but also to create interactive elements that use intellectual technologies for their functioning. In the market of modern software and developed scientific technologies there are many products that allow presenting the structure and features of functioning of different ecosystems in an accessible form [6, 10, 12, 17]. The developed model of the educational process allows using such software products and technologies for mastering professional competencies and labor functions.

5 Conclusion

Management and specialist training require the use of new methods to meet changing requirements and solve emerging problems. Flexibility and ability to adapt to emerging water resource utilization problems should be developed. Periodic training activities should be conducted at all levels in those organizations that are responsible for managing water delivery and quality. For this purpose, best practices should be applied in training, including the use of digital intelligent technologies and systems.

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