Educational Technology Quarterly, Vol. **2022**, Iss. 2, pp. 152-168 https://doi.org/10.55056/etq.6

System for digital professional development of university teachers

Nataliia V. Morze[1], *Oksana P.* Buinytska[1], *Liliia O.* Varchenko-Trotsenko[1], *Svitlana V.* Vasylenko[1], *Dariya L.* Nastas[1], *Anastasiia V.* Tiutiunnyk[1] and *Svitlana H.* Lytvynova[2]

[1]*Borys Grinchenko Kyiv University, 18/2 Bulvarno-Kudriavska Str, Kyiv, 04053, Ukraine*

[2]*Institute for Digitalisation of Education of the National Academy of Educational Sciences of Ukraine, 9 M.Berlynskoho Str, Kyiv, 04060, Ukraine*

Abstract. The article highlights the issues of developing a system for digital competence of the teacher. The paper describes the research that resulted in the development and implementation of the system for digital professional development for university teachers at the Borys Grinchenko Kyiv University. The principle of system adaptation is realized in two directions: to time possibilities of testing and minicourse passing; to needs of teachers according to professional direction and disciplines taught. A model of organisation of this system based on self-assessment, self-education and micro-teaching principles has been developed. The main structural elements of the system are diagnostic test and sets of minicourses. The approaches to the formation of the diagnostic test, including ensuring its integration, variability and validity, as well as the principle of its use in order to establish the level of digital competence of teachers in accordance with the developed corporate standard of digital competence were applied in detail. Using the example of the compulsory level of digital competence Analyst-Researcher (A) the use of mini-course sets for Integrator (B1), Expert (B2), Leader (C1) and Innovator (C2) levels are described. The system allows teachers to build their own professional development trajectory as a digital footprint reflected in a personal study, and the use of embedded business intelligence tools provides a visualised holistic picture of digital professional performance. The place of the system and its further development for professional development in the digital twin of the educational institution is highlighted.

Keywords: certification training, system for digital professional development, digital competence, e-learning

n.morze@kubg.edu.ua (N. V. Morze); o.buinytska@kubg.edu.ua (O. P. Buinytska); l.varchenko@kubg.edu.ua (L. O. Varchenko-Trotsenko); s.vasylenko@kubg.edu.ua (S. V. Vasylenko); d.nastas@kubg.edu.ua (D. L. Nastas); a.tiutiunnyk@kubg.edu.ua (A. V. Tiutiunnyk); s.h.lytvynova@gmail.com (S. H. Lytvynova)
http://eportfolio.kubg.edu.ua/teacher/152 (N. V. Morze); http://eportfolio.kubg.edu.ua/teacher/21 (O. P. Buinytska); http://eportfolio.kubg.edu.ua/teacher/10 (L. O. Varchenko-Trotsenko); http://eportfolio.kubg.edu.ua/teacher/59 (S. V. Vasylenko); http://eportfolio.kubg.edu.ua/teacher/2075 (D. L. Nastas); http://eportfolio.kubg.edu.ua/teacher/978 (A. V. Tiutiunnyk); https://iitlt.gov.ua/structure/departments/technology/detail.php?ID=49 (S. H. Lytvynova)
0000-0003-3477-9254 (N. V. Morze); 0000-0002-3611-2114 (O. P. Buinytska); 0000-0003-0723-4195 (L. O. Varchenko-Trotsenko); 0000-0002-5790-572X (S. V. Vasylenko); 0000-0002-9008-8100 (D. L. Nastas); 0000-0003-2909-7697 (A. V. Tiutiunnyk); 0000-0002-5450-6635 (S. H. Lytvynova)

1. Introduction

The objectively necessary mass transition to e-learning during the quarantine period has become a kind of global challenge for the whole educational environment, including higher education and teachers in particular.

An important issue is the quality of e-learning, as noted, for example, in the 2021 EDUCAUSE Horizon Report [23]. This focuses specifically on quality of the online learning as a technology, the use of analytics, open resources, a mix of blended and hybrid course models. At the same time, the requirements for digital competencies are increasing, which makes teachers in today's environment to effectively use digital tools to deliver online learning experiences.

For this reason, the issue of implementing an effective professional development system that contains research, didactic, leadership and digital components is of particular relevance. The *aim of the study* is to design and implement an system of professional development for teachers in digital areas.

The analysis of current research has shown that a large number of scholars pay a lot of attention to this issue.

Seel and Zierer [25] stress that the implementation of digital technologies in education will be effective if it is teacher and pedagogy will take the lead rather than technology. The main focus of educational responsibility has always been human development. The human being in pedagogy is both the starting point and the end result. This approach must also be applied to the digitalization of education. Digital technologies cannot become a substitute for the pedagogical component of the educational process. Moreover, digitalization must be subordinated to pedagogy.

Meyers, Erickson and Small [15] believe that the development of digital technologies and tools requires new knowledge and skills from the educator; the educator should ensure that applicants for education master digital tools in order to be ahead of the younger generation and help them master the necessary competencies to increase the availability of new knowledge.

Yarbro et al. [34] stresses that in the digital space it is the teacher who determines the pace of learning, organizes the topics that implement subject knowledge, and is responsible for students' progress.

The Digital Competence Profile of Educators (DigCompEdu) proposed in 2017 describes 22 competencies, the focus of which is not on technical skills, but on the teacher's ability to use digital technologies to enhance the educational process.

Kluzer and Pujol Priego [12] describe the implementation practices of the European Digital Competence Framework (DigComp) consisting of 50 case studies and tools.

Ottestad, Kelentrić and Guðmundsdóttir [22] define the digital competences of an educator as a set of components: general, which includes general knowledge and skills that teachers should have; didactic, which reflects the digital specificity in each discipline and professional oriented with a description of digital rice.

Professional development for Finnish teachers is organized directly by educational institutions, the National Board Institute of Education, the National Center for Professional Development in Education, teacher education departments and faculties of higher education institutions through a credit system [21].

