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ABSTRACT

The need for research into the effective application of blended learning technologies and evaluation of its effectiveness for universities, students, teachers and society is determined by little experience in the use of blended technologies. Consequently, the aim of this study is to determine the effectiveness of blended learning models for student learning in view of the specifics of academic subjects. The research involved the methods of survey, simulation, pedagogical experiment, mathematical statistics. The following models were involved in the studies of the first- and fourth-year students of the higher educational institutions (HEIs) of Ukraine during the semester: rotational, Enriched Virtual model, and a combination of rotational model to study professional subjects and Enriched Virtual model to study humanities.

Conclusions. The use of performance evaluation tools allows determining the state of readiness of the educational institution and students for involving blended technologies.

Prospects. The results of the study can be compared with the following studies of the effectiveness of other blended learning models for students of different majors, determining the effectiveness of blended learning in general. Other levels of effectiveness of blended learning — operational, strategic management — are unresolved issues.

Keywords: blended learning, technology, rotational model, Enriched Virtual model, higher education.

INTRODUCTION

The use of blended learning technologies is crucial for maintaining the quality of education through online learning and the need for teacher-student communication (Choi et al., 2021). Online learning has become widespread (Kumar et al., 2019), despite research on students' preference for traditional learning (Noor et al., 2020; Kumar et al., 2019). In turn, Semwal et al. (2019) examined that learning through digital technologies is as effective as traditional one. The results of Klimova (2020) prove the effectiveness of blended learning for learning English. The author argues that the success of learning depends on the variety of methods used to meet the needs of the selected sample of students (Klimova, 2020).

Blended learning technologies have a number of advantages over fully online learning for students who, as most studies have shown, give more preference to blended learning, but there are a number of unresolved issues. In particular, Cuesta Medina (2018) describes that most teachers act intuitively when using blended learning technologies, they adapt the content of traditional learning to blended learning. The development and implementation of blended learning technologies does not always correspond to what is considered or would be the best method for a certain sample of students. Visualization of content for quality perception by students, drawing up curricula with due regard to the time required to learn certain subjects, the ratio of online learning

and traditional meetings are necessary for the development and implementation of quality and effective blended learning (Cuesta Medina, 2018).

Blended learning has a proven potential to improve the effectiveness of meaningful student learning experiences, it is consistent with the values of traditional HEIs (Garrison & Kanuka, 2004). The authors proved that blended learning is more effective than traditional learning (Dziuban et al., 2018; Kyaw et al., 2019).

According to surveys, students consider online and hybrid (blended) learning as the foundation of pedagogy of the future (Kyaw et al., 2019).

Effective learning with the involvement of digital technologies requires appropriate teacher training, students' skills and access thereto, ongoing support and management of educational institutions to ensure effective learning (Ali, 2019; Rapanta et al., 2020).

It is not enough for quality learning using blended technologies to simply present old content in a new environment. It is necessary not only to transmit certain information, but to develop critical thinking skills and creative abilities. Blended learning promotes the development of these skills, creates opportunities for the development of a transformational learning environment (Garrison & Kanuka, 2004).

The paper (Garrison & Kanuka, 2004) outlines the requirements for the successful application of blended learning and improving the effectiveness of teaching and learning. Experts note the following criteria for the effectiveness of learning with the involvement of blended technologies – the dynamics of changes in knowledge and skills of students, the learning process, student satisfaction with the learning process (Garrison & Kanuka, 2004).

Blended learning models usually focus on the differences between superficial and physical characteristics, rather than on psychological or pedagogical characteristics (Hrastinski, 2019). The four main models of blended learning are:

— rotational model (online learning is one of the learning methods, students also learn through other methods — resident studies, laboratory-based work),

— flexible model — mostly study of the material online, face-to-face classes (FtoF) are held as needed,

— self-blend model — taking additional courses online as a supplement to traditional learning;

— Enriched Virtual model — students divide their time between HEI attendance and distance learning on the Internet (Hrastinski, 2019).

Many methods have been developed to assess the effectiveness of learning, but this does not contribute to a comprehensive idea about the effectiveness of learning. Dziuban et al. (2018) proposed to conduct a survey on attitudes toward learning and students' satisfaction with the learning process using data protocols to evaluate the effectiveness of blended learning.

Other researchers recommend evaluating the effectiveness of the learning process through self-assessment of educational resources of the educational institution (Lim & Wang, 2016).

The structure of self-assessment of the effectiveness of the educational institution in terms of teaching with the involvement of blended technologies consists of eight strategic dimensions:

— vision and policy alignment;

— curriculum;

— professional development;

— student learning support;

— infrastructure, facilities, hardware and resources;

— policy and institutional structure;

— partnership;

— research and evaluation.

Educational institutions can develop and implement internal and external learning processes that optimize educational potential taking into account the above aspects. Cuesta Medina (2018) notes that one of the factors in the effectiveness of learning in a blended system is teaching students and teachers effective approaches to self-study of the educational material. In turn, Pardo et al. (2017), Banoor and Issack (2020) proved the positive impact of teacher-student feedback on students' academic performance and their satisfaction with learning processes. Research by Hamdan et al. (2021) also shows that self-regulation of learning, self-efficacy on the Internet, student-content/student-student interaction, and the number of theoretical e-learning courses are significant predictors of student satisfaction with online education.

Student evaluation has always been one of the criteria for effective learning. Evaluation is a challenge both in learning online and in a blended system. In a study by Rapanta et al. (2020), experts point out that a continuous evaluation model should be introduced that is consistent with the cognitive expectation of self-regulation, which is very important for online learning. Self-regulation in the context of learning is the students' efforts to manage learning processes that are systematically focused on achieving goals (Cho & Shen, 2013 in Rapanta et al., 2020).

Another predictor of the effectiveness of blended learning is the use of different approaches in the study of different subjects (Vo et al., 2017). There is no research on the effectiveness of blended learning models for

teaching students of certain majors, studying certain subjects in different blended learning models (subjects of the humanities — the Enriched Virtual model, professional subjects — rotational model, choosing varieties of this model).
In this regard, the aim of this study is to investigate the effectiveness of the use of blended learning models in the educational process of first- and fourth-year students majoring in Economics.

