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POSSIBILITIES OF THE DIGITAL LEARNING SUPPORT ENVIRONMENT IN THE INTEGRATION OF EDUCATIONAL AND EXTRACURRICULAR ACTIVITIES

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Abstract: *In the period of digital economy development and education modernization, there is a need to expand pedagogical and methodological approaches to the organization of effective interaction of all subjects of the educational process, not only in educational but also in extracurricular activities. The article deals with the possibilities and main components of digital learning support environment, which is part of the Model of organisation of project activities of future technological education teachers. The main condition for the transformation of project activities in digital environment is the changes in the subject itself: motives, attitudes and positions. Interaction, development of digital tools, reflection of intermediate and final results in digital environment contributes to preparation for solving new professional tasks of future pedagogical activity. The authors describe the experience of using digital support environment in preparing future teachers of technological education and give general recommendations for using digital learning support environment in art and creative disciplines.*

Keywords: digital educational environment; environmental approach to learning; technological education; project activity.

INTRODUCTION

Today, Russia is implementing a number of initiatives aimed at developing a digital educational environment in general and higher education institutions. In 2018, the national project "Education" was approved, within the framework of which the federal project "Digital Educational Environment" is being implemented. This federal project aims to create and implement a digital educational environment in educational organisations and to ensure the implementation of the digital

transformation of the education system. As part of the project, work is being done to equip organisations with modern equipment and to develop digital services and content for educational activities.

For successful and effective work in the digital environment, it is necessary to take into account the modern information behaviour of young people. Therefore, in educational activities, it is important not only to transfer previous practices to a new format but also to look for new approaches that will allow the modern generation to be active and to form digital competences. The promising use of social networks in education is evidenced by the studies of contemporary authors (Al-rahmi et al., 2018; Rayens et al., 2018; Ansari et al., 2020; Morreale et al., 2020; Issa et al., 2021), which confirm that online collaborative learning helps students to be more creative, dynamic and scientifically oriented. As online tools and technology have evolved, social media has come to be seen as a key tool for supporting applied learning activities (Neelakandan et al., 2020). Social networks also have the advantage of providing a combination of tools that students can select, combine, and choose the ones that best fit their individual learning style and enhance their academic achievement (Neelakandan et al., 2020, p. 147; Langegård et al., 2021). Social networks, wikis and blogs provide the collaborative space required for the development of the activities offered in the programmes; likewise, they enable the formation of learning communities, in which students advance as a team to achieve the learning objectives and carry out collaborative work to support their learning process (Galvis & Carvajal, 2022).

BACKGROUND OF RESEARCH AND LITERATURE REVIEW

As digitalisation becomes a key concept in higher education institutions, it also largely affects quality issues (Tømte et al., 2019). Digitalisation of education involves various aspects of quality, ranging from organisational issues, technological infrastructure to pedagogical approaches (Bates, 2015; Selwyn, 2016). In the academic world, digital technologies have not been integrated into teaching practices, although students are taking advantage of their educational possibilities (Mercader & Gairín, 2020; Vázquez, 2015). Merkader and Geirin (2020), point to many barriers to teachers' use of technology, such as: excessive workload, strict curriculum, constant development (change) of technology, lack of technical support, inadequate assessment, ineffective leaders, diversified equipment, outdated software, lack of infrastructure and its poor quality, untimely and inadequate training, lack of planning, organisational culture, lack of goals, generation gap, lack of experience, pedagogical approaches, lack of time, prejudices and stereotypes, lack of motivation, denial of change, lack of confidence, need for excessive effort, technophobia, opinions and attitudes, etc. (Mercader & Gairín, 2020).

