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## THE IMPACT OF VIRTUAL LEARNING ENVIRONMENT ON FUTURE TEACHERS' PROFESSIONAL COMPETENCE IN LIFELONG LEARNING

EL IMPACTO DEL ENTORNO DE APRENDIZAJE VIRTUAL EN LA COMPETENCIA PROFESIONAL DE LOS FUTUROS DOCENTES EN EL APRENDIZAJE PERMANENTE

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### ABSTRACT

The study aimed to empirically test the impact of a virtual learning environment on the professional competence of future computer science teachers in lifelong learning by conducting a survey and comparing the professional competence of bachelor and master students, as well as their opinions on the impact of the virtual learning environment on future teachers' professional competence in lifelong learning. The surveying methods were cognitive, motivational, activity-based, and value-based. A survey of students found that a virtual learning environment has the most significant impact on the activity component of professional competence, and most students are motivated to use virtual learning environments to improve their professional competence. The survey of teaching staff revealed a positive attitude towards professional development through virtual learning environments, the prevalence among students of high and sufficient levels of professional competence and digital literacy. The obtained results can be used to adjust the virtual educational process

of future teachers' professional training in the system of Ukrainian HEIs.

### Keywords:

Academic staff, computer science teachers, HEIs, lifelong learning, professional development, students, virtual tools.

### RESUMEN

El estudio tuvo como objetivo probar empíricamente el impacto de un entorno de aprendizaje virtual en la competencia profesional de los futuros profesores de informática en el aprendizaje permanente mediante la realización de una encuesta y la comparación de la competencia profesional de estudiantes de licenciatura y maestría, así como sus opiniones sobre el impacto del entorno de aprendizaje virtual sobre la competencia profesional de los futuros docentes en el aprendizaje permanente. Los métodos de encuesta fueron cognitivos, motivacionales, basados en actividades y basados en valores. Una encuesta entre

estudiantes encontró que un entorno de aprendizaje virtual tiene el impacto más significativo en el componente de actividad de la competencia profesional, y la mayoría de los estudiantes están motivados para utilizar entornos de aprendizaje virtuales para mejorar su competencia profesional. La encuesta al profesorado reveló una actitud positiva hacia el desarrollo profesional a través de entornos virtuales de aprendizaje, la prevalencia entre los estudiantes de niveles altos y suficientes de competencia profesional y alfabetización digital. Los resultados obtenidos se pueden utilizar para ajustar el proceso educativo virtual de formación profesional de futuros docentes en el sistema de las IES de Ucrania.

#### Palabras clave:

Eprendizaje permanente, desarrollo profesional, docentes de informática, estudiantes, herramientas virtuales, IES, personal académico.

#### INTRODUCTION

Due to the continuous digitalisation of society and all spheres of human life and activity, the role of virtual environments in the educational process is increasing significantly. Moreover, virtualisation has enabled the educational system to respond adequately to the challenges posed by the global pandemic and the full-scale military invasion. However, the introduction of virtual platforms and digital tools into the educational process has increased the requirements for the teachers' professional competence in terms of improving digital skills, as the virtual space is dynamic today and requires constant changes from all its subjects. The above makes it necessary to empirically determine the impact of virtual learning environments on teachers in lifelong learning.

#### LITERATURE REVIEW

Scientific studies dwell on forming and developing future teachers' professional skills and competencies and confirm the importance of creating a virtual educational environment, identifying the challenges associated with changing the e-learning process, broadcasting engaging and interactive content to students, the need to bring the competencies of teachers and students in line with the requirements of the virtual educational environment, the importance of their readiness to work in a virtual academic format (Molotsi, 2020). Researchers emphasise the need to update teachers' digital competencies to meet the challenges of the twenty-first century (Caena, & Redecker, 2019) and claim that the use of virtual educational tools is essential to improve self-efficacy and self-development and to educate students (Amhag et al., 2019).

The development of professional competence is often considered as a unity of self-identification, self-esteem, self-determination, self-management, and self-development and as a means of successful professional development (Torres et al., 2021). Professional self-development correlates with creating a personality's individual educational and professional trajectory (Kravchenko et al., 2021) and continuous professional growth in the sustainable development of education and science (Sydorenko et al., 2020). The importance of professional self-development is increasing in the context of lifelong learning and the creative self-realisation of specialists in any field of activity (Mushynska, 2018). Professional self-development is related to spiritual and moral behaviour, the development of the person's emotional and motivational sphere, self-analysis skills, and the analysis of human relationships (Yekimov et al., 2020). In times of social challenges and pandemic restrictions, it is essential to build a creative educational environment for professional self-development in the context of modern trends in digital education (Bashkireva et al., 2021).