Research objectives*:*
1. Study the features of the blended learning system, blended learning models;
2. Develop curricula using rotational models, Enriched Virtual model, and a combination of rotational and Enriched Virtual models of blended learning to study particular subjects for first- and fourth-year students;
3. Analyse the effectiveness of the developed curricula with the use of different blended learning models for first- and fourth-year students, their impact on students' academic performance.

LITERATURE REVIEW
Research on the effectiveness of certain online learning tools can be divided into those that have dealt with the effectiveness of certain digital applications and tools, as well as those that have studied certain learning methods being effective in traditional learning in the digital environment. Evaluating the effectiveness of higher education is quite a difficult task in view of the lack of clear criteria for evaluating such effectiveness (Curaj et al., 2018).
The authors identified two groups of approaches to determining the effectiveness of HEIs. The first — resource-oriented — approach is focused on productivity in achieving the goal of the activity by minimizing the use of resources. The second — value-based — approach focuses on the results achieved for end users, including students, employers, society as a whole in terms of the value of a product or service (Curaj et al., 2018).
Lai & Bower (2019) conducted the first study, which describes in detail the assessment of the use of technology in education, as well as learning levels.
Barabash et al. (2021) also present a methodology for evaluating the effectiveness of distance learning system, which is built to ensure the reliability of the results and the objectivity of comparing options for its construction to select the appropriate learning option, which is effective in a particular case.
The choice of efficiency measures is greatly influenced by the combination of tasks of the university. The wrong balance can have negative consequences for institutions. According to experts, the characteristics of students (self-discipline and self-regulation, motivation), and design features of blended learning in selected HEIs are predictors of the effectiveness of learning with the involvement of blended technologies.
Specialists also suggested the criteria for measuring the efficiency, classified in the approach to the USTREAM project:
— operational efficiency (efficiency of professional, operational and support services, optimization of business processes and optimization of resource use);
— effectiveness in academic matters (effectiveness in research, teaching and learning);
— effectiveness of strategic management — a range of measures to shape the effectiveness and context of the value model to support performance and development management, capital management, etc.
Zabolotniaia et al. (2020) investigated the effectiveness of the Moodle learning management system for the implementation of innovation policy in HEIs.
Petrenko et al. (2020), Cojocariu et al. (2014) conducted a SWOT analysis of education using blended and distance learning technologies and showed the strengths, weaknesses, opportunities and threats. This allows optimizing the learning process, reinforce strengths, eliminate shortcomings and weaknesses to the maximum possible extent, improve the efficiency and quality of education.
Tudor Car et al. (2019) showed the effectiveness of problem-oriented learning in the digital environment similar to that of traditional classes. Dahdal (2020) writes about the effectiveness of WhatsApp to improve the quality of the educational process and communication between students.
Successful blended learning requires a high level of motivation and self-discipline.
Curaj et al. (2018) determined three levels of the efficiency of HEIs: systemic (national or regional), sectoral (joint activities in cooperation with other stakeholders), institutional (covers various levels of HEIs related to the development and implementation of institutional efficiency programmes).
Studies by Kintu et al. (2017) show that design features (quality of online tools and resources, quality of technologies used in the learning process) and characteristics of students, attitudes towards blended learning, self-regulation were significant indicators of student satisfaction with blended learning.
The students' self-study ability and a high level of interaction with the use of quality technology contribute to the creation of their own ideas in blended learning. But none of the studied characteristics presaged learning outcomes (Kintu et al., 2017).

Studies show a mixed number of factors for predicting the effectiveness of e-learning systems. DeLone & McLean information system success model is the most common among the studies on satisfaction with distance learning, while quantitative approach is the most common research method (Yunusa & Umar, 2020).
The questionnaire developed by Zimmerman and Kulikowich (2016) is an informative tool for evaluating the effectiveness of online learning. This questionnaire includes questions about online learning, student's time management, and the use of technology.
Research that evaluates ways to assess the effectiveness of learning with the involvement of distance and blended technologies does not include a survey on students' adaptation to learning. In turn, adaptation to the conditions of a particular HEI contributes to self-efficacy, academic achievement. The structure of the SACQ questionnaire has approximate approaches to student integration, which counteracts such negative factors as dropout, low levels of academic knowledge and learning effectiveness (Gravini Donado et al., 2021).
Summing up the findings of specialists on the effectiveness of technology, efficiency criteria were chosen at the university level, which allow to verify the impact of blended learning on the students' knowledge.

METHODOLOGY

Methods

A survey of teachers and students of pedagogical and economic majors was conducted to determine the effectiveness of blended learning in HEIs.
Survey of teachers: 1) on the use of blended learning models for the study of different subjects, opportunities for teaching through blended technology (Appendix 1, 2), experiment participation consent; 2) difficulties of teaching through the use of certain models, quality of learning and completion of assignments by students (Appendix 5);
Survey of students on their satisfaction with the learning process with the involvement of different blended learning models (Appendix 3), adaptation to learning (Appendix 4).
Simulation of the educational process with the involvement of blended learning models for different subjects.
Mathematical statistics of the results obtained in MS Excel.

Sampling

The study involved 32 teachers (PhD and higher degrees, 19 women, 13 men, average age — 42 years); first- and fourth-year students of the Educational and Research Institute of Trade, Service Technologies and Tourism of Luhansk Taras Shevchenko National University; Kyiv National University of Trade and Economics; Sumy State University, South Ukrainian National Pedagogical University named after K.D. Ushynsky.
The study involved a total of 138 students of pedagogical and economic majors of the first year of study (65 men, 73 women, average age — 19 years); and 122 students of pedagogical and economic majors of the fourth year of study (53 men, 69 women, average age — 23 years). The experiment was conducted on a voluntary basis upon oral consent, in compliance with ethical and privacy standards. Students agreed to publish the results of the study.

