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Abstract. This article considers the issue of implementing a model of blended learning to prepare master students majoring in Mathematics (speciality code in Ukrainian educational system "014 Secondary Education. Mathematics"). The research analyses the existing developments of the issue about the use of blended learning while training would-be mathematics teachers. The researchers determined and explained the stages of work on developing the online course "Methods for Teaching Mathematics to Students at Technical Universities", that is used when students learn methodological subjects of the curriculum. The research describes the development of the theoretical online course model and methodological recommendations on the learning materials and preparing papers for the course. The article offers recommendations related to the course structure. The course developers defined the usability criteria of the educational platforms, determined the stages of course users' activity, their content, and organization. The research describes the areas of online course activity management, the course tutors' and moderators' teamwork is defined as the main condition of its development and support. In order to prove the efficiency of implementing blended learning of the methodological subjects, an experiment was carried out during the assistant practice in technical universities that master students of the specialization "Mathematics" had. The results allowed confirming the efficiency of students' practical training during blended learning of the methodological subjects that in its turn encouraged the improvement of the assistant practice results.

1. Introduction

The permanent and considerable growth of technological resources generated a new concept of education that uses the blended learning [1–5]. Blended learning is a combination of the personal and online learning experience. The advantage of this multi-methodological approach is that it allows achieving the goals connected with traditional education. Due to this fact the actuality of developing cognitive online environments that ensure a complex training of higher school teachers combining traditional and online education is growing.

In order to confirm the correctness of the chosen approach the analysis of the researches and publications made by [6, 7], dedicated to the development of educational environments, was

carried out. The conclusions of the analyzed works proved that the problems of training higher school teachers can be solved by implementing the models of blended learning aimed at the students who can be self-organized and are ready to develop their skills. It was also proven by the scientists [8–11] who explained the conclusions about the global nature of the problem to give practical training to would-be mathematics teachers.

In the mentioned scientific works it is explained that blended learning ensures continuous learning in constantly changing and mobile environments. Besides, according to the research assessment [12–14], the advantages of blended learning include maximum flexibility, efficient and fast delivery of knowledge, and different options of personalization. According to [15], blended learning helps to solve the issues of improving the motivation of students who are involved in online courses [16].

Together with studying the problems in online education, in a range of publications, scientists emphasize the efficiency of using blended learning during mathematics teachers' training. Describing the development of the courses that ensure blended learning [17–19], studied the role of a teacher on high-quality online courses and summarized the students' and teachers' experience of learning online. The same problems interested the researchers [20–22], who pointed out that considerable use of modern Internet technologies while training specialists in different areas requires from higher school mathematics teachers skills to adapt to new conditions, permanently support and renew their knowledge to correspond to the growing demand for online education.

In order to satisfy the growing interest in high-quality online education [23] discuss the development of online systems and describe how to implement the development of a course that ensures the quality and consistency of both things – the content and learning design in university. The scientists recommend the model that ensures the general foundation for all university online courses. In this model, the academic departments choose what courses they want to turn into online courses and give recommendations to the course developers. Also, the scientists suggest a detailed description of the course development process, from concluding a contract to the consultation with the developer who created the instructions and reconsideration of quality standards.

[24] reviewed the literature for studying the problems while carrying online courses and defined three main categories that are connected with online education, instructors, and content development. The scientists described how to solve these problems using the survey among online course participants. Teachers' questions included the change of teachers' role, transfer from personal communication to online, time management, and teaching styles. The content questions included the instructors' role during the content development, multimedia integration into the content, the role of learning strategies during the content development, and suggestions on the content development. Also, in the context of the research, an interesting idea was given by [25, 26], who described how students together with offline classes got consultative online learning support. The results of the experiment proved that students were more motivated in a blended learning environment. The students' satisfaction with blended learning is shown in the researches done by [27–29]. The transforming potential of blended learning in higher education is presented in the research done by [30]. The research by [18] also proved the students' tendency to study more online during blended learning.

Thus, the range of problems that were described in the scientists' researches [18, 27–30] and connected with the implementation of blended learning in universities and online course development encouraged the authors of this article to determine the stages of their work on the development of the online course "Methods for Teaching Mathematics to Students at Technical Universities" [31] to prepare mathematics teachers during blended learning. At the stage of planning aims, the authors of the course were focused on the points of the concept given on the platform "Higher School Mathematics Teacher", developed by authors of [32]. The course developers followed the concept that student's achievement of the goals regularly will motivate

them to strive for more. That's why while making the curriculum the attention was focused on the achievable goals that students choose independently. Students' ideas influenced the course structure.

The theoretical analysis of the researches and resources [33, 34], that describes the online course structure and component development, and also the ideas given by the scientists [35], focused on the development of programs for online courses, allowed the authors of the article to include the creation of the course model to the stages of work on its development. At this stage, the attention was concentrated on the research done by the scientists [36, 37], who indicated that educational institutions face problems during the model development process. The researchers recommended relying on the survey among the students who represent their expectations from the course for the efficient, high-quality development of the online course model.