In Great Britain professional development takes place according to two models: the course

model based on universities and professional development directly based on school-based in-service education [14].

The professional development process in Canada includes various educational institutions: universities, departments of education, school boards, regional education centers, volunteer associations of subject teachers, teachers' unions, private providers of professional development services [29].

Professional development for U.S. teachers takes place in multilevel institutions of higher education [33].

According to the Pelletier et al. [23] at the beginning of the pandemic, educational institutions started to develop portals/hubs that included different educational resources and use new teaching strategies. The educational reference materials presented on them to help teachers move quickly from traditional to online learning. One of the best examples was the training of teachers at Indiana University and its partners. The developers actively developed the site's resources, allowing them to quickly review and redistribute materials to meet faculty needs. The site, its structure and content have also been used in the future not only by colleges and universities in the United States but also by other higher education institutions.

The pandemic requires new pedagogical approaches for educators to rethink the ways and methods of delivering content to applicants, motivating them, establishing electronic communication and collaboration, and evaluating performance [2, 4, 8, 10, 27].

At the same time, an important point in defining quality is standardisation, which is a complex multifactorial process.

The Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) standards for quality assurance in higher education [30]: internal and external, based on the experience of quality assurance in the Western European countries, set the only European format for quality assurance systems and the creation of a single European educational area. The documents stipulate that HEIs should have certain procedures and criteria to validate the qualifications and professional level of teachers [18, 19].

Given that Ukraine is a party to this space, higher education institutions implement these standards, which are specifically stated in the Law of Ukraine on Higher Education [32].

The professional standard for the group of professions "Teachers of Higher Education Institutions" [28] defines the conditions for the professional development of teachers and specifies a list of their job functions, each of which provides a detailed description of professional competences, noting the necessary knowledge, skills and abilities, a considerable part of which require a sufficiently high level of digital competence.

Taking into account the above-mentioned requirements in the professional standard of a teacher at Borys Grinchenko Kyiv University the "Teacher Profile" was developed, which reflects the manifestation indicators and learning outcomes of a university teacher in the context of such qualities: didactic, research, leadership and digital competence.

2. Digital professional development for university teachers

Professional development at the Borys Grinchenko Kyiv University is implemented in five modules: digital competence module, research competence module, leadership competence

module, didactic competence module, professional competence module [24].

The digital competence module is offered to teachers to develop digital competence, namely an introduction to modern educational trends, ways of introducing innovative technologies into the educational process, 21st century skills, the peculiarities of blended and online learning [11, 13, 17, 20, 26, 31, 35]. Participants explore tools for creating quality e-content, implementing formative assessment, effective communication and collaboration. Learning takes place in a blended learning format using the e-learning course "Digital Module" [6] located in the university's e-learning system (figure 1).

In order to improve the professional development system, teacher satisfaction is constantly monitored [5]. To analyse the dynamics of professional development indicators analytical data is tracked in real time using a modern business intelligence tool – Microsoft Power BI [9], which is a set of business intelligence services with cloud support for data analysis and visualisation. The main advantage of this tool is the ability to build interactive dashboards, with key performance indicators that are available for viewing from any device connected to the Internet.

The visualised report performed in Microsoft Power BI presents a detailed comparative analysis of teacher professional development individually and in the context of the structural units of Borys Grinchenko Kyiv University in the period 2018-2020. Examples of the details of the "Professional Development" dashboard and the dynamics of professional development by division and individual teacher are shown in figures 2, 3.

The availability of a detailed visual report enables the top management of the University to analyse the development of the teaching staff in dynamics, and for the teacher to rationally build a trajectory of self-development.

3. Designing the system for digital professional development of university teachers

According to the Concept of Digital Competence Development to improve the system of professional development the Corporate Standard of Digital Competence of University Teacher was developed, introduced to increase the level of digital competence of teachers, which is recognized as one of the key competences of successful person of the XXI century, to improve the quality of educational process, actualization of competitiveness of teachers by mastering new digital competences. The spheres of application of digital competence in Borys Grinchenko Kyiv University are determined by the main types of teacher's activities: teaching, research activities, professional communication and cooperation; digital self-management. Five levels of digital competence are defined:

- Analyst-Researcher (A), which is mandatory;
- Integrator (B1), Expert (B2) – sufficient;
- Leader (C1), Innovator (C2) – high.

Figure 1: The structure of the electronic training course "Digital Module".

3.1. Model of the system for digital professional development for university teachers

According to the approved digital competence standard, the systems for enhancing teachers' digital competence have been amended and the practice of compulsory university-wide testing of

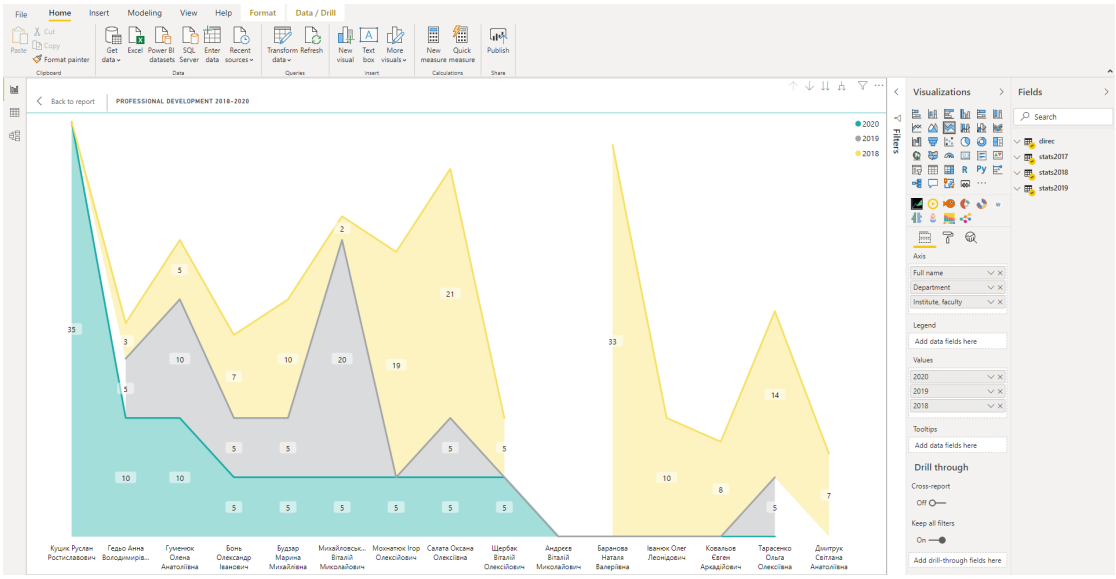


Figure 2: Example of a mapping of the dynamics of the division staff development.