Tools

Online questionnaires developed in Google Forms were used to evaluate the effectiveness of blended learning.
The survey of students was conducted on the basis of:

1) Online Learning Self-Efficacy Scales developed by Zimmerman and Kulikowich (2016). The original questionnaire offered 22 questions, each question was graded on a six-point scale, where 1 point means that students complete the assignments poorly, 6 points — complete the assignments at the expert level (Appendix 2).
2) Learning Adaptation Survey (using the SACQ questionnaire, presented in Appendix 3).
   The questionnaires were translated into Ukrainian, the evaluation criteria are presented in the Appendices.
   The teachers were surveyed through:

1. The tool for self-assessment of the educational institution proposed by Lim and Wang (2016), which includes eight strategic dimensions of the structure in the field of blended learning;
2. The questionnaire developed by the authors of this article to study the teachers' opinions on the effectiveness of blended learning models for a) subjects of different types; b) students with different wishes about the learning process.

Particular blended learning models in need of in-depth study were selected through a survey of teachers for the selected subjects. Questions to teachers are presented in the results of this study.
The Moodle learning management system was involved in the learning process. Introductory face-to-face classes were held at the beginning of the academic year to introduce teachers and students, the teaching and assessment system, conversations to increase motivation for self-study of students and discussion of personal issues of students in the blended learning process.
The experiment was conducted in three stages:

Stage 1 — introductory lectures, introduction into the blended learning system, acquaintance with students, surveys of teachers on the reasonability of studying subjects through particular models;
Stage 2 — conducting a semester through a blended learning system, the use of certain blended learning models for certain subjects;
Stage 3 — survey of students on the effectiveness of the proposed blended learning system, survey of teachers on the features of learning using different models for certain subjects, drawing conclusions and providing practical recommendations.
The first face-to-face lectures were held in addition to introductory lectures. Further learning in educational institutions was based on models presented in Table 1.

Table 1: Blended learning models used in the experiment, participating educational institutions and distribution of students

Blended learning model	Rotational (change of learning stations)	Enriched Virtual model	Rotational + Enriched Virtual
Features of the model-based learning in the experiment	all subjects from the curriculum were studied with the change of environment, mainly full-time, online learning was used as one of the types of work — lectures, online project implementation, surveys, etc.	all subjects of the curriculum were studied mainly online, face-to-face classes were held once a week (mostly seminars or laboratory-based classes)	the humanities were studied through the Enriched Virtual model, professional subjects of the cycle were taught through the rotational model
Higher educational institutions	Educational and Research Institute of Trade, Service Technologies and Tourism of Luhansk Taras Shevchenko National University	Kyiv National University of Trade and Economics	Sumy State University, South Ukrainian National Pedagogical University named after K.D. Ushynsky
Number of teachers and students	1st year - 46 students 4th year - 39 students 10 teachers	1st year - 46 students 4th year - 42 students 11 teachers	1st year - 46 students 4th year - 41 students 11 teachers

Criteria for the effectiveness of blended learning technologies in this study:
1. The results of a survey of first- and fourth-year students on understanding and satisfaction with the learning process, the blended learning technology;
2. Learning Adaptation Indicators using blended learning technologies (through the SACQ questionnaire);
3. Students' academic performance indicators;
4. Indicators of the survey of teachers on the self-efficacy of the educational institution in blended learning, the results of the survey on the quality of student learning.

RESULTS

The results of the summative experiment show that the readiness of students from different groups and educational institutions to study with the use of blended technology is almost the same (Figure 1). Students do not rate their readiness to study in a blended format too high, especially in relation to self-control, timeliness of assignment completion without unnecessary reminders.

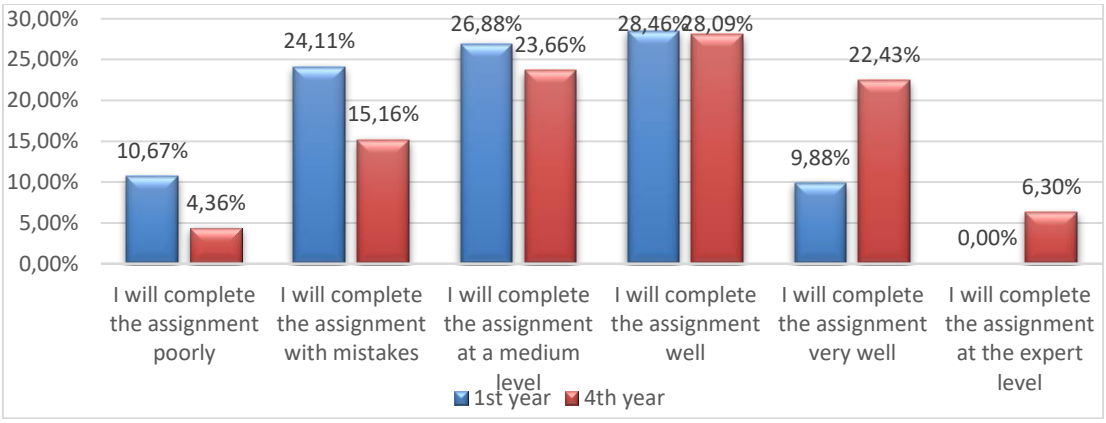

Fig.1: Survey results on students' self-efficacy for learning with the involvement of blended learning technology

Fourth-year students are more confident in their ability to learn through blended technology, but the problem of self-organization and timely completion of assignments is the same as for the first-year students, differences according to Student's t test are insignificant ($p > 0.05$).

Survey of teachers on self-assessment of readiness for the learning process using blended technologies shows that most of the strategic dimensions are in the "under consideration" and "starting/application" stages (Figure 2).

