Ecosystem Functions of Individual Style in a Digital Educational Environment

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Abstract – The relevance of the study is due to the development of digital technology and modeling of the ecosystem of digital education. The purpose of the article is to reveal the ecosystem functions of an individual style, as an integral phenomenon of personalization and the pedagogical conditions of its formation in a digital educational environment. Based on a questionnaire survey of 310 teachers of secondary vocational education institutions, the authors come to the conclusion that the personalization of the learning process is inextricably linked with the formation of an individual style (of activity, learning, communication, etc.). It was found that 45.1% of all the surveyed create digital materials by themselves, and do not stimulate students' self-learning activities. For 33.2% of teachers, students' activity in the online learning environment was only the subject of observation and analysis. Only a minimal group of respondents (6.5%) actively took part in students' online activities.

Keywords – digital educational environment, ecosystem of digital education, individual style, personalization of education, ecosystem functions of individual style.

1. Introduction

Rapid development of digital technologies provoked the enrichment of education with new opportunities and expectations since educators continually improve their professional competence and present diverse models of future learning [1]. Digital technologies are believed to provide a new inexhaustible resource of knowledge. Their use is associated directly with the enhancement of education quality due to the expansion and change of learning forms and choice opportunities. What is more, due to their introduction into the training process, the availability of world educational resources is constantly growing (video lectures delivered by world-class professors, various forms of online interaction, artificial intelligence (AI), gamification, virtual reality (VR), augmented reality (AR), and the like) [2], [3].

The more widespread use of online courses is seen as a prerequisite for the formation of a new innovative education platform Greenfield can become a leading driver in the development and transformation of education in general and all its institutions in particular. With the formation of this platform researchers associate the solution to the issue of the growing mass demand for education by providing broad access to learning resources.

However, the main expectations come from the new possibilities of training personalization [4]. It is highlighted as a primary objective in scientific research, in conceptual, analytical, and forecast materials developed by various expert communities and stated in program documents.

In the National Strategy for the development of artificial intelligence for the period up to 2030, improving the quality of educational services is attributed to the priority areas requiring the development and use of AI technologies. Based on AI, it is planned to adapt the educational process to the needs of students and the labor market, conduct a systematic analysis of learning efficiency indicators to optimize vocational guidance and early detection of children with exceptional abilities, automate the evaluation of knowledge quality and analyze information concerning learning outcomes.

Many scholars believe that the use of digital technologies will make it possible to move from the traditional in-class education to a personalized learning system; from collective education to individual one by changing the organization and methods of educational work [5], [6]. Nevertheless, appropriate changes should be massive and lead to the transformation of the whole educational system and the creation of a digital learning ecosystem.

At the same time, it should be noted that digital learning models are becoming quite common. They assign the major role to technological innovations like new technologies, big data analysis, digitization of education, automation and algorithmization of the training process, work in the network information space, etc. In this respect, the actual humanistic and pedagogical aspects of the digital educational environment's organization are now either not considered at all or take the back seat.

The purpose of the present paper is to outline the ecosystem functions of an individual style of learning, communication, and other activities as an integral part of personalization. Apart from this, the article aims to reveal the pedagogical conditions for the development of personalization in a digital educational environment.

2. Literature Review

Usually, modern concepts of digital education describe the learning process in the following form. The student's portfolio is deemed to contain a full range of his/her activities, potentially interesting for educational organizations and employers. Some researchers denote this data volume as a "digital educational footprint". Such portfolios are analyzed by intelligent digital robots: a digital mentor (builds a personal learning trajectory based on student's preferences and professional orientation and identifies hidden talents) and digital HR (offers the student to develop in the direction required by the employer). More radical researchers believe that the possibility of transferring knowledge to a new generation without the teachers as mediators is a myth, and educators themselves should retrain as developers of educational content or at least engage in scientific work.