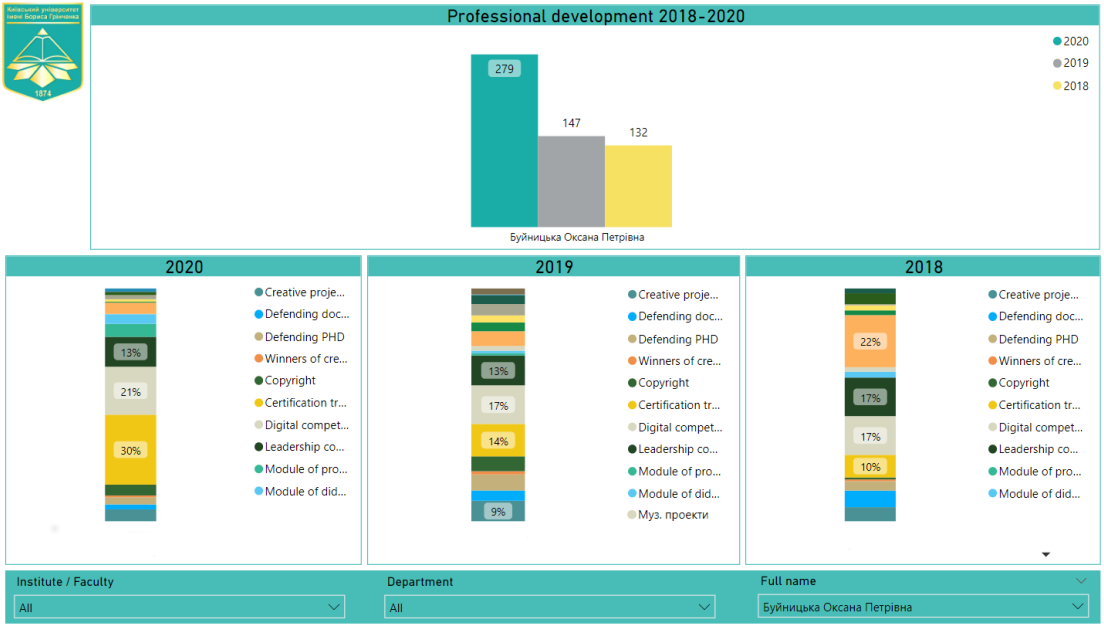


Figure 3: An example of reflecting the dynamics of professional development of a particular employee of the unit.

teachers has been abolished. Instead, an system of professional development has been developed, which is based on self-assessment, self-study, the principles of microlearning, e-learning and the like.

The adaptability of the system consists in giving the teacher an opportunity to choose the

subjects to be taught according to their own professional needs, taking into account the specifics of the disciplines they teach, and to work with the teaching materials 24/7/365.

The professional development system contains a diagnostic test and a structured set of mini-courses that are presented according to the levels of digital competence according to the fields of application.

The model of the professional development system is shown in figure 4.

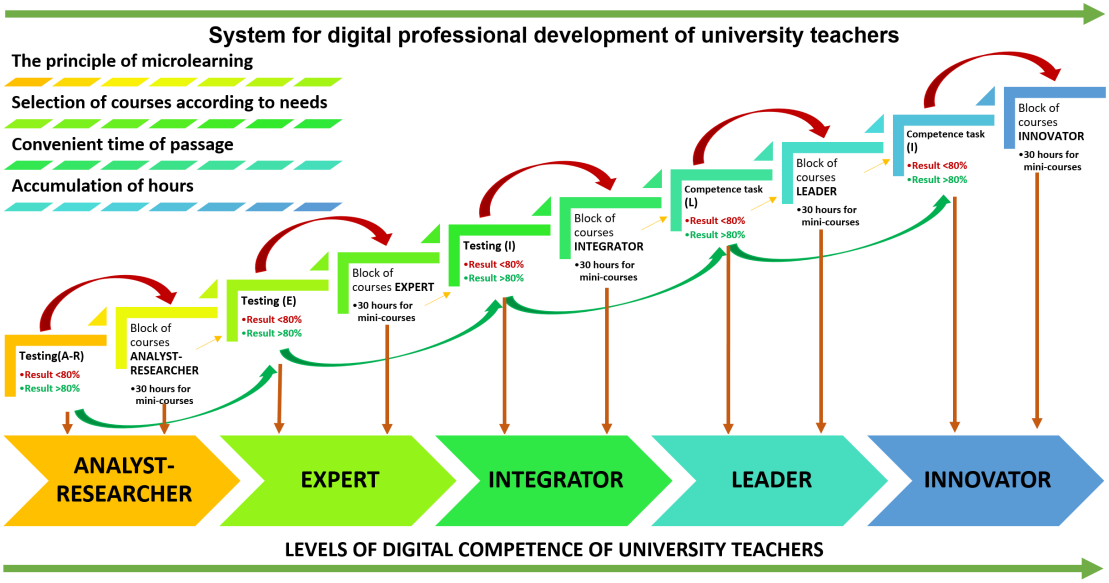


Figure 4: Model of system for digital professional development of university teachers.

The developed model allows the teacher to be aware and self-motivated to improve their skills, including in the digital skills, using a diagnostic test and passing mini-courses. First of all, the level of digital competence of a teacher is determined by the results of a diagnostic test, mastery of level mini-courses (every course contains a final test) with the possibility of building an individual trajectory of professional development and the marking in a personal office of the achievement of the appropriate level – the digital footprint.