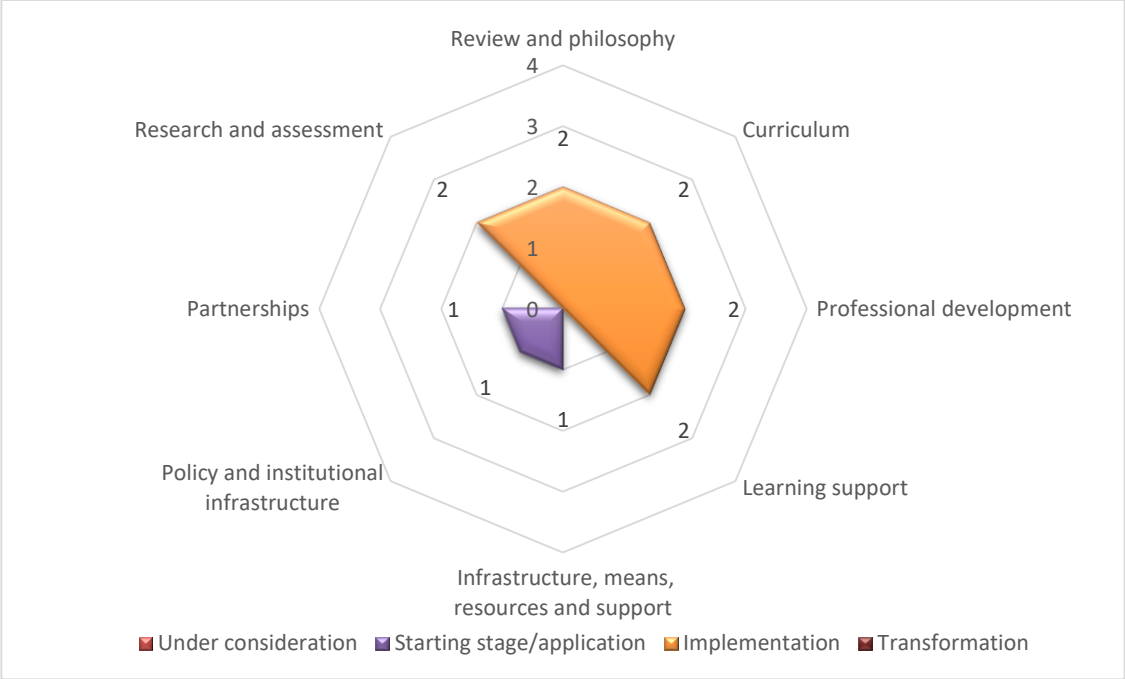

Fig. 2: The results of self-assessment of the effectiveness of educational institutions in teaching through blended technologies (assessment was conducted according to the criteria proposed by Lim & Wang, (2016))

Another survey of teachers shows their agreement that teaching different subjects requires different models of blended learning (Table 2).

Table 2: The results of a survey of teachers on the features of learning through blended technologies

Questions to the teachers	Answer option and distribution of answers		
	reasonable	unreasonable	Difficult to answer

In your opinion, is it reasonable to study the professional subjects using a rotational model of blended learning, and the humanities - using the Enriched Virtual model?	69.05%	28.57%	2.38%
What factors of choice of the blended learning model are the most influential?	opportunities of the educational institution to organize the educational process of students	teachers' opportunities to conduct the educational process according to certain models	Students' wishes
	52.38%	47.62%	59.52%

The evaluation of the effectiveness of blended technologies for teaching in HEIs revealed some unwillingness of students and unpreparedness of the educational institutions for the use of blended technologies. This is due to the insufficient level of development of blended learning technologies in Ukraine, short experience of teaching and learning with the use of blended technologies.
In this regard, a pedagogical experiment was conducted as described above (Section 2), and the effectiveness of the learning process using certain blended learning models was tested.
The academic performance of students who participated in the experiment was monitored after the experiment, which showed the following results (Figures 3, 4).

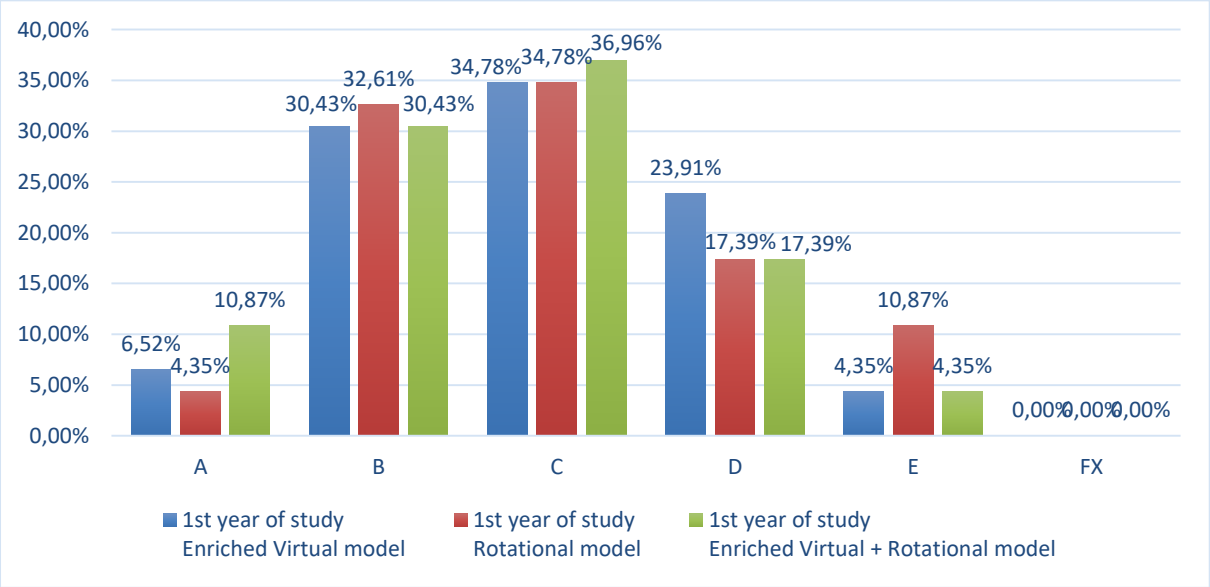

Fig. 3: Indicators of academic performance of first-year students after one semester of study according to a certain blended learning model

Indicators of academic performance of first-year students differ significantly between the group that studied through the Enriched Virtual model of blended learning and a combination of rotational and Enriched Virtual model ($p>0.05$).