The question of transforming teacher training in a rapidly developing digital environment is particularly relevant nowadays. Many teachers today are not properly trained to use innovative technologies in the classroom (Shurygin et al., 2022). Learning about technology is a crucial point for a teacher to understand how their students are able to communicate and, on the whole, how fast communication and interaction systems are developing and improving. One of the easiest ways to address the problem

of the educator's "fear of technology" is to improve teachers' technical skills through constant practice and training and to delegate some technical issues to those students who participate in mobile learning and can do so (Batunova et al., 2021). Krutikov (2020) believes that the determining factors in the formation of digital competence of future teachers are the actualization of the concept of digital transformation in education in the process of teaching students, formation of responsibility and motivation to use digital technologies in the classroom; filling the content of lectures and practical classes with relevant information; involvement of future teachers in the process of mastering knowledge on digital pedagogical technologies (Krutikov, 2020). In addition to training teachers in aspects such as the design of their courses for virtual forms of learning, it is necessary to train them in the use of technological tools that best suit the needs of their courses. In this way, they will be able to make their own decisions about which of these tools actually enable students to learn, or even participate in the development of new ones that meet this objective (Galvis & Carvajal, 2022).

The global COVID-19 pandemic has forced all teachers to embrace the digital learning environment, looking for new methods and approaches to teaching. In Owens, J. & Hudson, A. (2021) researchers found that the quality of self-study activities during the pandemic largely depends on the level of awareness of all the actors in the educational process. Therefore, there is an urgent need to provide adequate support for students who are least prepared for distance learning (Owens & Hudson, 2021). Reliability and sufficient availability of Information Communication Technology infrastructure, learning tools, digital learning resources in the form of Massive Open Online Courses, e-books, e-notes, etc. are of utmost importance in such severe situations (Huang et al., 2020). Many tools are available today and it is up to the teacher to choose the best one and use it to teach their students (Dhawan, 2020).

Today there are different approaches to the organisation of project activities in higher education. The Abai Kazakh National Pedagogical University (Seisenbayeva et al., 2020) offers a whole system of teacher and students activities in project-based learning, noting that at each stage of project work there should be a specific project. Here the main place is occupied by such organisational forms as workshops, project developments, excluding lectures and courses in this model. When such forms are organised, it becomes possible to carry out work in targeted diploma projects. Through these, the student is already involved in professional activities at specific work sites together with the professionals working there.

Another approach related to the use of network resources in the organisation of project activities in the methodological training of future teachers is presented in the study by Barinova, Dorofeev, Zaydullina and Arslanova (2020). The authors consider the possibilities of network services, which occupy a special place in solving the problems of each stage of project activities:

- information-planning stage;
- practical stage;
- reflective-evaluative stage.

The information-planning stage involves the use of open electronic libraries; tools for analysing the popularity of search queries (Yandex, Google, Wordstat and Trends);

archive.org archive and its web service The Wayback Machine. At the practical stage, teacher and student activities are synchronized by means of online file-sharing platforms: file hosting services (Yandex Disk, Google Drive) and collaboration services (Google Docs, Microsoft OneDrive). At the reflexive-evaluative stage, students reflect on the findings and prepare a presentation of the results of their work using the resources of SlideShare (slideshare.net) or the Google Slides service, which is part of Google Docs; the PowerPoint web service; the template and stock library (https://badanovag.blogspot.com/p/web-20.html); the Supa-Online video constructor; the free hosting Wix constructor (wix.com). Thus, the project methods in the methodological training of future teachers contributes to the introduction of digital smart didactics in education.

RESEARCH METHODOLOGY AND METHODS

The methodological framework of the study is based on the activity and environmental approaches: in accordance with the theory of human development in activity, the content of project activities of future teachers of technological education is studied; based on the theory of influence of educational environment conditions on student development, the use of a specially created DLSE, aimed at the developing subject, his requests and educational needs, is studied.