Researchers emphasise the significant role of self-education (Demchenko, 2019) and digital skills in developing future teachers' professional competence (Budnyk, 2019). All this confirms the complexity and multifacetedness of continuous professional training of future teachers (Kanibolotska, 2020), the dynamism of the "professional competence" concept (Koreneva, & Kyryenko, 2023), and the determinism of a teacher's professional competence by modern information challenges (Voitovych, 2020).

Scientists stress the importance of a teacher's professional competence and digital competence as key to a teacher's professional development in lifelong learning (Henseruk, 2019). Future computer science teachers' digital competence includes information, media, communicative and technical competences. There is a clear correlation between the high level of a future computer science teacher's digital competence and the development of a teacher's professional competence in general, as it consolidates knowledge, skills and abilities to use digital technologies for the successful organisation of the educational process, critical evaluation of information resources, their correct use in teaching activities, and readiness to introduce technological innovations (Klieba, 2019). Forming professional competence in future computer science teachers requires their enthusiasm for using digital technologies in education (Skaskiv, & Hlad, 2021). The academic component of this professional competence involves virtualising the educational environment to ensure the continuous acquisition, mastery, formation and development of future teachers' professional competences (Karabin, & Gromiak,

2022). Students' professional competence is considered in the context of informatisation and computerisation of the educational process (Isyanov et al., 2020), the ability to plan their further professional development (Khasanov, 2022), the use of the latest digital platforms and tools for future teachers' professional training (Makhkamova, 2023).

Scientists claim that virtual learning environments benefit teachers' continuous professional development as they expand the use of formal and non-formal learning (Jafar et al., 2020).

Researchers confirm the apparent correlation between the challenges of virtualisation of the educational process and the needs and interests of modern students, who increasingly use digital tools, virtual learning environments and social media (Lacka, & Wong, 2021). But at the same time, it is inappropriate to overuse those virtual learning formats that were acceptable in the era of the global pandemic, as the impact of virtual learning environments on students' achievement of higher education goals has not been studied yet (Lacka, & Wong, 2020). However, despite this, the use of "smart" virtual learning environments (virtual reality; information, design, interactive, training, game-based and other learning) remains relevant for improving the quality of education and the new educational paradigm (Odrekhivskyy et al., 2019). Teaching staff worldwide use virtual educational platforms and immersive computer applications. Numerous surveys have confirmed students' satisfaction with new digital learning tools and their intention to participate in improving virtual products used in the educational process (Bogusevschi et al., 2020). At the same time, teachers' readiness to work with virtual educational platforms is a significant concern, as empirical research confirms the insufficient level of teachers' digital competence in the lifelong learning system, which hinders the promotion of a new way of teaching (Artacho et al., 2020). At the same time, students are dissatisfied with methodological approaches to teaching in a virtual learning environment. Scientists have proven the importance of using virtual educational platforms for future teachers' training. There is also growing concern about the quality of education in the context of its virtualisation. It is necessary to develop measures to improve the effectiveness of the virtual learning process, in particular for students to increase learning motivation and self-discipline to participate in online classes and for teachers to improve the system of formative assessment, introduce group activities (quizzes, competitions) to stimulate group exchanges and develop social skills (Dung, 2020).

The studies mentioned above focus on the advantages and disadvantages of introducing virtual platforms into the educational process and the importance of teachers

and students' readiness to use virtual platforms to achieve academic goals. However, the impact of virtual learning environments on future teachers' professional competence in lifelong learning has not been adequately studied.

The study aims to empirically determine the impact of virtual learning environments on the professional competence of future computer science teachers in lifelong learning.

Research objectives:

- to determine the educational and qualification level of professional competence of future computer science teachers;
- to determine the impact of virtual learning environments on future teachers' professional competence in lifelong learning (through a survey);
- to conduct a survey of teaching staff in HEIs on the impact of virtual learning environments on the professional competence of future computer science teachers in lifelong learning;
- to make a comparative analysis of the level of professional competence of future computer science teachers in terms of students' educational qualification levels;
- to make a comparative analysis of the impact of virtual learning environments on the professional competence of future computer science teachers in the context of lifelong learning in terms of students' educational and qualification levels.