3.2. Diagnostic test to determine the level of digital competence of a teacher

The development of a diagnostic test to determine the level of digital competence of a teacher was carried out in several stages. First, the goals of the test were defined – self-assessment of the level of digital competence and determining the need for its further improvement. It is self-assessment that lies at the heart of a teacher's motivation to choose his/her own trajectory of professional development and improvement of digital resource skills. Traditionally, goal classification has been implemented similar to Bloom's taxonomy [1, 3, 7], but according to the levels of digital competence defined in the Corporate Standard, and the domain is described, will be diagnosed. It is defined that this test will assess the cognitive domain or cognitive sphere, i.e. knowledge and attitudes towards aspects of digitalization in the areas: learning activities,

research activities, professional communication and cooperation; digital self-management. Indirectly the psychomotor domain is assessed, because the passing of the test takes place using a digital tool in an system developed. The objectives do not include and consequently do not offer tasks for the assessment of the personal emotional domain.

The choice of testing as a measurement method offers a number of advantages given the rapid response in the self-assessment process. The diagnostic test determines the level of digital competence of teachers, i.e. the competences that colleagues have or do not have now according to the given descriptors of the corporate standard, detailing the skills of university teachers according to the levels of digital competence and the areas of application.

Secondly, a base of test tasks is created according to the matrix, which is developed based on the structure of digital competence standard and 97 descriptors. The matrix is three-dimensional 1 dimension is one of the four activities of a university teacher; 2 dimension is one of the five levels of digital competence; 3 dimension is conditional horizontal lines of development of a certain competence, which are formed according to the content and aspects of the activity.

In order to be able to provide a variable diagnostic test to determine the level of digital competence 3–5 alternative test tasks to each descriptor are provided.

The choice of test item formats is limited by the capabilities of the chosen tool, i.e. LMS Moodle [16]. We use test tasks of the following types: multiple choice with one or more correct answers, yes/no, establishing logical sequences or correspondences. Graphic objects of a certain quantity are used in the test tasks, but more textual materials.

Thirdly, in the process of shaping the test its integrated nature is taken into account and in connection with that two lines are defined, i.e. the test has subtests in accordance with the activities of university teachers and on the other hand it is integrated according to the levels of the competence. A decision was made at the physical conclusion of the test and accordingly it was taken into account in its specification, the subtests of the activities to be concluded into a test for the specific level of the competence. Thus a separate test for the confirmation or non-confirmation of the Analyst-Researcher level is created. The results will be processed as soon as a statistically relevant number of participants is achieved for the analysis and the summarising. There is no need to equalise the test when concluding it for a particular competence level, because its balance in terms of difficulty has already been taken into account, and consideration of the logical coverage of meaningful questions is provided by including test items in accordance with the matrix for the establishment of comprehension of the competence described by each descriptor without exception.

The validation process to establish the validity and reliability of the test results will take place in parallel. The participants will be informed of these nuances. The passing score is provisionally set at 80 percent. However, the feasibility of such a limit to determine the pass/fail result will also be tested and adjusted if necessary.

For professional development using the system the teacher is firstly invited to take the test to prove the compulsory level of digital competence “Analyst-Researcher”. If the teacher enters 80 percent of points, he/she can receive a certificate of confirmation of this level, or take the test of the highest level. If the compulsory level is not confirmed, the teacher can take the mini-courses directly in the professional development system. The list of mini-courses on offer generally enables the teacher to practise all areas of digital activity in accordance with the requirements defined in the standard.

3.3. Multi-level mini-courses in the system for digital professional development for university teachers

Mini courses are designed in the e-learning system of the university, which functions on the basis of LMS Moodle, the learning platform oriented to organise collaboration of educational process participants. It is used both for organising traditional distance courses and classroom learning support.

In order to realise the next stages of effective professional development in line with the model (figure 4), mini-courses with the possibility to accumulate a corresponding number of hours, e.g. a set for the Analyst-Researcher level (figure 5), have been developed.