The authors of the article also defined such a stage of work on the course development as the organization of their participants' activity and determination of its evaluation criteria. The researchers based their conclusions on the research done by [23, 24, 38] about taking into consideration the wishes of future potential course users.

The course design was determined as one of the stages of its development. While course tutors followed the position given by [39], that interface should be attractive and minimalistic in use [40] and thus, its main objective should be to allow the user to build their learning strategy. Also, during the design development, the principles of instructional design offered by [41], the principles of usability implementation given by [42] and suggestions on online course design and development mentioned by [43] should be taken into consideration.

The analysis of the researches done by the course developers [44, 45], as well as teaching mathematical subjects in technical universities proved the relevance of adding to the stages of online course development the creation of methodological recommendations for learning materials and the organization of course management.

The article aims to determine and explain the stages of the work on the course development for training would-be mathematics teachers during blended learning.

The achievement of the research aim was based on the description of:

(i) The course model creation
(ii) The development of methodological recommendations for learning materials and preparing papers for the course
(iii) The course design
(iv) The organization of course participants' activity and determination of evaluation criteria
(v) The course management
(vi) The experimental confirmation results of the efficiency when implementing blended learning for the subjects of the methodological cycle

2. Method
The authors of the research determined the stages of work on the course development for training mathematics teachers during blended learning: 1) building a course model; 2) development of methodological recommendations for learning materials and preparing papers for the course; 3) course design; 4) organization of the course participants' activity and determination of its evaluation criteria; 5) course management.

We offer to consider the methods that were used during every stage.

2.1. The development of the course model
The development of the theoretical model of the online course "Methods for Teaching Mathematics to Students at Technical Universities" [32] to prepare master students of the

specialization "014 Secondary Education. Mathematics" (hereinafter "Mathematics") was the first stage. While creating a model the researchers followed the next principles: system, humanity and professional orientation, flexibility, dynamics, and volatility. At this stage, the researchers created a survey using Google Forms [46] by posting it on the platform "Higher School Mathematics Teacher" in free access and offered it to master students. The survey questions were focused on finding out the future participants' expectations from the course. In particular, it was important for the course tutors to find out the nature of the problems that master students face during their assistant practice, master students' level of awareness about the methodological and technological peculiarities of active mathematics learning; understanding of cloud technologies and systems of computer mathematics while teaching mathematics in technical universities. The analysis of the master students' survey results helped to organize the feedback with the future course participants. Thus, the students were willing to get acquainted with the components of the professional training, get an experience of performing specific types of teacher's activity, and get acquainted with the parameters according to which the internal specialist's readiness for professional activity is evaluated.

Furthermore, the analysis of the respondents' answers allowed us to determine the structural components of the online course model: methodological environment; technologies of the learning environment; the component structure of professional training. In the methodological environment of the model, the course tutors offered the participants to learn the content, methods, forms, and means of learning mathematics in universities. The authors chose the systems of computer mathematics (SCM) [47], cloud technologies [48], and a project method [49] as the semantic filling of the component that ensures the technologies of the learning environment. Connection building between the methodological environment and technologies of the learning environment [50] is carried out using visual, instrumental, integral genesis.

Motivational and value-based, operational and activity-related, controlling, and corrective components during the professional training enable to structure and evaluate the parameters of the internal specialist's readiness for the professional activity. The visual illustration of the theoretical model of the online course "Methods for Teaching Mathematics to Students at Technical Universities" is shown in figure 1.

2.2. The development of the methodological recommendations for learning materials and preparing papers for the course

The second stage of work on creating a course was the development of the methodological recommendations for learning materials and preparing papers for the course. At this stage, the authors of the course used the method of analyzing research [33, 35] and resources [34] that provide recommendations on training, structuring, and development of the online course content. As a result of the analysis the course developers created the recommendations on the course structure, in particular:

1. The course materials should be provided as logical sections (learning "blocks") of the corresponding length for learning during 1–2 hours.
2. It is more appropriate to start every week and every new section with a material review, including structure, learning results, and approximate learning time review.
3. Every section, subsection, and the pages should have clear descriptive headings. It will help the student to plan on which sections they will work and allow them to review the topics that have already been learned.