The research hypothesis is that virtual learning environments contribute to the growth of future computer science teachers' professional competence and motivate them to continue self-improvement.

## MATERIALS AND METHODS

### Research design

The empirical testing included the following stages: preparatory, empirical, and final. At the preparatory stage, we formed a sample, selected research methods, and formulated the aim and objectives. At the empirical phase of the study, a survey of respondents was conducted on the impact of the virtual learning environment on the professional competence of future computer science teachers, diagnosing their level of professional competence. The results were interpreted at the final stage, and conclusions were drawn. The pilot study was initiated by the scientific communities of Ukrainian higher education institutions: HEI 1, HEI 2, and HEI 3.

### Sampling

In total, 140 future computer science teachers – bachelor and master students – aged 23 – 26 years – participated in the study. The reason for choosing students of different educational qualification levels is the need to identify students’ focus on continuous education, which should increase with the achievement of the appropriate level of training. All students worked in the “Moodle” virtual environment.

The reasons for drawing such a sample are as follows:

1. Students’ involvement in the use of virtual learning environments in the educational process;
2. students have a long experience of acquiring competences in a virtual learning environment;
3. students’ readiness and ability to use the resources and tools of the virtual learning environment.

Fifty academic staff members aged 40 – 50 years, involved in training students of pedagogical specialities, participated in the study.

All participants gave their voluntary consent to participate in the survey. The study was conducted during extra-curricular time and did not interfere with HEIs’ educational processes.

**Research methods**

The following methods were used in the study: diagnostics of future computer science teachers’ professional competence, surveys, qualitative and quantitative analysis of the data, and comparative analysis.

The diagnostics of future computer science teachers’ professional competence included a control test of students’ knowledge, skills and abilities conducted by teachers of HEIs (the levels: high, sufficient, average, and low).

The study also involved determining the impact of virtual learning environments on the professional competence of future teachers in lifelong learning through a survey of students and teaching staff.

The respondents were surveyed using Google Forms, based on the author’s questionnaire of bachelor and master graduate students of pedagogical specialities. The questionnaire (Appendix A) included 16 questions in four blocks: cognitive, motivational, activity-based, and value-based (Table 1).

Table 1. The structure of the author’s questionnaire to determine the impact of virtual learning environments on future teachers’ professional competence in lifelong learning

Blocks	Diagnostic Method
Cognitive	Respondents’ orientation towards expanding their knowledge on the use of virtual learning environments for professional self-development
Motivational	desire to use the virtual learning environments for professional development
Activity-based	positive experience of using virtual learning environments for professional development
Value-based	formation of a positive value attitude to the use of learning environments for professional development

Source: author’s development.

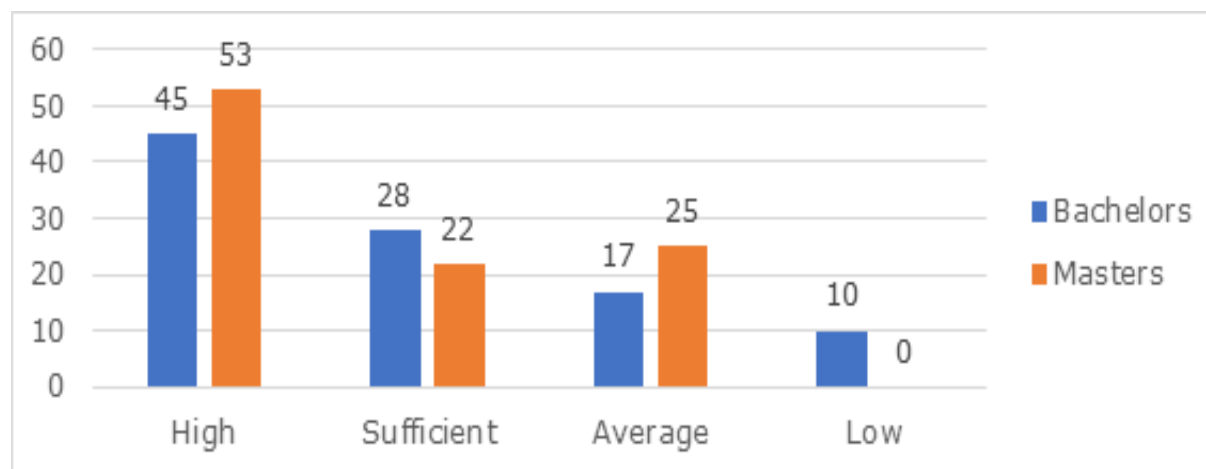
To determine the impact of virtual learning environments on future teachers’ professional competence in lifelong learning, we surveyed teaching staff, whom we asked to rate with a score from 1 to 12 the following diagnostic indicators of students: formation of professional competence, digital literacy, readiness to use virtual learning environments for self-development, understanding of the need for continuous professional development, positive attitude to professional development through virtual learning environments.