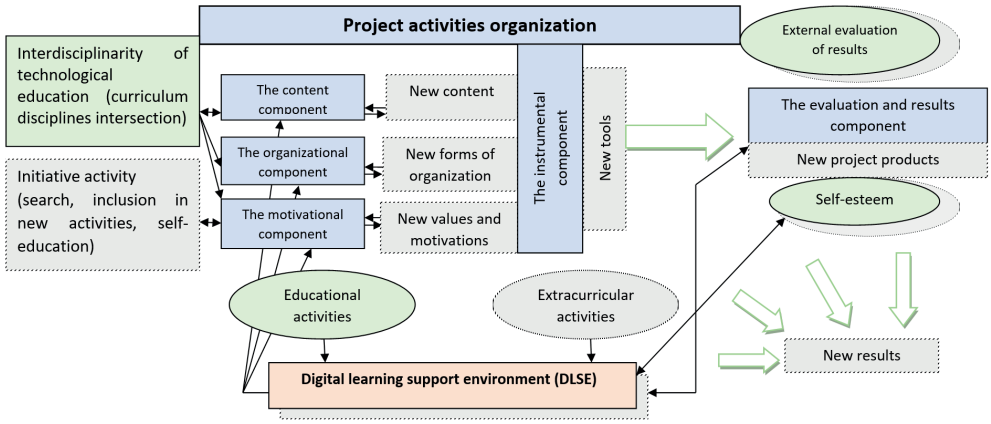
The study used modern methods of collecting and processing information: observation, questionnaires, theoretical analysis of the research problem, research of the products of the activity of future teachers of technological education; a combination of quantitative methods (methods of mathematical processing of the obtained data with subsequent analysis and generalization) and qualitative (method of digital traces network analysis) analysis of the results obtained.

PROJECT ACTIVITIES ORGANIZATION MODEL

As part of an experimental study (based at the Technological Education Department of the Herzen State Pedagogical University of Russia), the researchers developed a digital learning support environment (DLSE) for future teachers of technological education. The DLSE is an academic teacher-designed (based on social networking technologies) environment that allows the integration of combinations of educational and extracurricular (professionally directed) activities. Work in the DLSE was an obligatory part of extracurricular independent work of students in the study of the discipline “Design-project activity” (in accordance with the curriculum on the bachelor’s degree programme 44.03.01 Pedagogical Education, profile “Technology Education”). Thirty-four undergraduate students took part in the experimental work. These were students of the groups “Costume Design” and “Microsystem Technology”. The classes were held in the spring semester (February–June).

The following Model (Fig. 1) reflects the organisation of project activities of future teachers of technological education taking into account the functioning of the DLSE. The Model consists of traditional components: content, organisational, motivational, instrumental, evaluation and results. However, in order to obtain an innovative result,

the Model is supplemented by a the DLSE of future teachers of technological education. The digital environment actualizes the innovative outline of each component, resulting in: new content, new forms of organization, new values and motivations, new tools, as well as project activities going beyond the educational process, resulting in new activity products and new results.



F i g u r e 1. Project Activities Organization Model

S o u r c e: Own work.

The content component is implemented through the interdisciplinarity of technological education and through initiative activities: independent search for additional information and inclusion in new activities. The new content indicates the integration of various meaningful parts of academic disciplines.

The organisational component combines the phasing of project activities, as well as the specifics of building project interaction both in the classroom and in the digital environment, which constitutes new forms of organization. It is the inclusion of students of different courses in the project group to participate in initiatives of a professional profile (competitions, exhibitions, master classes, creative contests).

The motivational component, as well as the content component, is inseparably connected with initiative activity. Reflection on the project results plays an important role. The future teacher sees the potential of the project activity and can evaluate the project. At the same time, at the level of creativity, the cognitive interest in the designed object increases, the boundaries of spatial thinking are extended. New practices of network project interaction form new values and motivations.

The peculiarity of project activities is that the obligatory component is the instrumentality of actions. Taking into account the ongoing processes of transformation of technological education, new tools and, accordingly, new products of activity are emerging. New computer tools appear (special machines, automatic machine tools, robotic devices, etc.), which the future teacher needs to master and then introduce into the educational process, teaching computer graphics and drawing; computer-aided design (CAD) systems, robotics; electronics and electrical engineering.

The evaluation and results component combines an external professional and social evaluation of the final results of project activities by users of the digital environment, as well as self-assessment. It is not only important how the academic teacher evaluates the student, but also how the student evaluates himself, his internal motivation and activity satisfaction, which is also part of the innovative result.