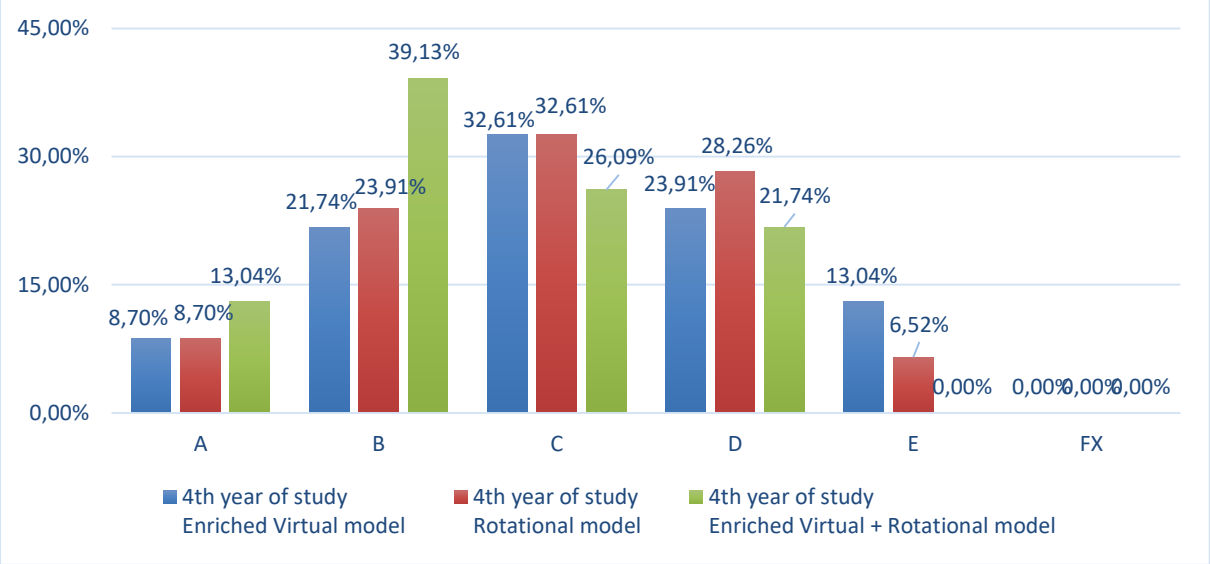

Fig. 4: Indicators of academic performance of fourth-year students after one semester of study according to a certain blended learning model

The group in which the combination of Enriched Virtual and rotational model of blended learning was used had significantly higher academic performance than the other two groups ($p>0.05$). It is positive to note that none of the students received an unsatisfactory grade and did not need to retake the credits in the subjects being studied. The results of the survey of teachers after the experiment are provided in Table 3.

Table 3: Survey of teachers after the experiment

Questions to teachers	Answer options and distribution of answers		
	more difficult than in traditional teaching	same as in traditional teaching	easier than in traditional teaching
The educational process was carried out according to the Enriched Virtual model	50.00%	7.14%	42.86%
The educational process was carried out according to the rotation model	54.76%	2.38%	42.86%
Students studied the educational material during the experiment	good	satisfactory	poor
	50.00%	26.19%	23.81%
Students completed the assignments	33.33%	38.10%	28.57%
Timely completion of students' assignments	28.57%	45.24%	26.19%

Teachers noted that it was more difficult for them to conduct classes using blended learning technologies. This can be explained by the lack of experience of teachers and educational institutions where the experiment with the involvement of blended learning technologies was conducted. The results of the SACQ survey of students on adaptation to study at the HEI showed that the students who studied with a involvement of the rotational combined with the Enriched Virtual models were significantly more likely to have high and above medium levels of adaptation than students who studied through the Enriched Virtual or rotational model (Figures 5, 6).

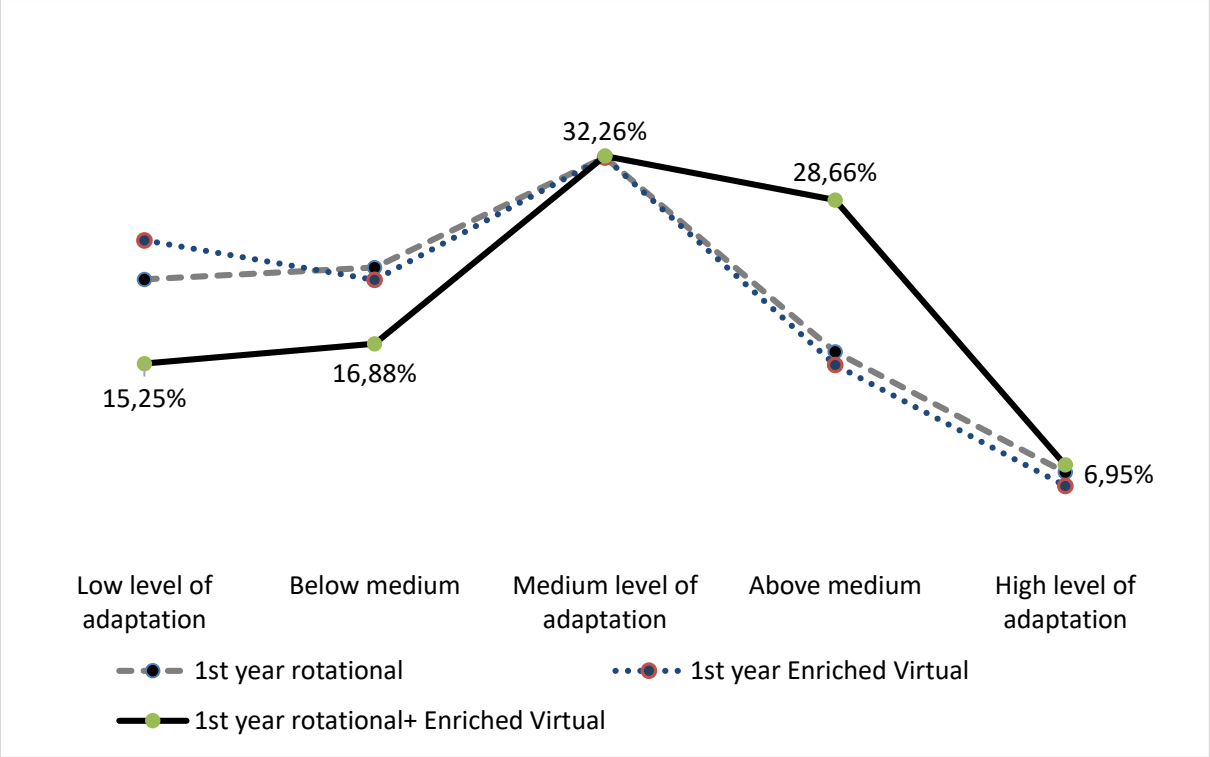

Fig. 5: Indicators of adaptation of first-year students to study using blended learning technologies

There is no significant difference between the indicators of adaptation of groups of fourth-year students who studied with the involvement of Enriched Virtual and the combination of Enriched Virtual and rotational models($p<0.05$) (Figure 6). Fourth-year students who studied using a rotational model had significantly higher rates of adaptation (Figure 6) ($p>0.05$).