The course developers suggested the recommendations on handing in the papers for the participants' processing on the course according to the information accessibility features and its quality as well as considering students' needs.
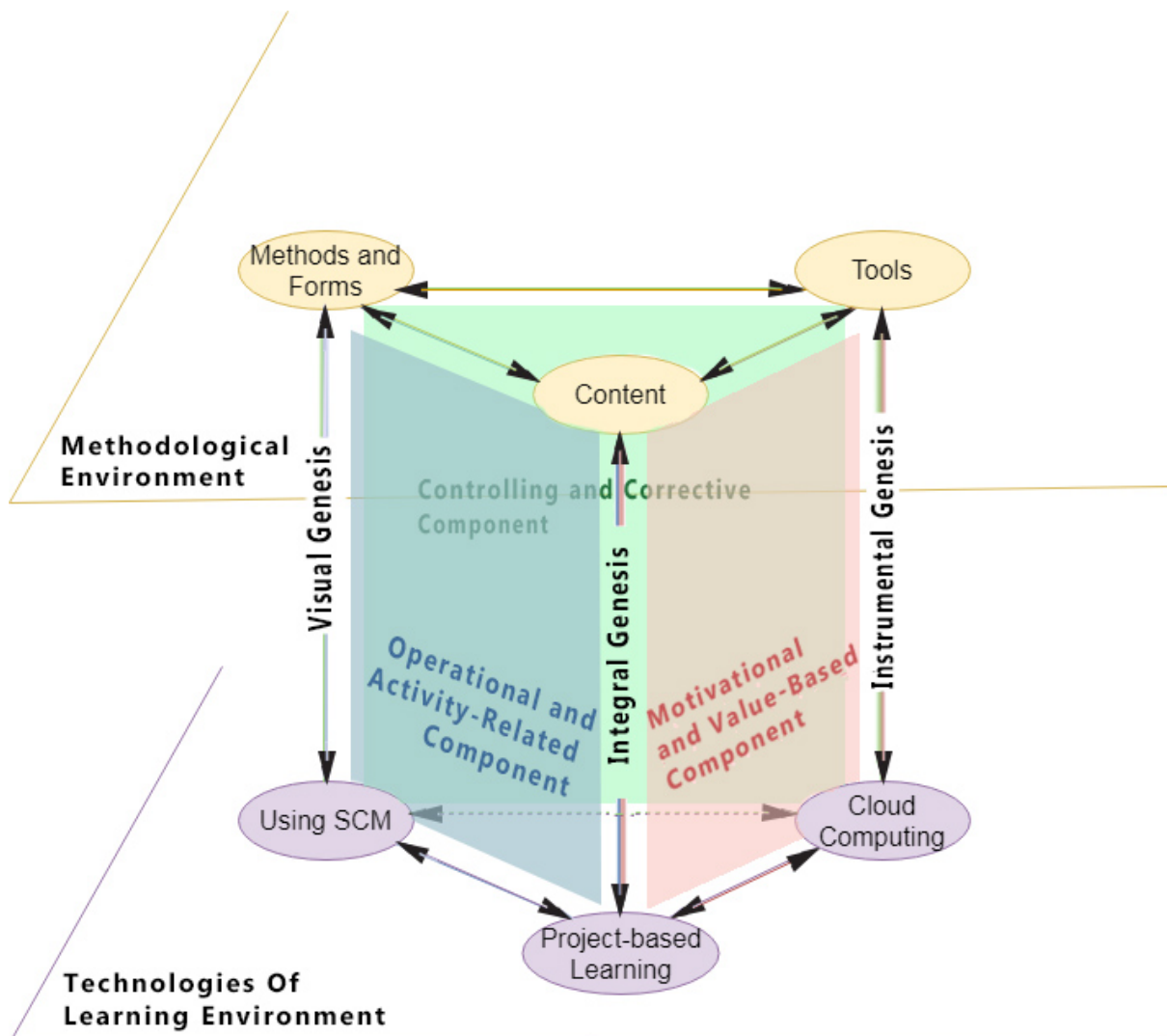
Figure 1. Theoretical model of the online course "Methods for teaching mathematics to students in technical universities".

The materials of lectures and practical tasks, according to the recommendations, can consist of video files, hypertext, demonstrative animation, audio, and video lectures, schemes, pictures, graphics, tables, drawings, information-reference materials, computer simulators. Presentations and other additional materials such as attached files and interactive supplements, resources, given in the reference list, can be also used. The course developers suggest using Camtasia software that can catch the video from the screen in order to create a video lecture of the online course.

Forum use during the course has several functions, that's why the course developers recommend: all the course participants to sign up for the forum to get notifications about new topics and answers on the forum; to use the forum for the participants' communication in the asynchronous mode, in other words, during a long time; to carry out discussions among the participants about their group mates' works using the forum, which is included in one of the course tasks. Moreover, the course developers recommend the participants to visit the forum to share examples of their works with each other and also to ask each other and teachers some

questions on the topics that are studied.

The creation of the course content has to be combined with the evaluation of the students who help to evaluate the quality of the developed learning materials and detect minor disadvantages. That's why the course developers recommend improving the course materials using the survey among the respondents who work with the courses. The authors of the course suggest using the surveys created in Google Forms.

2.3. The course design
The course design was determined as the next stage of the work on the course. The researchers defined the interface of the course on the educational platform as one of the factors that impact online learning results.

Using the Inductive Content Analysis Method the course developers carried out the analysis of the structure and principles of creating the most popular international and domestic systems of online education and determined the usability criteria of educational platforms [40]. These parameters were included in the survey among higher school teachers and students, and it was aimed at evaluating the relative importance (weight) for users of the determined usability criteria (Information Quality (IQ), System Learnability (SL), System Navigation, Visual Design, Instructional Assessment, System Interactivity, and Responsiveness). In order to do it, the respondents defined the criterion rating from 1 to 7 depending on its influence on the platform usability (where 1 is the most important). Working on the course design its authors followed the realization of the defined usability criteria on the platform "Higher School Mathematics Teacher" [32]. The ways of following the criteria are represented in table 1.