The primary data was recorded in the Excel spreadsheet processor. Statistical processing of the research results was carried out using Spearman’s rank correlation coefficient. Cronbach’s analysis (with Cronbach’s alpha value – 0.8) was used to determine the reliability of the author’s questionnaire.

## RESULTS AND DISCUSSION

The data on the diagnostics of future computer science teachers' professional competence are shown in Figure 1.

Figure 1. Professional competence of future computer science teachers, %.



Source: author's development.

As can be seen from Figure 1, a higher level of professional competence was found among master students, which indicates their higher readiness for professional development in the framework of lifelong learning.

The survey results of all respondents in percentage terms for each block of the questionnaire are summarised in Table 2.

Table 2. Averaged data on the impact of virtual learning environments on the professional competence of future computer science teachers in the framework of lifelong learning (%)

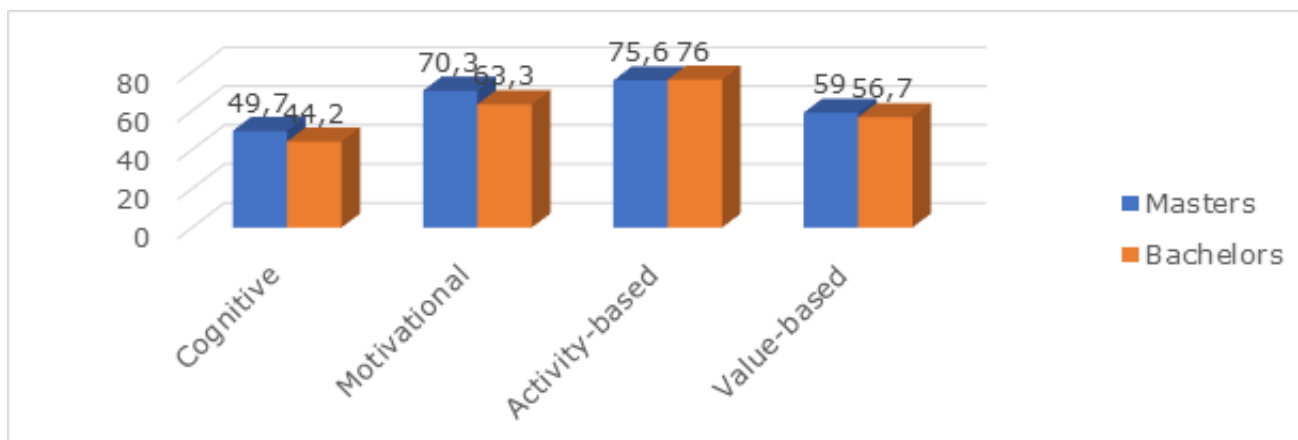
Categories of respondents	Blocks of the questionnaire				Mean value
	Cognitive	Motivational	Activity-based	Value-based	
Bachelor students of HEI 1	60	70	69	65	66,0
Master students of HEI 1	40,5	80	87	70	69,4
Bachelor students of HEI 2	55	74	89	67	71,3
Master students of HEI 2	47,3	56	76	56,3	58,9
Bachelor students of HEI 3	34,1	67	69	45	53,8
Master students of HEI 3	45	54	65	43,9	52,0
Mean value	47,0	66,8	75,8	57,9	61,9

Source: author's development.

As can be seen from Table 2, virtual learning environments have the most significant impact on the activity-based component of students' professional competence. This indicates that most respondents have positive experiences using virtual learning environments to develop their professional competence and are motivated to improve it. However, the students lack the knowledge, skills and abilities to use all the possible advantages of virtual educational space in the context of lifelong learning. This is also the reason for insufficient readiness to use virtual learning environments to improve future teachers' professional competence.