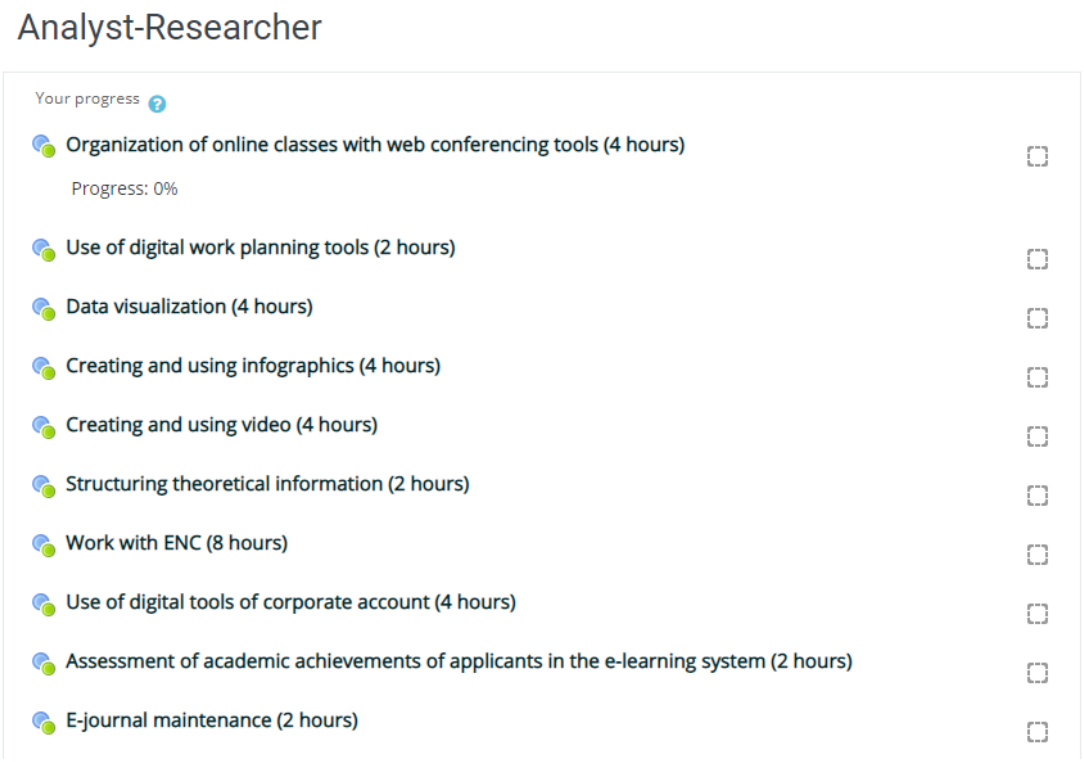


Figure 5: Set of mini-courses for the Analyst-Researcher level.

The title of each course indicates the number of hours that are allocated to studying the material and what will be entered into the accumulation system, there are also marks on the percentage of completion of the course and its completion.

Mini-courses contain educational materials, including mandatory ones with the appropriate mark, and a final test (figure 6).

The system provides tracking of tasks and own learning progress (figure 7, 8).

The full completion of the mini-course is displayed in the block "Status of completion of the course" of the mini-course, and the points scored, ie hours, are automatically displayed in the Journal of assessments of a certain level of digital competence (figure 9, 10).

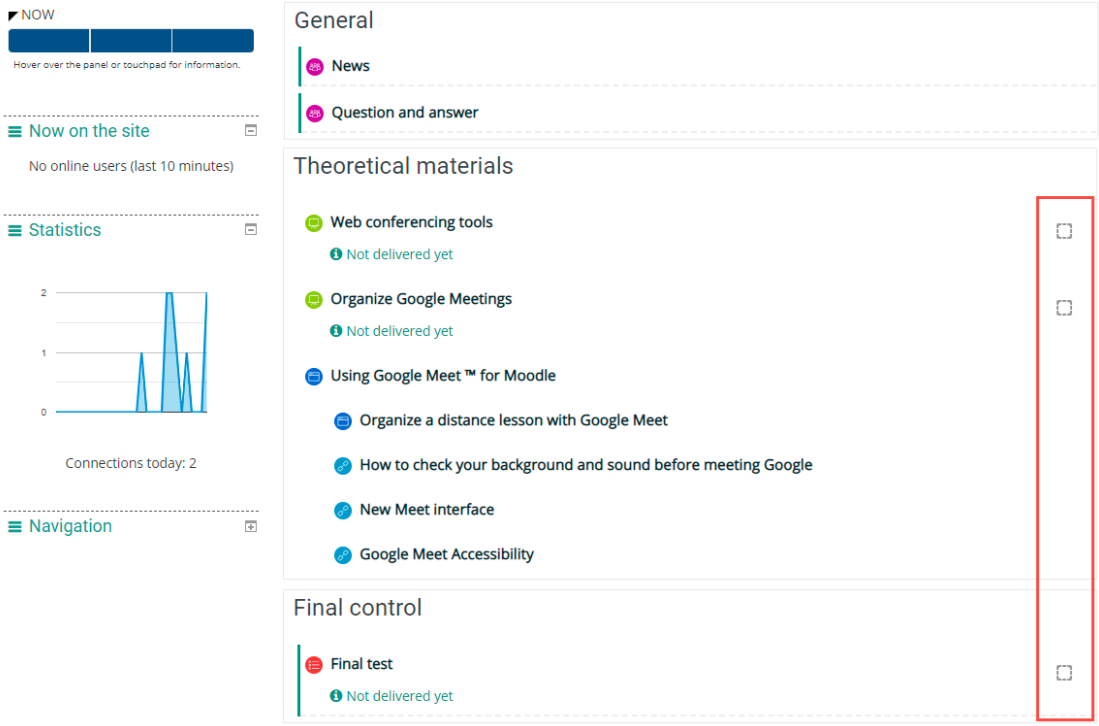


Figure 6: Example of the mini-course.

Figure 7: Tracking the performance of mini-course activities.

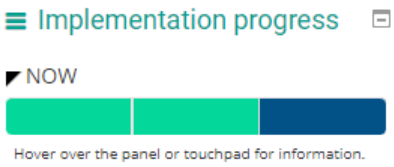


Figure 8: Progress of implementation.

For the convenience of all participants and for easy perception and understanding of the data obtained, we consider it advisable to use visualisation tools that speed up and simplify the data analysis process. In particular, to track user activity directly in the learning system, the "Statistics" block is used, containing automatically updated visualised information about the connection during the last month and the current day (figure 11).

The analysis of data from the additionally installed plug-in block "Progress of completion" and the report "Activity completion" for each level of digital competence separately allows to

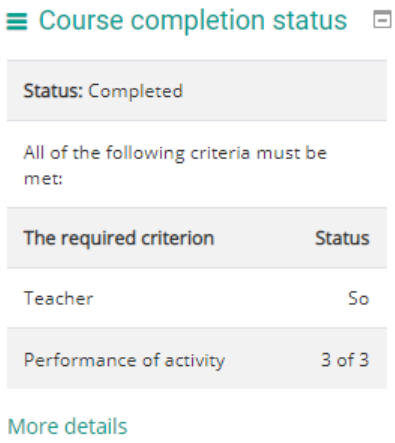


Figure 9: Course completion status.