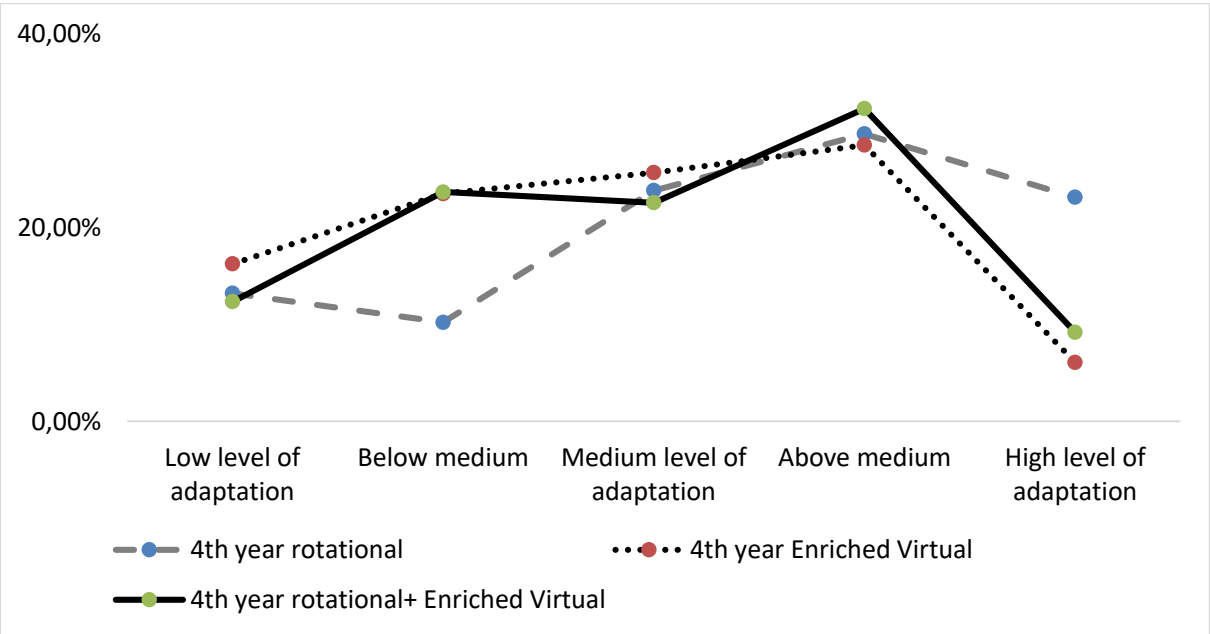

Fig. 6: Indicators of adaptation of fourth-year students to study using blended learning technologies

The indicators of adaptation of first- and fourth-year students who studied according to different blended learning models differ significantly ($p>0.05$).

There is a correlation between the indicators of adaptability to studies at a HEI and the indicators of academic performance of students of different years of study and groups, except for the indicators of 4th year students who studied with the use of a rotational model of blended learning (Table 4).

Table 4: Correlation between adaptation and academic performance

Blended learning model and the year of study	Correlation coefficient between the adaptation and academic performance
1st year rotational	0.63*
1st year Enriched Virtual	0.60*
1st year rotational + Enriched Virtual	0.72*
4th year rotational	0.33
4th year Enriched Virtual	0.74*
4th year rotational + Enriched Virtual	0.69*

Note: * - reliable correlation

Academic knowledge

The students who studied with a combination of rotation model and Enriched Virtual model had the highest level of academic knowledge (Table 5).

Table 5: Academic knowledge of students after the semester of study with the use of blended technology

Year of study, blended learning model	Students' grades on ECTS					
	A	B	C	D	E	FX
1st year Enriched Virtual	6.52%	30.43%	34.78%	23.91%	4.35%	0.00%
1st year rotational	4.35%	32.61%	34.78%	17.39%	10.87%	0.00%
1st year rotational + Enriched Virtual	10.87%	30.43%	36.96%	17.39%	4.35%	0.00%
4th year Enriched Virtual	8.70%	21.74%	32.61%	23.91%	13.04%	0.00%
4th year rotational	8.70%	23.91%	32.61%	28.26%	6.52%	0.00%
4th year rotational + Enriched Virtual	13.04%	39.13%	26.09%	21.74%	0.00%	0.00%

In view of the survey results, practical recommendations for the use of blended learning models in the educational process of students were developed with due regard to the peculiarities of studying different subjects.

DISCUSSION

According to Dziuban et al. (2018), Kyaw et al. (2019); Rapanta et al. (2020), teaching students with the involvement of blended technology is effective, but there are a number of unresolved issues. As Ali (2019) emphasized, the criteria for evaluating the effectiveness of learning using digital technologies need to be constantly improved, which is partially achieved in this study.

Dziuban et al. (2018), Hamdan et al. (2021) believe that the effectiveness of blended learning depends largely on the perception of the environment, but at the same time the choice of blended learning model has a great influence. Such factors as the ability of the educational institution to organize the educational process, the teachers' capabilities should be taken into account when choosing models of education. These results are consistent with the findings of Vo et al. (2017), who studied the application of blended learning technologies for STEM and non-STEM subjects.

As Banoor and Issack (2020) write, the use of certain blended learning models for certain subjects is effective, but requires highly qualified teachers to involve such models in the education, combination of full-time and online learning, and attention to each student. Therefore, teachers need more time for the organizational of the learning process than in traditional education. This justifies, however, learning outcomes and contributes to a high level of students' academic knowledge, as Lim and Wang (2016) stated. Cho and Shen (2013), Hamdan et al. (2021) state that the greatest difficulties for students arise in self-regulation and time management.