We conducted a comparative analysis of bachelor and master students regarding the impact of virtual learning environments on the professional competence of future computer science teachers in the framework of lifelong learning (Figure 2).

Figure 2. Comparative analysis of the survey of masters and bachelors on the impact of virtual learning environments on the professional competence of future computer science teachers in lifelong learning, %



Source: author's development.

As can be seen from Figure 2, master students have slightly higher scores than bachelor students. This indicates that masters, compared to bachelors, have:

- a more pronounced focus on deepening the knowledge of virtual learning environments for professional self-development;
- more examples of positive experiences of using virtual learning environments for professional development;
- a more pronounced positive attitude towards using learning environments for professional development.

They are also more likely to use the resources of virtual learning environments for professional development.

Based on the data in Table 3, it can be argued that most teaching staff note future teachers' positive attitude towards professional development through virtual learning environments. More than half of the surveyed report the prevalence of high and sufficient levels of professional competence, digital literacy, and understanding of the need for continuous professional development in students. At the same time, students have an average level of readiness to use virtual learning environments for self-development, which may be due to the lack of effective models for using virtual tools for professional growth.

Table 3. The results of the survey of teaching staff on the impact of virtual learning environments on the professional competence of future computer science teachers in lifelong learning (%)

Diagnostic methods	Levels				Mean value
	High	Sufficient	Average	Low	
Formation of professional competence	54	46	0	0	25
Digital literacy	68	22	20	0	27,5
Readiness to use virtual learning environments for self-development	22	28	50	0	25
Understanding the need for continuous professional development	62	28	10	0	25
Positive attitude to professional development through virtual learning environments	78	22	0	0	25
Mean value	56,8	29,2	16	0	25,5

Source: author's development.

The study makes it possible to identify the main directions for improving the use of virtual educational environments to develop the professional competence of future computer science teachers in lifelong learning:

- creating conditions for expanding students' knowledge base on the use of virtual learning environments for professional self-development;
- increasing the level of readiness to use virtual learning environments to improve the professional competence of future computer science teachers;
- forming a base of positive experience in using virtual learning environments for the professional development of future computer science teachers;
- creating consulting platforms for future computer science teachers on the use of virtual learning environments for professional self-development.

The following measures can be proposed to improve the use of virtual educational environments for the development of future computer science teachers' professional competence in lifelong learning:

1. Involvement of students in choosing different virtual educational environments to improve their professional competence.
2. Use of various virtual educational environment tools in the professional training of future computer science teachers.
3. Involvement of students in creating virtual didactic content for educational environments.
4. Avoidance of monotony in a virtual educational environment when conducting classes and monitoring learning achievements.
5. Motivation of academic staff to improve the methodology of organising students' work in the virtual educational environment.

## DISCUSSION

Scientists (Henseruk, 2019; Kanibolotska, 2020) have identified the importance of using virtual educational environments in the professional competence development of future computer science teachers in lifelong learning. Researchers also emphasise the need to use virtual instruments in the training of students and the readiness of teachers and students to work in the new virtual format of an interactive learning environment to be on par with their peers worldwide. Empirical research proves the convenience and speed of using educational content in the virtual space and the role of virtual tools in developing digital skills (Molotsi, 2020). Researchers note the impact of

virtual learning environments on learners' career development (Caena, & Redecker, 2019). A survey of teachers in Swedish educational institutions stated the systematic need for teachers and students to improve digital skills in the context of education virtualisation and the need for adequate scientific and methodological support for creating digital teaching and learning environments (Amhag et al., 2019). While noting the predominantly positive impact of virtual learning environments on the educational process, scholars identify problems that can hinder CPD because, without a vibrant online learning community, any constructive CPD requests cannot be met (Toole, 2019). However, it is necessary to avoid excessive use of virtual tools, so it is inappropriate to rely exclusively on digital, virtual instruments in the educational process (Pererva et al., 2020). The students' intention to participate in developing and improving existing virtual learning environments used by HEIs has been empirically proven (Bogusevski et al., 2020). At the same time, some studies have revealed students' dissatisfaction with the methodology of using virtual learning environments, which raises the need to pay special attention to training teachers to use virtual educational platforms, as students believe that teachers lack knowledge of using graphic editors, video editors, computer graphics editors, and the perfect use of planning, monitoring and control procedures. Research by the University of Granada proved the need for additional and thorough study of the opinions of students and teachers on the use of virtual learning environments (Pererva et al., 2020), which was implemented in our research.