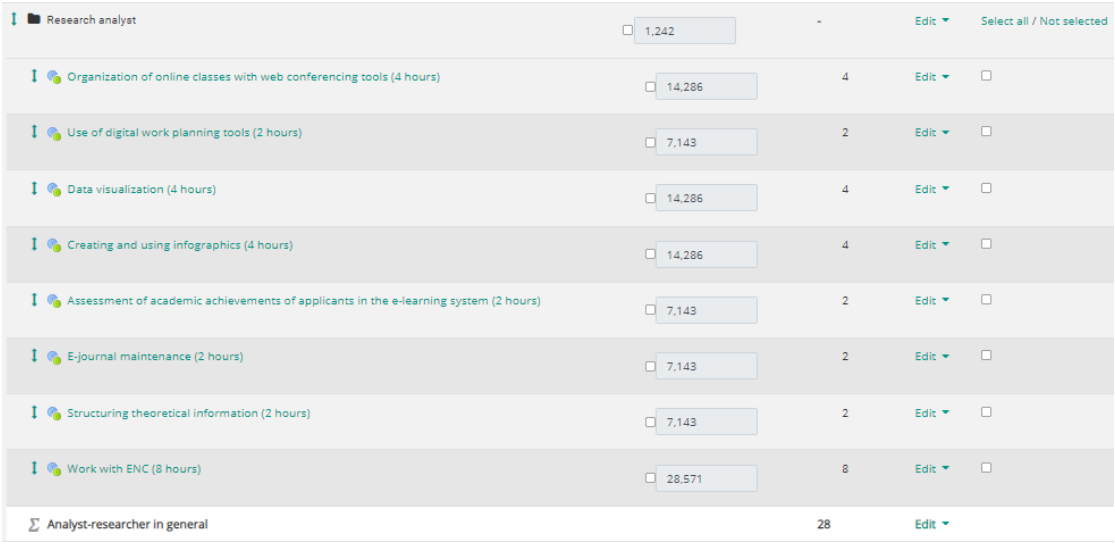


Figure 10: Journal of assessment.

evaluate the progress of each teacher in mastering mini-courses of a certain competence level, to identify which mini-courses are most or least in demand for further consideration in the process of improving the system as a whole (figure 12, 13).

The "Statistics" report displays data on user activity in the training system in general, taking into account the sets of mini-courses for all levels of digital competence (figure 14).

Thus, the results of analytical data on the activity of teachers on the course, high demand, the relevance of certain mini-courses or, conversely, low use give the opportunity to modernize the system, to develop more relevant courses.

The system additionally uses an embedded business intelligence tool – Power BI plug-in for the LMS Moodle platform, which will allow for a visualised holistic view of performance.

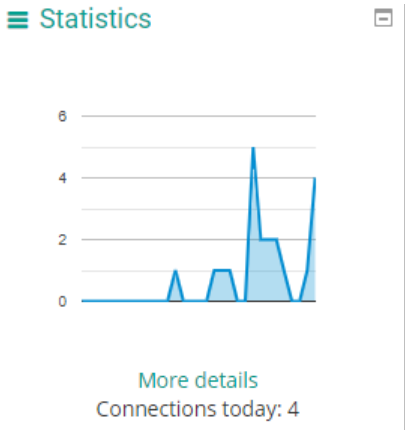


Figure 11: Statistics block.

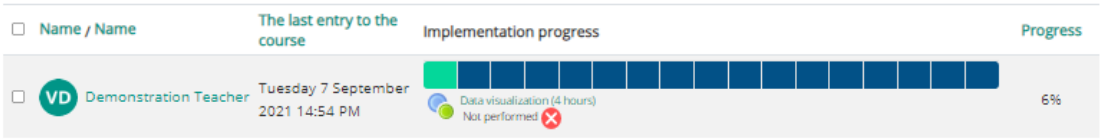
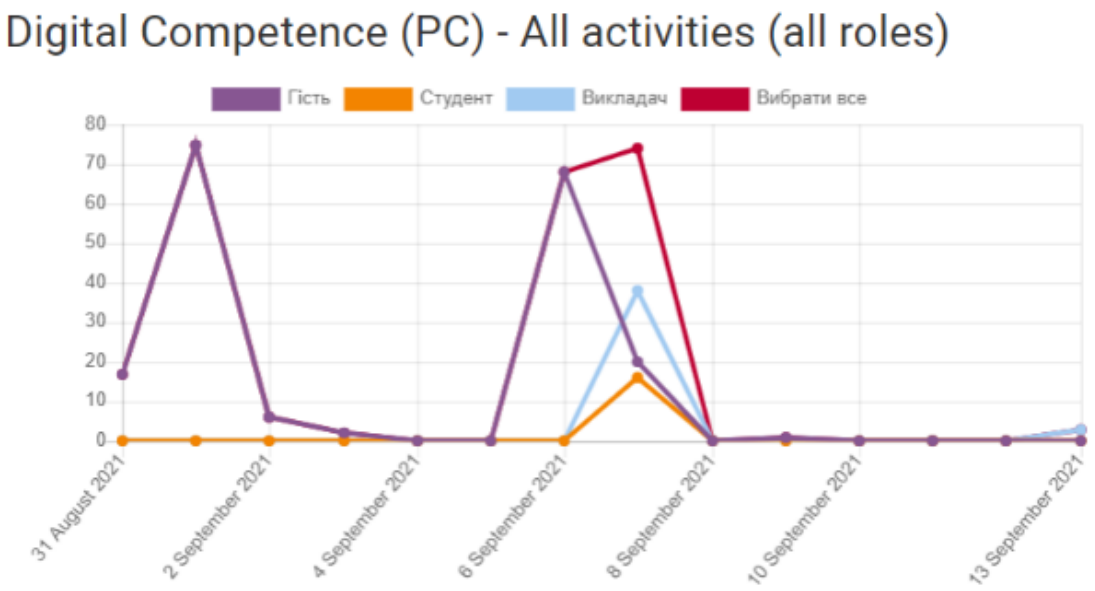


Figure 12: Implementation progress.

Figure 13: Activity completion report.



End of period (day)	Guest	Student	Teacher	Choose everything	Events
13 September 2021	0	0	3	3	Course Events
12 September 2021	0	0	0	0	Course Events
11 September 2021	0	0	0	0	Course Events
10 September 2021	0	0	0	0	Course Events
9 September 2021	1	0	0	1	Course Events
8 September 2021	0	0	0	0	Course Events
7 September 2021	20	16	38	74	Course Events

Figure 14: Statistics report.