The immersion of digital reality into education began with the improvement of communication tools that made distance learning truly effective [7]. The ability is not only to conduct TV classes or communicate with students by phone but also to maintain constant contact through the Internet has enhanced the education quality. The emergence of e-learning is associated with the possibility of broader satisfaction of the need for higher and special education for more people. E-learning solves numerous problems with education in many emerging economies and enables large international companies to compose a highly professional team for distance work [8]. Online education has gained a powerful impetus in development with the advent of cloud services and distributed computing technologies, which provided an opportunity to copy software installed on the specific electronic device.

As a result, students can get teaching materials or instructions and communicate with the instructor and other students regardless of time and distance. The formation of mobile networks has aggravated this process and presented the possibility of mobile learning — access to educational content and the ability to contact the teacher via mobile devices. It also promoted the increased application of VR and AR technologies to ensure student-teacher cooperation, even in case of their distant location [9]. The emergence of mechanisms for processing big data and the first steps toward AI development set the task of creating a digital teacher, as well as the participation of electronics in the pedagogical process and in the formation of study curricula and instructions. The increase in students' independence from the teacher and predetermined educational content (for example, textbooks selected according to the university program) has led to the fact that the individualization of learning became the central trend in education [3].

Creation of digital twins and mentors (special services that identify students' hidden talents and build a personal development trajectory with regard to professional orientation and portfolio), absolute transparency and measurability of a considerable number of educational parameters, processing a digital educational footprint throughout a person's life — all these and similar descriptions can be found in a wide variety of texts that demonstrate modern forms of digital technocracy [3], [6].

However, today, even specialists in the field of digital technologies express doubts concerning the achievement of personalization and individualization of education only as a result of the introduction and development of a single digital tools ecosystem.

This complexity of education should be disclosed from the perspective of the social system and its unavoidable humanistic component, underestimation of which inevitably leads to a dead-end in solving the problems of personalization and individualization of the educational process. For this aim, it is worth analyzing the individual style — a phenomenon inextricably linked with ideas regarding human personality.

Researchers analyzing cognitive style [10], [11], [12], [13], [14] come to the conclusion that it characterizes certain advantages of an individual in situations where personal cognitive style contributes

to the effective organization of activity. Kholodnaya [10] notes that style represents the ability to independently choose unique ways of cognitive interaction with the outside world, depending on the organization of individual mental experience and requirements of a particular situation. Boccia et al. [12] consider styles to be a systemic quality of human cognitive tools. Volkova and Rusalov [13] define cognitive style as a set of preference criteria used by a person to build models of the world in cognitive circuits. A number of studies have shown that individual style performs a system-forming function in the development of an integral individuality and stimulates the emergence of new links between the different-level properties of such individuality. By changing the nature of these connections between these properties towards their harmonization, the individual style thereby creates a new system of these properties [14].

Over the past ten years, the worldwide studies on the individual style are increasingly interested in its manifestations in various social spheres. For example, scholars investigate peculiarities of television style, political style, musical style, and even leadership style [15], [16]. Alternatively, the phenomenon of style is considered mainly within the framework of empirical psychological analysis with less attention paid to its essential nature.

Tolochek [17] was one of the first to draw attention to the fact that common features of approaches to the investigation of style developed in foreign and domestic studies are of static character, reflexivity, and psychocentrism. Before his investigation, the dynamics of individual style has hardly been examined. The individual style was regarded as a stable system of techniques and activity methods, and the corresponding research was based on the models of activity with fairly stable conditions. Research works focused only on the already existing levels and manifestations of style, which did not allow scholars to distinguish its genesis conditions and form a program for its development.

Digital learning enthusiasts believe that the emerging possibilities of processing big data will allow identifying individual styles of students when creating digital twins. On this basis, both students and digital twins can be offered possible learning paths and educational resources. However, such expectations are founded, as a rule, only on the increasing possibilities of recognizing already established individual styles. At the same time, many fundamental positions are not taken into account.