2.4. The organization of the course participants' activity and determination of evaluation criteria
The organization of the course participants' activity is an important aspect of efficient course learning. The content of every stage organization is represented in table 2.

The authors of the course offered master students a survey using an open online service, posting a survey on the platform "Higher School Mathematics Teacher" [32]. The survey questions were focused on the correction of the course topics and materials. The analysis of the survey results and respondents' suggestions on the forum helped to determine the stages of the participants' activity and the organization of these stages.

The authors determine the main stages of the activity on the course such as the course introduction, its aim, and objectives; weekly learning planning; theoretical data introduction; completing practical tasks; passing tests; communication with the course teachers and participants.

The authors of the course developed the criteria of evaluating the activity of the online course users using the analysis of the programs of university practices [51–54], where master students of the specialization "Mathematics" are prepared. Tutors evaluate the course participants' activity after the course following the next criteria: formed skills to organize the main forms of teaching mathematics in higher schools (scientific-pedagogical activity); formed skills to carry out the methodological analysis of the learning material and prepare learning methodological material for different types of classes (methodological activity); formed skill to choose and use modern technologies and learning methods (integration activity); acquiring experience of teaching activity, moral-ethical qualities that a higher school teacher should have, an individual creative style of the pedagogical activity, necessity of self-education (professional activity).

2.5. The course management
The efficiency of the online course process mostly depends on the organization of the course management. That's why the next stage was to find out about the management of the online

Table 1. Realization of usability criteria on the platform "Higher School Mathematics Teacher".

Criterion name	Criterion function	The conditions of criterion realization on the platform "Higher School Mathematics Teacher"
Information Quality (IQ)	Describes the information correspondence in the system to the learners' needs	The use of programming tools for text formatting, integration of graphic, video and audio information, link, formula, testing, and survey integration
System Learnability (SL)	Describes the learning easiness and speed	
System Navigation	Reflects the quality of navigational tools	Is ensured using the main and additional menus of the platform that are placed in the upper part of the interface and are present on every page, it allows the user to follow the necessary section
Clear sequence	Describes the clear logical consistency of pages	Posting "breadcrumb" navigation on the pages that allows to visually represent the hierarchy of the pages of the upper level and navigate on them
Visual Design	Describes the aesthetics of the learning system visual design	The use of a basic range of colors in RGB coding model (light colors are for the body, dark are for the main content and additional colors are for structural elements and references), that ensures readability and aesthetic design; satisfies the objectives of the platform information value, general structure of the platform interface, that includes a header, footer, sidebar, and content layout elements; the text is ensured by Typography, that includes a stylistic design for headings, subheadings, and the main text
Instructional Assessment	Describes the easiness and efficiency of evaluation tools	Feedback forms, testing subsystems, and file downloads are used
System Interactivity	Rreflects the presence of simple interaction tools between the participants of the learning process	The platform users' forum is used that ensures the interaction of student–teacher, teacher–student, student–student
Responsiveness	Describes the quality of the system image on mobile devices with different resolution	The adapted size of the text, headings and, subheadings, links, buttons, size of the images, and other interface elements are used

course process.

The researchers surveyed master students and mathematics teachers of higher schools. The

Table 2. The organization of the course participants' activity.

Stage of activity	Organization of the stage		Method
	Tutors' activity	Participants' activity	
Course introduction, its aim, and objectives	Formulates the course objectives, defines work terms	Users start studying on the course from the registration point, that's why for every participant the first learning week on the course starts individually, and also according to the learning start, the individual time of finishing the learning week is defined	Video
Weekly learning planning	Formulates the weekly objectives	Users get acquainted with the plans and objectives for the learning week	Video
Theoretical data introduction	Represents the learning topic	Users get acquainted with the theoretical material, work it out at their own pace during the learning week	Text documents, for giving the main theoretical data; videos
Completing practical tasks	Offers resources that allow students to be involved in different types of activity	Users watch the video with the recommendations on the practical task; choose the mathematics section independently for the creation of their product according to the weekly tasks; complete the task; represent the work by posting it on the weekly forum	Video with recommendations on how to make lecture notes or a system of exercises for the practical class; higher mathematics textbooks
Taking tests	Offers the participants a knowledge self-check	Users check the level of the topic assimilation, after taking the test, the topic is counted done if 60% of the answers are correct, the number of taking the test is not limited	Tests
Course participants' cross-checking	Offers to use earlier developed criteria of the task evaluation	Users check the works of two group mates; evaluate them and discuss the works on the forum	Task evaluation criteria
Modern technologies use while learning mathematics in technical universities	Offers to involve modern learning technologies to prepare practical weekly tasks	Users get acquainted with the examples of modern technologies use	Resources to be used: a project method, computer mathematics systems, cloud technologies
Communication with teachers and course participants	Encourages the course participants to take part in weekly forums	Users take part in weekly forums	The forum on the platform that is the main criterion of learning a course

survey for teachers allowed finding out the respondents' attitude to teamwork in creating courses and also the coordination of the team members' activity involved in the platform support. Also, the course developers carried out a theoretical analysis of the researches and resources that implement the recommendations on training, structuring, and developing the content for online courses. The analysis of respondents' answers for the offered questions and studies of the recommendations influence the description of the methodological requirements for the online course structure and content.