4. Conclusions and prospects for further research

The requirements of the present and the regulations adopted at different levels prompted the participants of the study to revise the approaches and ways of professional development. Thus, the results of the study designed an system for digital professional development for university teachers in accordance with the developed model, the main components of which are equal digital competence, diagnostic test, sets of mini-courses for each level.

A diagnostic test has been developed which considers the need to integrate the skills of using digital tools in all teaching activities: research, teaching, professional communication and

digital self-management. It is designed to determine the current level of digital competence of a teacher. Mini-courses, compiled according to teacher's digital competence levels, declared in the developed Corporate Digital Competence Standard, containing materials, in accordance with certain descriptors according to activities.

Professional development of a teacher in the system begins with a diagnostic test, based on the results of which a referral is made to take mini-courses of an appropriate level.

The developed system for digital professional development provides an opportunity to visually observe one's own digital footprint in a personal study room and promotes teachers' self-motivation to improve their digital competence and, consequently, the quality of educational services in general.

Taking into account the diversity and significant differences in disciplines as well as individual teachers' ability to devote certain time to study, the system is adapted so that teachers choose mini-courses at their own discretion and have access to the study materials of the system 24/7/365.

In the future, it is planned to expand the teacher professional development system in other areas: research, didactic, leadership and professional development. This will enable teachers to acquire additional knowledge and continuously improve their skills in order to fulfill their professional responsibilities.

The experience of implementing a system for digital professional development can be useful for other universities, which can take the proposed system model as a basis and adapt it to their own conditions and needs.

References

[1] Anderson, L.W., Krathwohl, D.E., Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J. and Wittrock, M.C., eds, 2001. *A Taxonomy for learning teaching and assessing: A revision of Bloom's taxonomy of educational objectives.* Addison Wesley Longman, Inc. Available from: https://www.uky.edu/~rsand1/china2018/texts/Anderson-Krathwohl%20-%20A%20taxonomy%20for%20learning%20teaching%20and%20assessing.pdf.

[2] Bakhmat, L., Babakina, O. and Belmaz, Y., 2021. Assessing online education during the COVID-19 pandemic: a survey of lecturers in Ukraine. *Journal of physics: Conference series*, 1840(1), p.012050. Available from: https://doi.org/10.1088/1742-6596/1840/1/012050.

[3] Bloom, B.S., ed., 1956. *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook I: Cognitive Domain.* New York: Longmans. Available from: https://www.uky.edu/~rsand1/china2018/texts/Bloom%20et%20al%20-Taxonomy%20of%20Educational%20Objectives.pdf.

[4] Bondarchuk, O.I., Balakhtar, V.V., Ushenko, Y.O., Gorova, O.O., Osovska, I.M., Pinchuk, N.I., Yakubovska, N.O., Balakhtar, K.S. and Moskalov, M.V., 2022. The psychological safety of the educational environment of Ukrainian higher education institutions in a pandemic: empirical data of a comparative analysis of participants' assessments studying online. *Proceedings of the 1st Symposium on Advances in Educational Technology - Volume 1: AET.* INSTICC, SciTePress, pp.14–31. Available from: https://doi.org/10.5220/0010920100003364.

[5] Buinytska, O., Varchenko-Trotsenko, L., Terletska, T. and Nastas, D., 2020. Modernization

of electronic learning system of the university to the needs of the participants of the educational process. *Open educational e-environment of modern university*, (9), pp.1–14. Available from: https://doi.org/10.28925/2414-0325.2020.9.1.

[6] Buinytska, O. and Vasylenko, S., 2018. Using e-courses to enhance the future teachers‘ digital competence. *Open educational e-environment of modern university*, (SPECIAL EDITION), pp.44–62. Available from: https://doi.org/10.28925/2414-0325.2019s5.

[7] Bulakh, I. and Mruha, M., 2006. *We create a quality test.* Kyiv: Testing Center at the Ministry of health of Ukraine.

[8] Burov, O.Y., Kiv, A.E., Semerikov, S.O., Striuk, A.M., Striuk, M.I., Kolgatina, L.S. and Oliinyk, I.V., 2020. AREdu 2020 - How augmented reality helps during the coronavirus pandemic. *CEUR Workshop Proceedings*, 2731, pp.1–46. Available from: http://ceur-ws.org/Vol-2731/paper00.pdf.

[9] Data Visualization | Microsoft Power BI, 2021. Available from: https://powerbi.microsoft.com/.

[10] Falfushynska, H.I., Buyak, B.B., Tereshchuk, H.V., Torbin, G.M. and Kasianchuk, M.M., 2020. Strengthening of e-learning at the leading Ukrainian pedagogical universities in the time of COVID-19 pandemic. *CEUR Workshop Proceedings*, 2879, pp.261–273.

[11] Hodovaniuk, T.L., Makhometa, T.M., Tiahai, I.M., Medvedieva, M.O., Pryshchepa, S.M. and Voznyak, A.V., 2022. Educational trainings as one of the effective forms of digital competence development of secondary school teachers. *Proceedings of the 1st Symposium on Advances in Educational Technology - Volume 2: AET*. INSTICC, SciTePress, pp.372–381. Available from: https://doi.org/10.5220/0010931900003364.

[12] Kluzer, S. and Pujol Priego, L., 2018. *DigComp into action, get inspired make it happen: A user guide to the European Digital Competence framework.* (JRC Science for Policy Report, EUR 29115 EN). Publications Office of the European Union. Available from: https://doi.org/10.2760/112945.

[13] Kuzminska, O., Mazorchuk, M., Morze, N., Pavlenko, V. and Prokhorov, A., 2019. Study of Digital Competence of the Students and Teachers in Ukraine. *Communications in computer and information science*, 1007, pp.148–169. Available from: https://doi.org/10.1007/978-3-030-13929-2_8.

[14] Machin, S. and Vignoles, A., 2018. *What's the good of education?: The economics of education in the UK*. Princeton University Press. Available from: https://doi.org/10.2307/j.ctv301fj7.