As a characteristic of a person's individuality, style is a process and result of a person's continuous interaction with his/her surroundings [10]. Personal style is in the constant process of development and corrections. It integrally harmonizes the internal structures of one's personality and forms the most successful conditions for action, thereby actively transforming the environment or adapting to the current situation.

Consequently, the personalization of learning cannot be reduced only to the identification of already established individual styles. It should include the creation of conditions for individual activity and choice, which is possible only in an educational environment enriched with developmental opportunities. Modern models of the digital educational environment, as a rule, offer trajectories, knowledge systems, and tools defined by the program or digital mentor, inevitably narrowing the individual activity. Simultaneously, the process of active individual style formation and its necessary conditions are not taken into account in the models of the digital educational environment.

For illustrative purposes, it is worth recalling the career path of Steve Jobs, a groundbreaker of the information technology era. After just one semester, Jobs dropped out of a highly prestigious private university in Portland. Since he was not interested in the compulsory program, he saw no point in studying it. He was expelled, but for another year with the permission of the dean's office, Jobs attended free creative classes that he was interested in, including a calligraphy course [18]. At that moment, most likely, neither Steve Jobs himself nor any mentors could explain this choice. Moreover, today, probably no AI application could offer him to drop in this course, even if all his personal characteristics were investigated. Later, Jobs said: "If I had never dropped in on that single course in college, the Mac would have never had multiple typefaces or proportionally spaced fonts. And since Windows just copied the Mac, it's likely that no personal computer would have them" [18]. This suggests that it is unlikely that a digital mentor will be able to foresee the future and decide what would be useful to study and what not. Limiting one's choice can lead to reducing the number of possible life trajectories.

Within the polysystemic approach, individual learning style is considered not so much as a system of unique training methods, but as a system-forming function that integrates and harmonizes the interaction of integral individuality, internal and external conditions and requirements of learning activity. Nowadays, it is widely believed that live human communication is supplanted in the digital environment, and the person is replaced by information copies, digital twins, and virtual models [8]. Researchers believe that in the modern communication process, the person is often substituted with his/her "part" or aspect. This fact creates the feeling of the incomplete presence of a

conversation partner. Newly developed means of communication allow one to hide behind a mask and paint false information as real. Such a mask can hide even a whole organization, a team of programmers, or just a computer program. For this reason, scholars provide more and more arguments on the dehumanization of communication and human elimination from the conversation process.

Communication dehumanization cannot but has a negative effect on the individual personalization process. A human loses mental connection with other people, which allows him/her to be unique and form individual learning and behavioral patterns. Considering this, it becomes more difficult to understand what is significant and what is not in the structures of individual activity. Several researchers assume that the replacement of real communication with its virtual forms leads to various types of digital autism among children [19]. Many boys and girls find it easier to chat on social networks than to start a live conversation. On the other hand, many sources indicate the effectiveness of using the digital environment elements to enhance social interaction, particularly in the learning process [6], [14].

Studies on individual style, which have been actively pursued in recent decades both in Russia [17] and abroad [20], [21], [22], enable re-evaluating its role. An individual style is referred to as not only the way of self-presentation or adaptation of a person. It performs ecosystem functions in a social ecocenosis necessary for the preservation, harmonization, and development of huge social communities, and not just an individual human. In ecology, a pattern, according to which the required level of biodiversity is a condition for self-preservation and population development, was developed a long time ago. The biogenetic and socio-cultural diversity of people, expressed in style features, is an integral and necessary aspect of human existence. The mobility and variability of an individual style represent a manifestation of its ecosystem functions. For example, Kamińska writes about the individual style not only as a typological characteristic but as a dynamic structure. She analyzes in detail the concepts according to which the style is perceived as a fast-changing phenomenon and describes it as a constant process of adaptation to the conditions of a particular environment.

The process of digitalization of education transforms the educational environment at the same pace as the human living space changes. This fact already affects the evolution of the individual characteristics of people. Though, if in the living space, due to its natural diversity and developed types of social interaction, nothing prevents a shift in style structures, then in a purposefully designed digital educational environment, this can become a serious challenge.