However, most studies focus on the advantages and disadvantages of using virtual learning environments in developing future teachers' professional competence in lifelong learning.

Our research is distinguished by a comprehensive approach to studying students' opinions and the parameters for assessing the impact of virtual learning environments on future teachers' professional competence, which we offered to students (cognitive, motivational, activity-based, and value-based blocks of the survey) and teachers (formation of professional competence, digital literacy, readiness to use virtual learning environments for self-development, understanding of the need for continuous professional development, positive attitude to raising professional level through virtual learning environments).

Our research is essential due to studying the influence of virtual learning environments on future teachers' professional competence in lifelong learning.

The research gives grounds for developing future teachers' professional competence in the virtual learning space in lifelong learning.

## CONCLUSIONS

The introduction of virtual learning environments into the professional training of future computer science teachers has necessitated the study of the impact of this environment on the professional competence of future teachers in lifelong learning. Virtual learning environments have been proven to affect future teachers' professional competence. After all, they motivate students to use virtual learning environments for professional self-development. Working in virtual learning environments allows students to gain positive experience and form a positive attitude towards using learning environments for professional development. Virtual learning environments also positively impact the formation of professional competence, digital literacy, readiness to use virtual learning environments for self-development, understanding of the need for continuous professional development, and a positive attitude towards professional development through virtual learning environments.

The research results confirm the hypothesis that virtual learning environments contribute to the growth of future teachers' professional competence and motivate them to improve continuously.

Further scientific research may focus on various models for developing future teachers' professional competence in virtual and lifelong learning. Of particular empirical interest may be determining the parameters of a productive, rationally organised virtual learning environment as an essential component of future teachers' professional development.

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APPENDIX A

Table 4. A questionnaire to determine the impact of virtual learning environments on the future teachers' professional competence in lifelong learning

№	Blocks/questions	Answers / Points		
		1	2	3
Cognitive block				
1	Do you have enough knowledge, skills and abilities to use virtual platforms?	Yes	Partially, I systematically improve them	No, I am constantly engaged in self-education
2	Have you ever had to learn to work in a virtual space on your own?	No	Partially	Yes
3	Do you analyse the skills required to work with virtual learning platforms?	Yes, partially	Yes, systematically	Yes, I systematically examine and improve them based on the analysis
4	Are you comfortable studying in a virtual educational space?	No	Partially	Yes
Motivational block				
5	Are you looking for self-improvement to improve your performance on virtual platforms?	No, I am satisfied	Yes	Yes, I work in this direction
6	Do you have a constant need for professional development?	Yes, in some aspects	Yes, one needs to improve constantly	Yes, I strive for continuous self-improvement and implement my own self-development programme
7	In your opinion, does the effectiveness of your learning in the virtual space depend on motivation?	Partially	Yes	Yes, motivation is the basis of productive activity
8	Does your virtual learning affect your professional competence?	No	Partially	Yes
Activity block				
9	Do you have any positive experience of improving your knowledge, skills and abilities through virtual learning environments?	Partially	Yes	Yes, I have a lot of positive examples
10	Do you work systematically in a virtual environment to improve your knowledge, skills and abilities?	I work occasionally	I work systematically	I work systematically and have positive examples of work
11	Is your digital competence sufficient to work in a virtual learning environment?	No	Insufficient, it requires improvement	Insufficient, I work on improvement
12	Do you search for interesting virtual learning tools for professional development on your own?	No, I am satisfied with what the teachers offer us	Yes, sometimes I search for	Yes, I find and learn a lot of new things
Value block				
13	Do you self-analyse the effectiveness of your learning in the virtual educational space?	If necessary	Yes, occasionally	Yes, systematically
14	What is your attitude to learning in the virtual space	Negative	Rather positive	Positive
15	How do you assess the readiness of your teachers to work in a virtual learning environment?	Sufficient	Sufficient, but it could be improved	Insufficient, significant adjustments are required
16	What would you like to change in the virtual learning format?	Everything is fine	Methods of content presentation, control methods	Methods of content presentation, control methods, and monitoring are necessary to optimise feedback tools.

Notes: Levels: high – 14 – 16 points, sufficient – 11 – 13 points, average – 8 – 10 points, low – 7 points or less.