An innovative element of the Model is the DLSE of project activities of future teachers of technological education. Blinov (2019) considers the digital environment as "a system of conditions and opportunities that implies the presence of an information and communication infrastructure and provides a person with a set of digital technologies and resources for self-realization, personal and professional development, solving everyday and professional problems". We believe that everything is transformed in the digital environment, from the pedagogical system, its methodological foundations to psychological positions, the attitudes of the subjects of the educational process: students, teachers, management of the educational institution (Noskova, 2020).

The study of the discipline "Design-project activity" was organised in the blended learning form: online video lectures on the Moodle platform; laboratory work in the classroom and the organisation of extracurricular independent work on the Moodle platform with access to the DLSE (remotely). The discipline "Design project activity" involves the future teacher's study of the theoretical foundations of design and creation of their own projects in the process of laboratory work. A feature of the discipline is also a combination of traditional graphic tools and techniques with digital tools. The course programme involves working with a range of digital tools, including professional graphic editors: Adobe Photoshop, Corel Draw, Adobe Illustrator, Adobe Lightroom; graphic editors focused on the intermediate level of training: Gravit Designer, Gimp, Photomaster, Paint Tool Sai 2; mobile applications for editing and working with images: PicsArt, Bazaart. Graphic composition skills for creating a collage were acquired through the digital tool Bomomo, and exercises on colour harmony through the application Color Scheme. Images could be selected and searched through the social Internet service Pinterest (Noskova et al., 2021). The intermediate results of the tasks were placed in the learning DLSE for discussion and correction with the academic teacher and group mates. Creating the author's promotional video, reflecting the stages of work on the corporate identity, involved working with professional video editors Adobe After Effects; Adobe Premiere Pro; editors for video processing editors, focused on the average level of training: Chello, Moovly, Video; as well as in mobile applications for editing and working with video: Inshot, VN Video Editor Maker.

Thus, in the DLSE there is an opportunity to choose according to the level of preparation, as well as the preferences, aspirations and position of the student. At the same time, the environment accumulates digital traces, activity products, ratings, comments, which serve as a visual representation and reflection of the student's work, his activity, interaction with group members in the learning process; allows to track and evaluate progress; motivates others to be active.

RESULTS AND DISCUSSION

The authors hypothesized the idea of introducing the DLSE, aimed at developing new aspects of universal and general professional competences through the use of digital tools, digital objects, networking, into the project activities of future teachers of technological education along with an instrumental environment that contributes to the formation of basic competences.

The levels of future teachers' involvement in the DLSE were investigated in educational and extracurricular activities. As part of extracurricular activities, the study was conducted among undergraduate students of technological education (future teachers of technological education) in the full-time and part-time departments. In the 2019/2020 academic year, the total number of full-time and part-time undergraduate students (1-4 courses) who took part in the experiment was 106 people. In the 2020/2021 academic year, full-time and part-time undergraduate students of 1–4 courses (100 people) also took part in the experiment. The work was carried out in two directions: in the initial courses (1, 2) and in the senior courses (3, 4).

As part of the educational activities, the study was carried out in the process of mastering the discipline „Design project activity" (curriculum for the undergraduate program 44.03.01 Pedagogical Education, profile "Technological Education"). In the 2019/2020 and 2020/2021 academic year, the number of focus group participants was 34 people. The students who took part in the experiment were students of the groups "Costume Design" and "Microsystem Technology". Students were given the opportunity to develop a design project, taking into account the specifics of their areas of professional activity.

To determine the absolute increase in the level of involvement of future teachers of technological education in extracurricular project activities, we selected the completed tasks of the discipline "Design-project activity", the implementation of which implied the use of the DLSE. The assessment was implemented by the level of formation of three criteria of project-creative orientation: cognitive criterion (the knowledge, ideas of future teachers about project activities, understanding the essence of project tasks; qualitative assessment of knowledge: awareness; systematic; performance); motivational criterion (the desire of the future teacher to prove himself as a creative person, interest in project activities); activity criterion (ability to plan and carry out project tasks of a creative nature, to think figuratively, in an original way, outside the box; a qualitative assessment of project activities).

Each of the criteria has a system of indicators characterizing the manifestation of the studied qualities according to this criterion. The degree of manifestation of indicators for each criterion is measured using the measurement tools and research methods described earlier.