The developers structured the course "Methods for Teaching Mathematics to Students at Technical Universities" [31] following weekly planning. The authors introduced the material review at the beginning of every week and every new section, including course participants' introduction to the structure, learning results, and approximate learning time.

The adaptation of the mass production to the requirements of a particular consumer on the educational platform "Higher School Mathematics Teacher" [32] takes place using a partial content change following a definite request, adding extra tasks and materials to the course. The discussions on the forum that are regularly monitored by the course tutors allowed monitoring the content quality, involvement of the potential participants to the material development, creation of the conditions of constant support for the course participants, prompt reaction to their suggestions.

The areas of the online course activity management pointed out by the authors allowed determining the necessary actions concerning management, terms of action, and participants (table 3).

3. Results

The experimental research on the impact of blended learning implementation was held during 2019–2020 while master students of the specialization "Mathematics" learn methodological subjects of the curriculum and during the assistant practice in technical universities.

The experiment hypothesis. The analysis of the theoretical works on the methodology for training master students, the determined theoretical basis of blended learning in the methodological training of future mathematics teachers in technical universities allowed formulating a hypothesis: the efficiency of blended learning during the methodological training of future mathematics teachers in technical universities will be high under the condition of the systematic use of traditional offline learning and online learning of the subjects of the methodological cycle. According to the model of the author's methodology, the use (option A) or non-use (option B) during the assistant practice of the online course "Methods for teaching mathematics to students in technical universities" [31] was determined as the variable. Option A is based on the fact that students during their assistant practice used the materials of the online course [31]. Option B is based on the fact that students during their assistant practice did not use the materials of the online course [31] but used only the offline learning materials that were offered by the teacher following the blended method. Invariable conditions: the number of experiment participants in experimental groups; similar initial students' level in both EG; duration of the learning and assistant practice; using the model of blended learning for the subjects of the methodological cycle where the training for the assistant practice is carried out, evaluation criteria, experimenter.

The selection of the experiment participants. 87 master students of the second training year of Kryvyi Rih State Pedagogical University, Sumy State Pedagogical University named after A. S. Makarenko, National Pedagogical Dragomanov University, Berdyansk State Pedagogical University, Vinnytsia Mikhailo Kotsiubinskyi State Pedagogical University were involved in the experiment, those who had their assistant practice at that time. In order to get equal groups at the beginning of the experiment, the control and experimental groups of students included those who had the same average success rate for the subjects of the methodological cycle. The

Table 3. Management organization on the course.

What is necessary to do?	Who carries it?	When should it be done?
The preparatory stage of the course development		
To work out a survey and spread it among the potential course participants and teachers aimed at finding out the expectations from the course	Course developers	During the course planning
To carry out the theoretical analysis of the researches and resources and make recommendations on the preparation, structuring, and development of the content for online courses		
To describe methodological requirements for the structure and content of online courses		
To structure the course on the online platform	Course developers	During the development of the course content
To develop the course content, forms, and methods of knowledge control		
To support technically the content management during the course creation	Content-manager	
To provide the search for course participants; advertise and promote the course	Client-manager	
Course opening		
To register the users on the course; to provide access to the course	Client–manager	Before the beginning of the course learning
Stage of the course use during the learning period and skills development		
To form the participants' group; to create the course schedule	Client-manager	During participants' learning on the course
To provide the proper efficiency of the course elements during all the time of its use	Content–manager	
To interact with the course participants during individual and group online consultations; to control the learning process	Course tutors	
Finishing learning on the course		
To give a certificate about passing the course	Client–manager	During the last week of the course
Course improvement		
To change partly the content following a particular request; to add extra tasks and materials to the course; to monitor regularly the discussions on the forum; to involve potential participants in the course material development; to react promptly to the course participants' suggestions	Course tutors	Periodically during the course
To support technically the content changes during the course improvement	Content–manager	

students of the experimental group learned the subjects of the methodological cycle: "Methods for Teaching Mathematics in a Specialized School" (MTMSS); "Innovative ICT in Education" (InICT) following the methodology of blended learning. Students of the control group learned the same subjects following the traditional methodology. The same teachers evaluated the pedagogical traineeship in universities (assistant practice) in both groups. During the assistant practice, two experimental groups (EG_1 and EG_2) were created. The students of group EG_1 (19 participants) were offered to sign up for the online course [31] during the practice (option A of the author's methodology model). The students of the experimental group (EG_2 – 21 participants) and of the control group (CG – 47 participants) had their assistant practice without the course implementation (option B of the author's methodology model).

Pre-experimental test. This test was carried out in order to find out the students' success rate for the subjects of the methodological cycle at the beginning of the master's studies. Table 4 represents the average success rate for every subject of the methodological cycle and pedagogical traineeship that the students of the experimental and control groups had during the bachelor's studies. The average success rate is 0.761 in EG_1, 0.804 in EG_2 and 0.761 in CG.