3. Materials and Methods

Research design and sample

This pedagogical study was conducted during 2019-2020 to determine the possibilities of learning personalization in a digital educational environment from the teachers' perspective. Data collection was carried out through an online survey of educators from 80 colleges and vocational schools of the Sverdlovsk region, who implement secondary vocational and professional training programs. The respondents were teachers of humanitarian, general professional, and specialized disciplines, as well as masters of vocational training. As a research toolkit, the authors used a questionnaire developed by the NAFI Research Centre [23] during the investigation of school and university teachers' digital literacy.

The sample population comprised of 310 people (80% women and 20% men). The respondents' average age equaled 44.8 years. According to work experience, the respondents were distributed as follows:

- 24% (work experience up to 5 years);
- 15% (work experience from 5 to 10 years);
- 20% (work experience from 11 to 20 years);
- 24% (work experience from 20 to 30 years);
- 17% (work experience over 30 years).

Additionally, it should be noted that 15% of respondents did not have a university degree.

Survey

The survey contained four questions with a predetermined number of possible answers. Only one answer could be chosen. The set of answers was formed based on preliminary selective interviewing of research participants from different universities of the Russian Federation. The objective of this interviewing was to describe the real pedagogical practice of educators, select their most common types of activity, and use these activities as possible answers in the questionnaire. Each group of questions covered one aspect of pedagogical activity focused on individualization of learning in a digital environment: experience in using digital technologies in teaching; use of digital technologies to personalize learning in a digital environment; assessment of the teacher control over the learning process in the online environment; assessment of the real need for digital technologies to share learning material provided by the study courses.

Data Analysis

The analysis was carried out by determining the percentage of one or another answer's occurrence. The results were evaluated and based on the outcomes of quantitative studies on teachers' involvement in the use of digital technologies in blended and online learning and the assessment of their performance [6], [8], [24]. Received data were grouped for each question separately. The total amount of participants' answers on a specific question was taken as 100%. In order to process statistical data and prepare a graphical presentation of the results, a Microsoft Excel spreadsheet was used. The sampling error, in turn, did not exceed 0.49.

Research Limitations

The study covered a relatively narrow segment of specialists in professional higher and secondary education institutions of only one geographic region of the Russian Federation. Therefore, it cannot be claimed comprehensive either in geographical terms or in all academic areas.

Ethical Issues

The teachers of the indicated types of educational institutions were sent invitations to participate in the research via official letters to the corresponding educational institutions' e-mail addresses. The participation was totally voluntary and anonymous. Involved educators received explanations concerning the purpose and process of the study and official assurances about their personal data safety. Persons who agreed to be engaged filled out the questionnaires and sent them from anonymous e-mails for fairness, unbiased assessment of the results, and data safety.

4. Results

The present study was devoted to the identification of emerging difficulties in pedagogical activity in the digital educational environment. The focus was set on the level of teachers' concentration on creating conditions for personalization and individualization of students' learning in a digital educational environment, an indication of the top-priority issues that receive the most significant amount of educators' attention, and the most commonly used tools during training.

Figure 1 presents educators' answers to the question "How long have you been using digital technologies in professional activities?", distributed to the following sections:

- up to five years (38.6%);
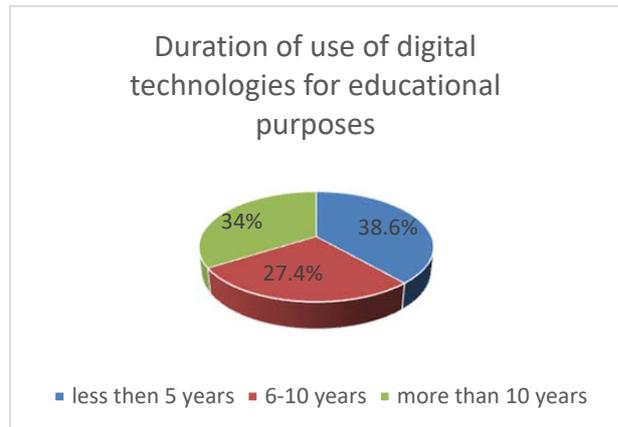- from six to ten years (27.4%);
- more than ten years (34%).