Table 1 shows the number of students for each level of inclusion (1 – basic, 2 – advanced, 3 – high) in extracurricular project activities.

Table 1. The effectiveness of the inclusion of future technological education teachers in extracurricular project activities using the DLSE

Levels:	Criteria for the diagnosis of student involvement in the implementation of project activities					
	Motivational criterion		Cognitive criterion		Activity criterion	
	Number of students	% of the number of students	Number of students	% of the number of students	Number of students	% of the number of students
2019–2020 academic year						
1	34	100%	34	100%	34	100%
2	22	64.7%	16	47%	10	29.4%
3	4	11.7%	2	5.8%	14	41.1%
2020–2021 academic year						
1	34	100%	34	100%	34	100%
2	24	70.5%	22	64.7%	16	47%
3	10	29.4%	10	29.4%	28	82.3%

Source: Own work.

The absolute increase in the level of involvement after the introduction of the DLSE according to the increased level of the motivation criterion is 5.8%, the cognitive criterion is 17.7%, and the activity criterion is 17.6%; according to the high level of the motivation criterion, it is 17.7%, the cognitive criterion – 23.6%, the activity criterion - 41.2%.

Thus, the data obtained as a result of the experimental work confirmed the hypothesis put forward.

During the experimental study, we identified the following general approaches to ensure the transformation of project activities in art and creative training, through the use of the DLSE:

a. **willingness and readiness of the academic teacher** to work both in the classroom environment, and in the DLSE: to design, create and maintain the environment; to monitor and implement through the DLSE the correction of activities of future teachers of technological education;
b. creation of **clear and convenient** structure of the DLSE with reflection of project activity stages, which imply presentation of practical results of work: stage of practical realization and defence of the project. Supporting visualization of intermediate and final results, as well as evaluation of the implementation of these stages allows improving the process of project implementation.

By the clear and convenient structure of the DLSE we mean:

- individual thematic discussions;
- a newsfeed with useful materials;
- photo and video collections;

- recording of interim results (maintenance of activity ratings reflecting different aspects of learning and extracurricular activities in order to monitor and correct further actions, support the reflective nature of actions).

c. ensuring **the diversity of communication channels**, which allows:
- to build and develop horizontal connections;
- to carry out information and organizational pedagogical support of the future technological education teacher in choosing the object of design or inclusion in existing projects;
- to carry out collaborative activities on the basis of special network services.

The combination of work in the classroom and in the DLSE allows for strengthening:
- information component: information is transformed into the format of posts that can be saved and accessed at any time to refer to the necessary materials;
- communication component: a variety of communication channels allows to prompt feedback from the academic teacher and group mates, exchange opinions and comments, mutually evaluate the interim and final results, published news (Kuusimäki et al., 2019);
- learning management: the possibility of simultaneous distribution of information, conducting surveys, timely correction of educational activities.

CONCLUSION

To summarize, our results are close to the findings by Barinova, Dorofeev, Zaydullina and Arslanova (2020). As the colleagues point out, the most difficult part for students was the research part of the project activity, which is due to the fact that the level of skills formation was insufficient to systemise and analyse a large amount of information. But generally, most of the students are ready to organize project activities using network services. In addition to studying the levels of future teachers' involvement in the DLSE, individual reflective interviews were conducted with students who participated in the experimental study. Future teachers were asked the following questions:
- Did the work in the DLSE facilitate classroom project activities?
- Were there any deterrents to activities in the DLSE?