Table 4. The average success rate for the subjects of the methodological cycle during the bachelor' studies.

Subjects	CG	EG_1	EG_2
MTM	0.76	0.758	0.804
ICTT	0.75	0.76	0.814
Pedagogical traineeship (PT)	0.775	0.765	0.795
Average rate	0.761	0.761	0.804

The determination of the success rates took place according to the grading system (table 5).

Table 5. Grading system: national and ECTS and success rates.

Total for all types of learning activities	ECTS estimate	Estimate according to the national grading system	Success rate
90–100	A	Excellent	High
80–89	B	Good	Sufficient
71–79	C		
61–70	D	Satisfactory	Average
50–60	E		
30–49	Fx	Unsatisfactory	Low
0–29	F		

The number of students in EG (in %) at the same success level for every subject of the methodological cycle and practice is represented in table 6.

In order to determine the presence of differences in the success rate, Mann Whitney U–test that is meant for evaluating the difference between two selections following a feature level that is measured by quantity was used. The empirical value of the criterion U reflects the level of the coincidence zone between the sets. The lower $U_{empir.}$ is, the more reliable the difference in results might be. Reliable differences can be observed if $U_{empir.} = U_{cr.}0.05$. "In order to

Table 6. The ratio of the students' number and the success rate (in %).

EG	High level			Sufficient level			Average level			Low
	MTM	ICTT	PT	MTM	ICTT	PT	MTM	ICTT	PT	
EG_1	15.8	21.1	15.8	52.6	42.1	47.4	31.6	36.8	36.8	—
EG_2	33.3	33.3	28.6	47.6	52.4	52.4	19.1	14.3	19.0	—
CG_2	15.9	20.1	15.2	51.7	41.5	48.1	32.4	38.4	36.7	—

process the data, it is necessary to determine the hypotheses: H_0 and H_1." Hypothesis H_0 is accepted if $U_{empir.} > U_{cr.}0.05$. Hypothesis H_1 is accepted if $U_{empir.} = U_{cr.}0,05$. The comparison of the results of the pre-experimental test in EG_1 and EG_2. The average success rate in CG and EG_1 was 0.761, in EG_2 it was 0.804. CG and EG_1 makes selection 1, EG_2 makes selection 2. H_0 – the level of training in selection 1 is not lower than the level in selection 2. H_1 – the level of training in selection 1 is lower than the level in selection 2. Thus, Mann Whitney U–test use proved that the groups of students with the same initial training level took part in the experiment.

Experimental learning. At the next stage of the research master students' experimental learning, which was held following two options of the author's methodology, was implemented. The first part of the experiment was invariable: the students of the experimental groups (EG_1 and EG_2) learned the subjects of the methodological cycle following the methodology of blended learning. The students of the control group (CG) followed the traditional methodology. The second part was variable: Option A was based on the opportunity given to the students of the experimental group 1 (EG_1) who could sign up for and pass the online course "Methods for teaching mathematics to students in technical universities" [31] during the assistant practice. Option B was based on the opportunity given to the students of the experimental group 2 (EG_2) and control group to pass the assistant practice without any online course involvement.

Post-experimental test. The results after the experimental test are provided in tables 7, 8. In table 7 the average success rates for every subject of the methodological cycle and practice are given, in table 8 the correlation of students' number and the success rate (in %) is determined.

Table 7. The average success rate for the subjects of the methodological cycle during the master's studies.

	Control group	Experimental groups	
Subjects	CG	EG_1	EG_2
MTM in a specialized school (MTMSS)	0.806	0.835	0.863
Innovative ICT in education (InICT)	0.795	0.852	0.871
Pedagogical traineeship in universities (PTU)	0.815	0.842	0.869
Average rate	0.805	0.843	0.876

The growth of the average success rate for the subjects of the methodological cycle and pedagogical traineeship after the experiment is represented in table 9.

The growth is visually represented in figure 2–4.

So, in all the groups in all the subjects, the positive dynamics is recorded, but the growth of the success rate according to option A, when students had online support during the practice is higher than according to option B. That is why it is possible to state about the efficiency of the practical training among students during blended learning of methodological subjects. The

Table 8. The ratio of the students' number and the success rate (in %).

| EG	High level			Sufficient level			Average level			Low
	MTMSS	InICT	PTU	MTMSS	InICT	PTU	MTMSS	InICT	PTU	—
EG_1	16.3	21.6	16.9	52.9	42.2	48.4	30.8	36.2	34.7	—
EG_2	36.3	35.8	30.6	48.8	53.9	53.4	14.9	10.3	16.0	—
CG	16.0	21.1	16.3	51.9	41.0	47.6	32.1	37.9	36.7	—

Table 9. The growth of the average success rate (ASR) for the subjects of the methodological cycle according to the experiment results.