Figure 1. Duration of use of digital technologies for educational purposes

Figure 2 shows the distribution of teachers' responses concerning the question: "Do you apply digital technologies to offer students individual learning opportunities?" In particular, 8.7% of educators said that digital technologies are not applicable in professional activities, since they believe that all students have to complete the same tasks regardless of their academic performance. Out of the whole sample, 19.4% of teachers provided students with personalized recommendations on how to use supplementary digital resources to improve learning outcomes. At the same time, 11.9% of instructors offered additional digital materials and assignments to those who surpass or, on the contrary, lag behind the curriculum. The survey revealed that 45.1% of teachers considered students' individual needs and characteristics when developing educational material. Together with this, only 14.9% regularly adjust and improve their teaching methods and materials to better suit students' needs, preferences, and interests.
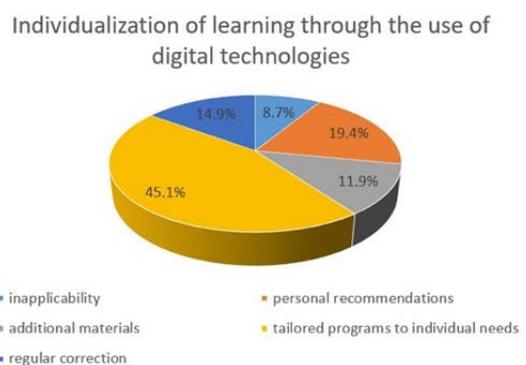

Figure 2. Individualization of learning through the use of digital technologies

Figure 3 demonstrates the distribution of teachers' answers to the question "How much do you control students' work and communication in currently used collaborative online environments?" It was manifested that 8.7% of the teachers did not control students' activities in online environments, while 16.1% of the surveyed believed control to be absolutely unacceptable. Among all those involved, 33.2% monitored general online environments and only occasionally controlled students' discussions. In parallel, 35.5% of teachers regularly controlled and analyzed students' online activity, and only 6.5% participated in online conversations on an ongoing basis providing motivating or corrective comments.

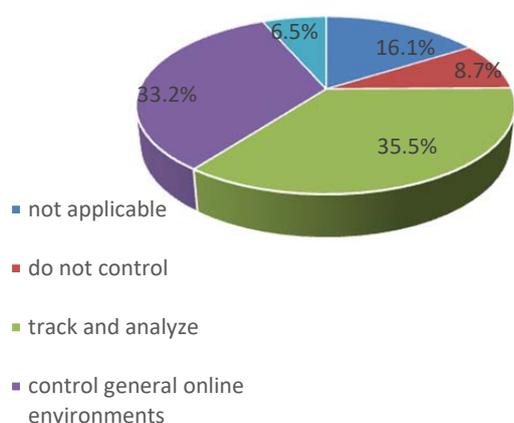**Teacher's control of work and discussions in the online environment**

Figure 3. Teacher's control of work and discussions in the online environment

To the question "Do you give assignments that require using digital technologies for joint study and communication with each other and an outside audience?" 40.6% of educators answered that their students take advantage of digital technologies to interact with group mates and other people. Another 22.9% of teachers stated that students use digital technologies mainly to communicate with each other. About 13.5% of respondents said that they regularly give assignments that allow students to gradually develop their collaboration skills, while 15.5% held an opinion that students should communicate or do collaborative projects on the Internet rarely. At the same time, only 7.5% of teachers noted that there is no need to provide students with feedback.