Analysis of the data obtained as a result of the reflective interview showed that 84% of future teachers of technological education were successful in project activities and proved themselves in the DLSE. According to the students, this was facilitated by the fact that the DLSE is a new format of work, respectively, which attracts and engages in activities, motivates to show initiative; there is a convenience of communication with both the academic teacher and the group mates; there is an opportunity to control and monitor not only their own progress, but also the progress of colleagues, which is also a motivation to get the work done. 12% of future teachers were successful in project activities, but not active in the DLSE. This was largely influenced by the fact that this group of students does not maintain social networks and they find it difficult to take the initiative in the digital environment. Such format of interaction in the DLSE limits the student more than it gives freedom and new ideas. It is worth noting that all students completed the final course work, involving the use of different graphic and video editors (of the student's choice). However, 12% of students

were not very active in the DLSE, which involves participation in the discussion of project ideas, interim and final results; publication of interim and final results of the work; evaluation of the activities of group members, self-analysis of project activities based on methodological recommendations, digital footprints and accumulated project materials. 4% of students fell into the group of those who were not successful in the implementation of the project, but were active in the DLSE. For this group, the main deterrent was the lack of artistic and design skills when creating the project.

The use of the DLSE in the disciplines of artistic and creative orientation will allow to solve professional problems in a new way, taking into account the modern information behaviour of young people, as well as stimulating students to be active, help to find personal meanings (the development of future teachers' professional qualities in the process of implementing various projects: social, artistic and creative, engineering, etc.) and to get involved in various educational initiatives.

Working in the DLSE project activities in the process of mastering the discipline "Design-project activity" made it possible to involve future teachers of technological education in extracurricular project activities, as well as conclude about the students' readiness for:

- implementation of the project "in digital form";
- change of the educational position: from an executive position to an active educational position, independently exercising self-control and self-management, as well as mutual control and mutual management of educational activities in the process of project implementation;
- development of mutually enriching cooperation (use of digital tools and educational resources, sharing);
- development of horizontal connections;
- inclusion in extracurricular project initiatives.

Nowadays, in the era of lifelong learning, we have the opportunity to improve the quality of professional qualifications through the use of the digital environment, but it is necessary to find the appropriate application.

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REFERENCES

Al-Rahmi, W.M., Alias, N., Othman, M.S., Marin, V.I., & Tur G. (2018). A model of factors affecting learning performance through the use of social media in Malaysian higher education. *Computers & Education*, *121*, 59–72. https://doi:10.1016/j.compedu.2018.02.010.

Ansari, J.A.N. & Khan, N.A. (2020). Exploring the role of social media in collaborative learning the new domain of learning. *Smart Learn. Environ, 7*(1), 59–72. https://doi.org/10.1186/s40561-020-00118-7.

Barinova, N., Dorofeev, A., Zaydullina, S., & Arslanova, M. (2020). Technologies In The Implementation Of Paradigm Of The Future Teacher Training. *Humanistic Practice in Education in a Postmodern Age*, *European Proceedings of Social and Behavioural Sciences*, *93*, 116–125. https://doi.org/10.15405/epsbs.2020.11.13.

Bates, A.W. (2015). *Teaching in a Digital Age.* Retrieved from https://pressbooks.bccampus.ca/teachinginadigitalagev2 (accessed 3 July 2022).

Batunova, I., Lobyneva, E., Nikolaeva, A., & Baturina, N. (2021). Teaching IT Specialists with the Help of Online Learning. *Socio-economic Systems: Paradigms for the Future,* 1091–1098. https://doi.org/10.1007/978-3-030-56433-9_114.

Blinov, V.I. & Dulinov, M.V. (Eds.). (2019). *Didactic Specialty Vocational Education and Training Project*. „Pero".

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems*, *49*(1), 5–22. https://doi.org/10.1177/0047239520934018.

Galvis, Á.H., & Carvajal, D. (2022). Learning from success stories when using eLearning and bLearning modalities in higher education: a meta-analysis and lessons towards digital educational transformation. *Int J Educ Technol High Educ*. *19*(1). https://doi.org/10.1186/s41239-022-00325-x.

Huang, R.H., Liu, D.J., Tlili, A., Yang, J.F., Wang, H.H., Zhang, M., Lu, H., Gao, B., Cai, Z., Liu, M., Cheng, W., Cheng, Q., Yin, X., Zhuang, R., Berrada, K., Burgos, D., Chan, C., Chen, N.S., Cui, W., Hu, X., et al. (2020). *Handbook on facilitating flexible learning during educational disruption: The Chinese experience in maintaining undisrupted learning in COVID-19 outbreak*. Smart Learning Institute of Beijing Normal University.