|	Before the experiment			After the experiment			Growth			
Subjects	CG	EG_1	EG_2	CG	EG_1	EG_2	CG	EG_1	EG_2	Subjects
MTM	0.76	0.758	0.804	0.806	0.835	0.863	+0.046	+0.077	+0.059	MTM in specialized schools
InICT	0.75	0.760	0.814	0.795	0.852	0.871	+0.045	+0.092	+0.057	Innovative ICT in education
Pedagogical traineeship	0.775	0.765	0.795	0.815	0.842	0.869	+0.040	+0.077	+0.074	Pedagogical traineeship in universities
Average rate	0.761	0.761	0.804	0.805	0.843	0.876	+0.044	+0.082	+0.072	Average rate
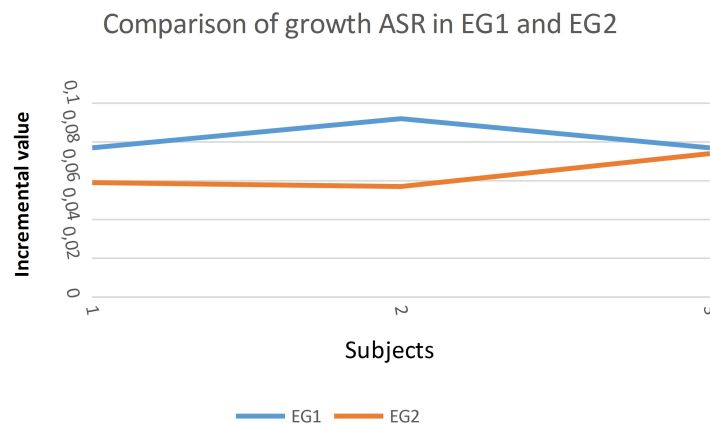
Figure 2. Growth of ASR in groups EG_1 and EG_2.

efficiency of blended learning for methodological subjects also contributes to the improvement of the results of the pedagogical traineeship (assistant practice) in universities.
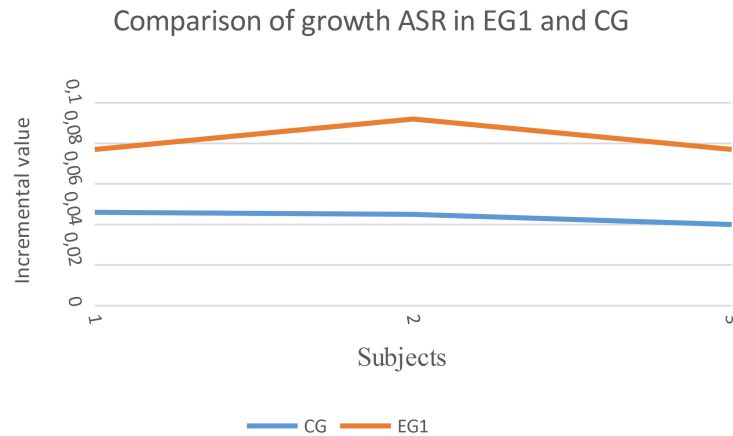
Figure 3. Growth of ASR in groups EG_1 and CG.
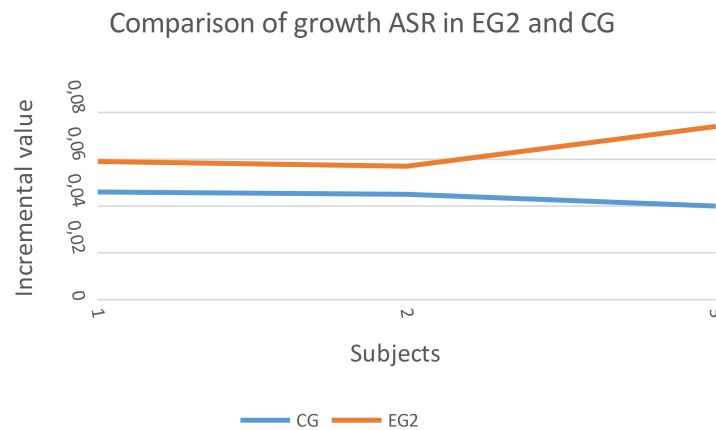
Figure 4. Growth of ASR in groups EG_2 and CG.

4. Discussion

The idea of implementing the models of blended learning for training mathematics teachers in higher schools was proven in the researches by [8–11]. [38], who were focused on the online course use during the development of the environment for blended learning, stated that the model of the online course should help to organize the learning process on the Internet encouraging efficient, integral, and motivated users' practice. During the online course development in order to create such an environment the conclusions of the researches done by [23, 24] were considered, and the necessity to develop a survey aimed at detecting the wishes of the future potential course participants during its development was proven. Taking into account the course participants' ideas and recommendations the scientists helped to develop a model of the online course "Methods for teaching mathematics to students in technical universities" [31]. The selected approach allowed determining the structural components of the online course model: methodological environment; technologies of the learning environment; components of the professional training. The authors of the model based their ideas on the fact that master students' assimilation of the learning material, which was included in the methodical component, encourages their more conscious understanding of the practical implementation

of the content, methods, and forms of teaching mathematics in technical universities. The researchers' recommendations, their practical developments, guidance for course tutors enables master students' preparation for offline classes, the development of learning and learning-methodological materials for teaching mathematics. The component functioning of the learning environment technologies is based on using cloud technologies and a project method. The researches done by [55–57] proved the necessity to choose cloud technologies. The scientists stated that due to providing convenient access to the network of computing resources that ensure and release from routine calculations, the use of cloud technologies encourages the intensification of calculations and the attention concentration on more significant questions of the learning process. Selecting the project method, course tutors were concentrated on the works given by [58–60]. The conclusions made by the scientists proved that learning based on projects fosters fast students' personal growth, encourages their self-development and self-management. Visual, instrumental, integral genesis in the model structure helps to set up connections between methodological and technological components of the model learning environment and ensures the efficiency of work with learning materials of these components.