[15] Meyers, E.M., Erickson, I. and Small, R.V., 2013. Digital literacy and informal learning environments: an introduction. *Learning, media and technology*, 38(4), pp.355–367. Available from: https://doi.org/10.1080/17439884.2013.783597.

[16] Mintii, I.S., Shokaliuk, S.V., Vakaliuk, T.A., Mintii, M.M. and Soloviev, V.N., 2019. Import test questions into Moodle LMS. *CEUR Workshop Proceedings*, 2433, pp.529–540.

[17] Moiseienko, M.V., Moiseienko, N.V. and Kiv, A.E., 2020. Didactic conditions for the formation of digital competence of students of pedagogical universities. *Educational dimension*, 54(2), p.165–178. Available from: https://doi.org/10.31812/educdim.v54i2.3866.

[18] Morze, N. and Varchenko-Trotsenko, L., 2014. Electronic portfolio as a tool for measuring the performance of a teacher of modern universities. *Information sciences and technology in education*, (53), pp.36–41.

[19] Morze, N. and Varchenko-Trotsenko, L., 2016. Educator's e-portfolio in the modern

university. *CEUR Workshop Proceedings*, 1614, pp.231–240.

[20] Morze, N.V. and Buinytska, O.P., 2017. Raising information and communication technologies competence of scientific and pedagogical employees - a key requirement of the quality of educational process. *Information technologies and learning tools*, 59(3), p.189–200. Available from: https://doi.org/10.33407/itlt.v59i3.1667.

[21] OECD, 2010. *Strong Performers and Successful Reformers in Education. Lessons from PISA for the United States*. OECD Publishing. Available from: https://doi.org/10.1787/9789264096660-en.

[22] Ottestad, G., Kelentrić, M. and Guðmundsdóttir, G.B., 2014. Professional digital competence in teacher education. *Nordic journal of digital literacy*, 9(04), pp.243–249. Available from: https://doi.org/10.18261/issn1891-943x-2014-04-02.

[23] Pelletier, K., Brown, M., Brooks, D.C., McCormack, M., Reeves, J., Arbino, N., Bozkurt, A., Crawford, S., Czerniewicz, L., Gibson, R., Linder, K., Mason, J. and Mondelli, V., 2021. *2021 EDUCAUSE Horizon Report | Teaching and Learning Edition*. Boulder: EDUCAUSE. Available from: https://library.educause.edu/resources/2021/4/2021-educause-horizon-report-teaching-and-learning-edition.

[24] Regulations on advanced training of scientific and pedagogical employees of the university, 2015. Available from: https://kubg.edu.ua/phocadownload/Nauka/stajuvannia/polozhennya_pidvyschennya2015.pdf.

[25] Seel, N.M. and Zierer, K., 2019. Bibliometric synthesis of educational productivity research: Benchmarking the visibility of German educational research. *Research in comparative and international education*, 14(2), pp.294–317. Available from: https://doi.org/10.1177/1745499919846189.

[26] Soroko, N.V., 2020. Methodology for teachers' digital competence developing through the use of the STEAM-oriented learning environment. *CEUR Workshop Proceedings*, 2732, pp.1260–1271.

[27] Sultanova, L.Y., Tsiuniak, O.P., Milto, L.O., Zheludenko, M.O., Lyktei, L.M., Petrenko, L.M. and Uchitel, A.D., 2020. The potential of Google Classroom web service for lecturers of higher educational establishments under pandemic conditions. *CEUR Workshop Proceedings*, 2879, pp.346–365.

[28] Teachers of higher education institutions, 2021. Available from: https://mon.gov.ua/ua/news/zatverdzheno-standart-na-grupu-profesij-vikladachi-zakladiv-vishoyi-osviti.

[29] Thomas, L., ed., 2013. *What is Canadian about Teacher Education in Canada? Multiple Perspectives on Canadian Teacher Education in the Twenty-First Century*. Canadian Association of Teacher Education. Available from: https://prism.ucalgary.ca/handle/1880/113301?show=full.

[30] Tomas, C. and Kelo, M., 2020. *ESG 2015–2018 ENQA Agency Reports: Thematic Analysis*. (ENQA occasional paper, 28). European Association for Quality Assurance in Higher Education.

[31] Trubavina, I., Dotsenko, S., Naboka, O., Chaikovskyi, M. and Meshko, H., 2021. Developing digital competence of teachers of humanitarian disciplines in the conditions of COVID-19 quarantine measures. *Journal of physics: Conference series*, 1840(1), p.012052. Available from: https://doi.org/10.1088/1742-6596/1840/1/012052.

[32] Verkhovna Rada of Ukraine, 2014. Law of Ukraine "On Higher Education". Available from:

https://zakon.rada.gov.ua/laws/show/1556-18.

[33] Wei, R., Darling-Hammond, L. and Adamson, F., 2010. *Professional development in the United States: Trends and challenges*. Dallas: National Staff Development Council. Available from: https://edpolicy.stanford.edu/sites/default/files/publications/professional-development-united-states-trends-and-challenges.pdf.

[34] Yarbro, J., McKnight, K., Elliott, S., Kurz, A. and Wardlow, L., 2016. Digital instructional strategies and their role in classroom learning. *Journal of research on technology in education*, 48(4), pp.274–289. Available from: https://doi.org/10.1080/15391523.2016.1212632.

[35] Yaroshenko, O.G., Samborska, O.D. and Kiv, A.E., 2022. Experimental verification of efficiency of the formation of information and digital competence of bachelors of primary education based on an integrated approach. *Proceedings of the 1st Symposium on Advances in Educational Technology - Volume 1: AET*. INSTICC, SciTePress, pp.644–652. Available from: https://doi.org/10.5220/0010926800003364.

A. Online Resources

- Plug-in for the LMS Moodle "Progress of completion".
- Plug-in for the LMS Moodle "Statistics".
- Plug-in for the LMS Moodle "Power BI"