Issa, T., Alqahtani, S.G., Al-Oqily, I., Goktalay, S.B., Köse, U., Issa, T., Abu Salih, B., & Almufaraj, W.K. (2021). Use of social networking in the Middle East: student perspectives in higher education. *Heliyon, 7*(4), e06676. https://doi.org/10.1016/j.heliyon.2021.e06676.

Krutikov, M. (2020). Formation of digital competence of rising teachers in the process of professional training. *Contemporary Problems of Science and Education, 6*, 92. https://doi.org/10.17513/spno.30414.

Kuusimäki, A.-M., Uusitalo-Malmivaara, L., & Tirri, K. (2019). The Role of Digital School-Home Communication in Teacher Well-Being. *Frontiers in Psychology*, *10*. https://doi.org/10.3389/fpsyg.2019.02257.

Langegård, U., Kiani, K., Nielsen, S.J., & Svensson, P. (2021). Experience nursing students in the pedagogical transition from on-campus learning to distance learning using digital tools. *BMC Nursing, 20*(1). https://doi.org/10.1186/s12912-021-00542-1.

Mercader, C. & Gairín, J. (2020). University teachers' perception of barriers to the use of digital technologies: The importance of the academic discipline. *International Journal of Educational Technology in Higher Education*, *17*(1). https://doi.org/10.1186/s41239-020-0182-x.

Morreale, S.P., Thorpe, J., & Westwick, J.N. (2020). Online Teaching: Challenge or Opportunity for Communication Education Scholars? *Communication Education, 70*(1), 117–119. https://doi.org/10.1080/03634523.2020.1811360.

Neelakandan, S., Annamalai, R., Rayen, S.J., & Arunajsmine, J. (2020). Social Media Networks Owing To Disruptions For Effective Learning. *Procedia Computer Science*, *172*, 145–151. https://doi.org/10.1016/j.procs.2020.05.022.

Noskova, T.N. & Kozina, N.D. (2021). Digital environment for supporting the project activities of undergraduate studing "Technology Education" in higher school. *Society. Communication. Education*, *3*(12), 81–92. https://doi.org/10.18721/JHSS.12307.

Noskova, T.N. (2020). *Didactics of the digital environment*: *Monograph*. St. Petersburg: Publishing house of the Herzen State Pedagogical University.

Owens, J. & Hudson, A. (2021). Prioritizing teacher emotions: Shifting teacher training to a digital environment. *Educational Technology Research and Development, 69,* 59–62. https://doi.org/10.1007/s11423-020-09921-y.

Rayens, W. & Ellis, A. (2018). Creating a Student-Centered Learning Environment Online. *Journal of Statistics Education*, *26*(2), 92–102. https://doi.org/10.1080/10691898.2018.1475205.

Seisenbayeva, Z., Nuriev, M., Rauandina, A., Osmanova, Z., & Seitkaziyev, R. (2015). The role of project activity in the formation of future specialists. *Opción*, 394–422. Retrieved from https://www.produccioncientificaluz.org/index.php/opcion/article/view/23532. ISSN 1012-1587.

Selwyn, N. (2016). Education and Technology: Key issues and debates. London, Bloomsbury.

Shurygin, V., Ryskaliyeva, R., Dolzhich, E., Dmitrichenkova, S., & Ilyin, A. (2021). Transformation of teacher training in a rapidly evolving digital environment. *Education and Information Technologies*, *27*(3), 3361–3380. https://doi.org/10.1007/s10639-021-10749-z.

Tømte, C., Fossland, T., Aamodt, P., & Degn, L. (2019). Digitalisation in higher education: Mapping institutional approaches for teaching and learning. *Quality in Higher Education, 25*(1), 98–114. https://doi.org/10.1080/13538322.2019.1603611.

Vázquez, E. (2015). Ubiquitous and mobile learning through "apps". In E. Vázquez & M.L. Sevillano (Eds.). *Mobile digital devices in education. Ubiquitous learning*, (pp. 135–154). Madrid: Narcea Ediciones. ISBN 978-84-277-2100-5.