Summarizing the study results, one can conclude that, firstly, instead of organizing an active information search activity of students, most teachers still take personal charge of the development of educational materials (45.1%), perceiving this as a means of individualization of teaching. In the same manner, the majority of respondents rely on the

traditionally established differentiation of learners into advanced and lagging ones rather than using new digital opportunities to maximize everyone's involvement in the educational process. Secondly, it was found that while using digital technologies, pedagogical activity is prevailingly shifting towards monitoring students' activities and not aimed at organizing joint online projects. Thirdly, the examination uncovered that students' work in interactive online environments is outside of purposeful pedagogical activity, as a rule remaining only an object for observation and analysis of only a part of educators (33.2%). Fourthly, it was noted that the organization of the communication space and collaboration in the digital educational environment are far from becoming a priority in the teacher's activities.

Thus, the main factors influencing education personalization and the formation of an individual learning style, such as creating conditions for independent activity, use of digital educational environment capabilities to involve students in the educational process, and organization of a communication space and joint activities, are often not included in the list of compulsory teachers' activities. What is more, they are usually failed to become the subject of pedagogical attention.

The reasons for this situation can be different. Among them, the use of digital technologies only as an addition to traditional learning methods, lack of new didactic models of working in the digital environment, and a limited number of digital tools used. In contrast, a purely instrumental approach when only one or another digital technology is in the spotlight can lead to an extreme narrowing of possibilities for an individual style formation. The preference for algorithmic forms of organizing activities in the digital educational environment as well as the exclusion of active search, initiative, and reliance on one's own experience in overcoming difficulties that are expected to be offered by a digital mentor is fraught with the loss of many functions of subjectivity and individual flexibility.

It is believed that personalized education, which should be based on the student's preferences and image of the desired future, is being replaced by a customized one. Existing services for the personalization of education and the so-called constructors of educational trajectories can only seem to contribute to the flexible development of a personality. Factually speaking, all these services offer simplified personalization tools based on the assessment of students' academic achievements, situational context, and, the most dangerous, implication of "ideal" profiles that society should strive for.

Nevertheless, it is the personal style that is responsible for identifying and shaping future goals. Already at the cognitive level, style acts as a fractal, which, like a sponge, absorbs meaningful information patterns from the boundless information field and classifies information as significant and insignificant. Moreover, personal style contributes to the customization (or, if necessary, restructuring) of all individual resources and personality structures.

5. Discussion

It is conspicuous that the first difficulties related to the formation of digital platforms, the emergence of network educational resources, and the use of digital technologies aroused interest in learning style and resulted in the growth in the number of scientific publications on this matter. Initially, researchers' attention was drawn to the increased level of students' loneliness and standoffishness when using virtual environments compared to traditional in-class learning mode [7], [24]. Though, later, owing to the discrepancy between the expected growth in the number of learners engaged in online courses with the actual, significantly lower, as well as the high percentage of those who did not finish the course at all, the search for educational solutions was directed at taking into account personal training style rather than just forming professional skills [25].

Today, the importance of individual styles in the creation of a digital educational environment has become a popular discussion topic [6]. Many Russian researchers not only substantiate the need to consider individual learning styles and the necessity for teaching methods to vary depending on the specific conditions and students' educational background. Scholars also indicate that the style characteristics should be bear in mind when developing learning software and materials [26]. It is also emphasized that any digital educational environment should allow students to form their educational ecology, i.e., choose a comfortable and adaptive environment based on their individual learning style [6], [19], [26].

The study of individual style is becoming a matter of growing concern while designing a digital educational environment using AR and telepresence technologies [5] since the actual effect of immersiveness cannot be achieved without its notice. The individual learning style tunes all human perception channels and a person's subjective self-identification in the environment. Experts engaged in the design of immersive learning environments indicate that the real presence of a conversation partner and the sensations of one's own body are very important for successful cognitive activity. At the same time, there is a constant adjustment of the perception of oneself and the environment as well as search for the necessary forms and instruments of activity preferred by the subject based on his/her individual configuration or style.