At the stage of developing the methodological recommendations for learning materials and preparing papers for the course the experience of the learning group working on the development of online courses APass (https://apasseducation.com) and analysis of the research done by [61, 62] played an important role. Taking into account the recommendations suggested by the scientists, the course developers created the recommendations on the course structure. It is offered to ensure the efficiency of the learning aim on the course using such means as clear aim; matching of the aim and student's expectations; direct correspondence between the learning aims and students' actions during the course and their evaluation; selection of learning materials and technologies that correspond to the learning aims, motivate students and support their results. Moreover, the development of the forum during the course is agreed with the conclusions made by [63], who prove that the forum plays not only an informative role in the participants' communication but also encourages an active participants' role in the discussions on the forum, their tendency to show the highest level of learning the material.

After getting acquainted with the factors that determine the success of the online courses, described in the works of [64,65], we involved experienced experts in teaching mathematics before the preparation and development of high-quality content. The developers, when started creating the course content, supported the idea that the content as the main tool of evaluating the quality of online courses should be followed by the students' estimate. This idea was confirmed in the works of [36, 66, 67].

At the stage of the course design development, the researchers followed the recommendations given by [68] who studied the convenience of using educational websites from the university students' point of view. The course interface on the educational platform was determined as one of the factors that influence the results of online education. The analysis of the recommendations and advice given by [69, 70] helped to describe the organization of the course participants' activity and determine the main stages of the activity: introduction to the course aim and objectives; weekly learning planning; theoretical training; completing practical tasks; taking tests; communication with course teachers and participants.

The position expressed by the authors of the article on the necessity of the development management and online platform support is agreed with the researches that describe the solution to the problems that students face during online learning [71, 72]. The areas of online course activity management allowed determining the necessary tutors' actions related to the management, terms of action, and performers at the preparatory stage of the course development, when opening the course, at the stage of using the course during the learning process, and skills development when finishing the learning on the course and course improvement.

5. Conclusions

The authors of the research used the technology of blended learning combined with the use of traditional offline teaching and online teaching for the subjects of the methodological cycle so that master students could succeed during the pedagogical traineeship (assistant practice) in universities.

The stages of work on the development of the online course "Methods for teaching mathematics to students in technical universities" [31] are determined in the research and the objectives of every stage are described.

At the stage of developing a course model, researchers recommend basing the theoretical model of an online course on the idea of blended learning for subjects of an integrated methodological cycle to prepare students for assistant practice. In particular, the course tutors recommend a methodological environment that allows its users to learn the content, methods, forms, and means of teaching mathematics in universities during MTMSS classes and online lectures. The content of the model component that ensures the technologies of the learning environment, according to the recommendations of the course developers allows the efficient subject assimilation and participants' learning of the modern technologies course for teaching mathematics to students in technical universities, such as systems of computer mathematics, cloud technologies, a project method. Link building between the methodological environment and technologies of the learning environment is carried out using visual, instrumental, integral genesis that students get during the assistant practice in universities.

The development of methodical recommendations for educational materials and preparation of papers for the course is defined by researchers as the second stage of work. The researchers recommend building the course content and the process of its learning on the principles of personal orientation, practical realization, flexibility, independence, and voluntary nature. According to the recommendations given by the course authors, the learning materials should correspond to the students' expectations and encourage motivation during the course.

As for the development of course design, at this stage of work researchers recommend creating it following the usability criteria of the educational platforms and minimalism criteria that ensure the easiness of the course material perception, do not overload the users with extra information.

Organizing the activities of course participants and defining the criteria for their evaluation is also an important stage of working with the course. At this stage, the authors of this course have identified areas for managing the activities of the online course, and this in turn allowed to determine the necessary actions for course management, timing, and the team of performers.

In the last stage of working with the course, the researchers identified the issue of the management of the course. In order to ensure the high-quality management of the course, it is recommended in the research to use teamwork at the stage of creating and ensuring the online course functioning.

The results of the experiment show the growth of the average success rate in the subjects of "MTM in the specialized school" and "Innovative ICT in education" and positive results of the pedagogical traineeship in universities among the students of EG compared with CG. Namely, the average rate in the groups CG, EG_1, EG_2, respectively, is +0.044, +0.082, +0.072. Which in turn indicates the positive results of blended learning.

The vector of further research is the development of an online course for learning the discipline of the methodological cycle by master students "MTM in a Specialized School".

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