According to Gravini Donado et al. (2021), students' adaptation has a positive correlation with their academic knowledge. Kintu et al. (2017) note that the choice of blended learning model has a significant impact in addition to the peculiarities of students, which are predictors of learning effectiveness. Despite the possible students' unwillingness to study through blended technology, the use of certain methodologies can achieve a positive academic effect.

CONCLUSION

Blended learning technologies are actively spreading, and imposed quarantine restrictions forced Ukraine, among other countries, to develop them. However, it is necessary to control the quality of knowledge obtained in the process of blended learning, which leads to the search for effective models for studying different types of subjects, conducting research on the effect of blended learning on students' academic knowledge, studying students' perception of blended learning. The study revealed the effectiveness of certain blended learning models (rotational, Enriched Virtual model, and their combination) for studying particular subjects. Students who studied with the use of the Enriched Virtual model had significantly lower indicators. According to the teachers who took part in the study, the subjects that need more detailed study should be studied through the rotational model of blended learning, while the humanities should be studied through the Enriched Virtual model.

The obtained results of adaptation of first- and fourth-year students to studying in HEIs and their academic performance indicators show that the combination of rotational and Enriched Virtual model is the most effective for adaptation of students to studying in HEIs and their academic performance.

The survey results allowed stating that students who study with the use of blended learning technologies have difficulties mainly with self-organization. The level of technology skills was medium, learning online was also perceived by students quite positively.

The level of satisfaction of first- and fourth-year students with the blended learning process using different models for the study of particular subjects was high.

Survey of teachers on conscientious completion of assignments, teaching students using different blended learning models shows that students generally studied the educational material well (50% of teachers), and the majority (38.10%) completed assignments satisfactorily.

The results of students' academic performance show that students who studied with the use of two blended learning models depending on the subject have the highest grades — "A" (10.87% of first-year students and 13.04% of fourth-year students). At the same time, first-year students who studied according to the rotation model, and fourth-year students who studied according to the Enriched virtual model had the largest number of "E" grades.

In general, fourth-year students are better prepared to study with the use of blended technology, as shown by the results of the experimental survey (confidence that they would perform assignments very well — 9.88% of first-year students, 22.43% of fourth-year students, confidence that they would assignments at expert level — 6.30% of fourth-year students), and indicators of adaptation to the educational process (only 6.95-5.24% of first-year students have a high level of adaptation, while this figure is 23.11% - 6.10% for fourth-year students). This is due to the adaptation of senior students to the conditions of study in higher educational institutions.

The obtained results for the effectiveness of blended learning models can be used for planning and organizing the educational process in higher educational institutions for the study of different subjects for different majors. The combination of surveys on the selected questionnaires, the study of the self-efficacy of the educational institution allows a diverse assessment of the quality of blended learning in a particular higher educational institution.

Future research is aimed at studying the effectiveness of other blended learning models (a la carte, flexible model).

LIMITATIONS

The limitations of this study include the selected groups of students (pedagogical and economic majors), their initial skills and abilities to learn through the use of blended technology. Students who participated in the study had experience of distance learning due to imposed quarantine restrictions, and this experience may not have been very positive because of not being prepared for such learning conditions.

We assume that students without any distance learning experience or with experience of well-organized distance or blended learning may have other blended learning self-efficacy indicators. The study also considered two (out of four) blended learning models.

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Appendix A

Questionnaire 1:Survey of teachers on the peculiarities of blended learning technologies

Questions to teachers	Answer options and distribution of answers		
	appropriate	inappropriate	Difficult to answer
In your opinion, is it appropriate to study professional subjects using a rotational model of blended learning, and the humanities — using the Enriched Virtual model?	69.05%	28.57%	2.38%
What factors in choosing a blended learning model are most influential?	capabilities of the educational institution to organize the educational process of students	capabilities of teachers to deliver the learning process according to certain models	students' wishes
	52.38%	47.62%	59.52%

Appendix B

Survey of teachers on the self-efficacy of the educational institution proposed by Lim & Wang (2016).

Assess the strategic dimensions of an educational institution's readiness for education using blended technology

Development and implementation level	1 Under consideration	2 Starting stage/application	3 Implementation	4 Transformation
Vision and policy alignment				
Curriculum				
Professional development				
Student learning support				
Infrastructure, facilities, hardware and resources				
Policy and institutional structure				
Partnership				
Research and evaluation				

Appendix C

Survey of students on Online Learning Self-Efficacy Scale developed by Zimmerman & Kulikowich (2016).

1 - complete the assignments poorly;
5 - complete the assignments at the expert level.

Questions	**1**	**2**	**3**	**4**	**5**
Navigate online course materials efficiently					
I can find the course program online					
Communicate effectively with my instructor via e-mail					
Communicate effectively with technical support via e-mail, telephone, or live online chat					
Submit assignments to an online dropbox					
Overcome technical difficulties on my own					
Navigate the online grade book					
Manage time effectively					
Complete all assignments on time					
Learn to use a new type of technology efficiently					
Learn without being in the same room as the instructor					
Learn without being in the same room as other students					
Search the Internet to find the answer to a course-related question					
Search the online course materials					
Communicate using asynchronous technologies (discussion boards, e-mail, etc.)					
Meet deadlines with very few reminders					
Complete a group project entirely online					
Use synchronous technology to communicate with others (such as Skype)					
Focus on schoolwork when faced with distractions					
Develop and follow a plan for completing all required work on time					
Use the library's online resources efficiently					
When a problem arises, promptly ask questions in the appropriate forum (e-mail, discussion board, etc.)					

Appendix D

Student Adaptation to college questionnaire (SACQ) *

67 statements in this form describe the experience of studying in college. Read each one and decide how well they apply to you now (over the last few days). For each statement, select the asterisk at the point on the continuum that best shows how close that statement applies to you. Select one asterisk for each question.

Note:* Questions related to lonesomeness for home were omitted, marked in italics.