Sommer [27] has proposed a model of perception and formation of a subjective image as a result of the action of a multi-tiered filter system. He identifies eleven sensory filters and states they affect the formation of a person's individual reality image and its perception model. For example, the seventh filter influences the perceived reality depending on the dominance of each individual's channels of perception. On the other hand, the eighth filter (rejection of reality) is based on an individual's attitude to what is perceived in accordance with personal experience, a system of beliefs, and values [27]. Sommer's study composes a picture of the complex work of an individual style, its role in creating the image of reality, and in orientation in a particular environment.

Sergeyev [28], the author of the concept of an immersive learning environment, proposes to study the learning environment as a dynamic process in which the subject plays a leading role. The environment itself is formed as a result of personal (not always conscious) involvement of various elements presented not only as objects that can be observed but also social aspects and interpretations that depend on the state of a student. It is impossible to fully form the learning environment in advance without the individual's participation, since a person's interests in the subject of learning at a given moment of time are unknown, as well as the purposes for which one undertakes one or another learning course.

In any environment, including educational, one forms an individual action plan. It includes multi-stage selection, processing of incoming information, and the realization of functions of reduction, selective attention, understanding, correlation with the body needs, categorization, storage in a database, restoration, correction, and application [28]. Individual perception characteristics endow the experience of each person with a unique character. A flexible digital environment based on big data analysis is gradually becoming able to adapt to the student's needs. However, researchers emphasize the importance of close interaction with both the human teacher and other learners in any training mode [8]. The individual style performs, first of all, the function of cognitive control and is included in the conceptual comprehension of the immersive learning environment as an integral component of the formation of the environment's internal plan. Therefore, the style component cannot be ignored when designing immersive learning environments [11].

Today it is not a problem to test which soft skills of a student are sufficiently developed and which require additional attention. Many ways and techniques for their improvement exist. Notwithstanding this, such a constant pursuit of the ideal often does not make allowance for students' choice concerning the desired qualities. The challenges of using the digital environment identified in the current study are consistent with those described in other scientific works on teacher's professional training [4], [9]. Previous generations of educators significantly differ from the digital natives in psychological terms. For this reason, now, many technologies and methodologies focus on preparing teachers for a new instruction style in a novel learning environment [4].

From the standpoint of today's realities, a growing number of options are being formed to create proper conditions for the personalization of training. In particular, it is the combination of a digital educational environment with real joint activity (blended learning) [3], [6] and the development of telepresence technologies, which take into account all the complexity of one's personality and his/her individual style to a greater extent than other digital technologies.

6. Conclusion

Based on the analysis of Russian and foreign scientific sources, as well as on the basis of a survey of 310 teachers of secondary vocational educational institutions, it was revealed that the personalization of education is inextricably linked with the formation of an individual style (of activity, learning, communication, etc.). It was found that 45.1% of the interviewed teachers develop digital materials themselves and do not stimulate students to self-learning. For 33.2% of educators, student's activity in the online learning environment remains only a subject of observation and analysis. At the same time, only a small group of respondents (6.5%) took an active part in the online learning process. The survey outcome demonstrated that modern Russian teachers more often focus on personal communication and do not fully use capabilities of a digital environment.

The authors presumed that the prevalence of digital education ecosystem models, formed on the grounds of an instrumental and technological approach that takes no notice of the socio-humanitarian ontologies of the educational process, does not allow solving the problems of personalization of learning. In digital education ecosystem models, personalization of education comes down only to identifying the already established individual styles of students and adapting their preferences to the digital learning

mode. Thus, it can be stated that personalization in Russian vocational educational establishments is replaced by customization of training.

Research results indicated an insufficient level of formation of the psychodidactic competence of Russian teachers and their unwillingness to personalize learning in a digital educational environment. The ecosystem concept of the online learning environment can be formed only by virtue of the integration of technological and humanistic approaches. Digital learning technologies should be combined with live communication and joint participation in social practices. Otherwise, instead of the expected personalization of education, studying in a digital technological environment may lead to students' depersonalization.

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