Questions	1 Does apply to me at all	2	3	4	5	6	7	8	9 Applies to me very closely
1. I feel that I fit in well as part of the college environment.									
2. I have been feeling tense or nervous lately.									
3. I have been keeping up to date on my academic work.									
4. I am meeting as many people, and making as many friends as I would like at college.									
5. I know why I'm in college and what I want out of it.									
6. I am finding academic work at college difficult.									
7. Lately, I have been feeling blue and moody a lot.									
8. I am very involved with social activities in college.									
9. I am adjusting well to college.									
10.I have not been functioning well during examinations.									
11.I have felt tired much of the time lately.									
12.Being on my own, taking responsibility for myself, has not been easy.									
13.I am satisfied with the level at which I am performing academically.									
14.I have had informal, personal contacts with college professors.									
15.I am pleased now about my decision to go to college.									
16.I am pleased now about my decision to attend this college in particular.									
17.I'm not working as hard as I should at my course work.									
18.I have several close social ties at college.									
19.My academic goals and purposes are well defined.									
20.I haven't been able to control my emotions very well lately.									
21.I'm not really smart enough for academic work I am expected to be doing now.									
**22.Lonesomeness for home is a source is of difficulty for me now. (This item is omitted due to the peculiarities of blended learning)*									
23.Getting a college degree is very important for me.									
24.My appetite has been good lately.									
25.I haven't been very efficient in the use of study time lately.									
**26.* 26.I enjoy living in a college dormitory. *(Please omit if you do not live in a dormitory; any university housing should be regarded as a dormitory.)*									
27.I enjoy writing papers for courses.									
28.I have been having a lot of headaches lately.									
29.I really haven't had much motivation for studying lately.									
30.I am satisfied with the extracurricular activities available at college.									
31.I've given a lot of thought lately to whether I should ask									

for help form the Psychological/Counseling Services Center or from a psychotherapist outside of college.									
32.Lately, I have been having doubts regarding the value of a college education.									
** 33. I am getting along very well with my roommates(s) at college. (Please omit if you do not have a roommate.)*									
34.I wish I were at another college or university.									
35.I've put on (or lost) too much weight recently.									
36.I am satisfied with the number and variety of courses available at college.									
37.I feel that I have enough social skills to get along well in the college setting.									
38.I have been getting angry too easily lately.									
39.Recently I have had trouble concentrating when I try to study.									
40.I haven't been sleeping very well.									
41.I'm not doing well enough academically for the amount of work I put in.									
42.I am having difficulty feeling at ease with other people at college.									
43.I am satisfied with the quality or the caliber of courses available at college.									
44.I am attending classes regularly.									
45.Sometimes my thinking gets muddled up too easily.									
46.I am satisfied with the extent to which I am participating in social activities at college.									
47.I expect to stay at this college for a bachelor's degree.									
48.I haven't been mixing too well with the opposite sex lately.									
49.I worry a lot about my college expenses.									
50.I am enjoying my academic work at college.									
51.I have been feeling lonely a lot at college lately.									
52.I am having a lot trouble getting started on homework assignments.									
53.I feel I have good control over my life situation at college.									
54.I am satisfied with my program of courses for this semester/quarter.									
55.I have been feeling in good health lately.									
56.I feel I am very different from other students at college in ways that I don't like.									
**57.On balance, I would rather be home than here. (This item is omitted due to the peculiarities of blended learning)*									
58.Most of the things I am interested in are not related to any of my course work at college.									
59.Lately I have been giving a lot of thought to transferring to another college.									
60.Lately I have been giving a lot thought to dropping out of college altogether and for good.									

61.I find myself giving considerable thought to taking time off from college and finishing later.									
62.I am very satisfied with the professors I have now in my courses.									
63.I have some good friends or acquaintances at college with whom I can talk about any problems I may have.									
64.I am experiencing a lot of difficulty coping with the stresses imposed upon me in college.									
65.I am quite satisfied with my social life at college.									
66.I'm quite satisfied with my academic situation at college									
67.I feel confident that I will be able to deal in a satisfactory manner with future challenges here at college.									

The SACQ questionnaire is a two-page 67-item assessment consisting of four subscales measuring academic adaptation (24 items), social adaptation (20 items), personality and emotional attitudes (15 items), and commitment to goals and institutional obligations. The survey can be conducted individually or in groups, and it takes about 20 minutes.
Grades in the original are set on a 9-point Likert scale in the range of "Does not apply to me at all" to "Applies to me very closely". In this study, questions related to the peculiarities of lonesomeness for home or living conditions were omitted due to the peculiarities of blended learning. The level of adaptability was determined by four subscales and in general. The sub-scales for the questions are the following:

Academic adaptation

1. Motivation – questions No. 5, 19, 23, 32, 50, 58
2. Application – questions No. 3,17, 29, 44
3. Performance – questions No. 6, 10, 13, 21, 21, 25, 27, 39, 41, 52
4. Academic environment – questions No. 36, 43, 54, 62, 66

Social adaptation

1. General – questions No. 1, 8, 9, 18, 37, 46, 65
2. Relationship with other people – questions No. 4, 14, 33, 42, 48, 56, 63
3. Lonesomeness – questions No. 22, 51, 57
4. Social environment – questions No. 16, 26, 30

Personality emotional structure

Psychological – questions No. 2, 7, 12, 20, 31, 38, 45, 49, 64
Physical well-being – questions No. 11, 24, 28, 35, 40, 55

Adaptation

General – questions No. 15, 60, 61
This educational institution – questions No. 16, 34, 47, 59

Calculation of points on sub-scales and total number

Academic adaptation	Social adaptation	Personality emotional structure	Adaptation	Total scale

The obtained results are processed in the context of the whole scale, the number of points for the question is calculated, not taking into account the questions related to lonesomeness for home.
Assessment of the level of adaptability was based on the points scored:
0 - 126 — low level of adaptation;
127-190 – below medium;
191-315 — medium;
316-441 — above medium;
442-567 — high level of adaptation.
Also available at: https://www.pdffiller.com/jsfiller-desk15/?projectId=902662220&loader=tips&replace_gtm=false#7e8232835b29419f85915b874a6eaa18

Appendix E

Survey of teachers on teaching through blended technology

Questions to teachers	Answer options and distribution of answers		
	more difficult than in traditional teaching	same as in traditional teaching	easier than in traditional teaching
The educational process was carried out according to the Enriched Virtual model			
The educational process was carried out according to the rotation model			
Students studied the educational material during the experiment	good	satisfactory	poor
Students completed the assignments			
Timely completion of students' assignments			