

THE IMPACT OF THE USE OF BLENDED LEARNING TECHNOLOGY IN SCHOOL MATHEMATICS EDUCATION ON THE EFFECTIVENESS OF TEACHING

Roza KADİRBAYEVA¹
Baktygul ALİMKULOVA²
Madina JAMANKARAYEVA³
Kuralai ATİRBEK⁴

ABSTRACT

The purpose of this study is to assess the impact of the use of blended learning technology in school mathematics education on the effectiveness of teaching from the point of view of teachers. This study used the case study method, which is one of the most qualitative studies.

The study used a semi-structured form of preliminary interview and questionnaire. 126 math teachers working in various secondary schools of Kazakhstan took part in the survey conducted during the study, and 25 teachers of Shymkent city took part in the interview. During an interview conducted as a result of the study, most math teachers stated that pupils have a low interest in math lessons. As a result of the survey, math teachers were identified who had no idea about blended learning at all. The teachers who participated in the study noted the variety of educational materials that allow pupils to manage themselves and encourage them to self-study, as well as access to various teaching methods, as an advantage of using blended learning technology in teaching mathematics. And as a disadvantage, they noted the insufficient software of the blended learning environment, the vulnerability of the software and hardware of online learning, as well as the inability of teachers to use technology effectively. In addition, the majority of math teachers noted that the use of blended learning technology has a positive effect on the effectiveness of learning.

Based on the results of the study, it is concluded that the use of blended learning technology in mathematical education is effective for increasing the interest of pupils, the effectiveness of learning and allows improving the quality of education. It was also revealed the need for teachers to take special advanced training courses that teach methods of applying the technology of blended learning in mathematical education.

Keywords: Mathematical Education, Blended Learning, Technology, School, Pupils.

¹ Doct.of ped.sc., South Kazakhstan State Pedagogical University, Shymkent, Kazakhstan, roza-1961@mail.ru

² Master, South Kazakhstan State Pedagogical University, Shymkent, Kazakhstan, deva-11.09@mail.ru

³ Cand.of ph.-m.sc., South Kazakhstan State Pedagogical University, Shymkent, Kazakhstan, d_madina08@mail.ru

⁴ Master, South Kazakhstan State Pedagogical University, Shymkent, Kazakhstan, atirbek979797@gmail.com
Arařtırma Makalesi/Research Article, Geliř Tarihi/Received: 21/04/2023–Kabul Tarihi/Accepted: 12/05/2023

OKUL MATEMATİK EĞİTİMİNDE HARMANLANMIŞ ÖĞRENME TEKNOLOJİSİNİN KULLANIMININ ÖĞRETİMİN ETKİNLİĞİ ÜZERİNDEKİ ETKİSİ

ÖZET

Bu çalışmanın amacı, okul matematik eğitiminde harmanlanmış öğrenme teknolojisinin kullanımının öğretmenler açısından öğretimin etkinliği üzerindeki etkisini değerlendirmektir. Bu çalışmada en kalitatif çalışmalardan biri olan vaka çalışması yöntemi kullanılmıştır.

Çalışmada yarı yapılandırılmış bir ön görüşme ve anket formu kullanılmıştır. Araştırmada Kazakistan'ın çeşitli ortaokullarında görev yapan 126 matematik öğretmeni, Çimkent şehrinin 25 öğretmeni yer aldı. Çalışma sonucunda yapılan bir röportajda çoğu matematik öğretmeni, öğrencilerin matematik derslerine ilgisinin düşük olduğunu belirtmiştir. Anket sonucunda harmanlanmış öğrenme hakkında hiçbir fikri olmayan matematik öğretmenleri belirlendi. Araştırmaya katılan öğretmenler, matematik öğretiminde harmanlanmış öğrenme teknolojisini kullanmanın bir avantajı olarak, öğrencilerin kendilerini yönetmelerine ve kendi kendine çalışmaya teşvik etmelerine ve çeşitli öğretim yöntemlerine erişmelerine olanak tanıyan çeşitli eğitim materyallerine dikkat çekti. Dezavantaj olarak, karma öğrenme ortamının yetersiz yazılımına, çevrimiçi öğrenmenin yazılım ve donanımının savunmasızlığına ve öğretmenlerin teknolojiyi etkin kullanamamasına dikkat çektiler. Ayrıca matematik öğretmenlerinin çoğunluğu, harmanlanmış öğrenme teknolojisinin kullanımının öğrenmenin etkinliği üzerinde olumlu bir etkisi olduğunu belirtmiştir.

Çalışmanın sonuçlarına dayanarak, matematik eğitiminde harmanlanmış öğrenme teknolojisinin kullanılmasının öğrencilerin ilgisini arttırmada, öğrenmenin etkinliğinde etkili olduğu ve eğitim kalitesinin iyileştirilmesine olanak sağladığı sonucuna varılmıştır. Ayrıca, öğretmenlerin matematik eğitiminde harmanlanmış öğrenme teknolojisini uygulama yöntemlerini öğreten özel ileri eğitim kursları alma ihtiyacı da ortaya çıkmıştır.

Anahtar Kelimeler: Matematik Eğitimi, Karma Öğrenme, Teknoloji, Okul, Öğrenciler

1. INTRODUCTION

Today, global changes in the world and industrial relations direct the education system to "free human development", creative initiative, independence, competitiveness, mobility of the future specialist and his effective adaptation in this world. And now the question of more complete provision of education with a subjective and socially integrated result is being raised. In this regard, it is known that the issues of improving and optimizing the traditional education system with the help of information and communication technologies (ICT) are being studied at the global level.

Within the framework of this study, along with many pedagogical innovations, the technology of blended learning has also appeared. In general, it is believed that blended learning does not have a clear authorship, it arose spontaneously as a result of numerous attempts to change existing teaching methods and principles. Currently, the concept of "blended learning" is interpreted as a form or continuation of DE.

This concept arises due to the widespread use of computer technologies, such as the concepts of "e-learning" and "mobile learning", and includes the use of digital resources in traditional learning.

The term "blended learning" and the terminology describing it were first mentioned in a press release of interactive learning centers in the late 90s. It says that along with online courses, the company conducts courses using a blended approach to learning. Since then, the terms "blended learning" and "hybrid learning" have been used in the scientific literature.

As a result of studying the works related to the problem under consideration, it was noticed that foreign scientists were initially engaged in defining the concept of "blended learning" and the basics of organizing blended learning. These are: Curt Bank, Norm Friesen, (Darling Painter, Purnima Valiathan, Donald Clark, etc.

Curt Bank (2006) believes that blended learning integrates full-time and distance learning technologies in a certain proportion, which allows using two training modes simultaneously, eliminating all their disadvantages.

Norm Friesen (2012) gives the following definition: "Blended learning is a range of opportunities offered by combining the Internet and electronic media, as well as forms that require the real presence of teachers and students in the classroom".

Purnima Valiathan (2002) uses the concept of "blended learning" to describe solutions that combine different approaches to the transfer of educational content, such as collaborative software, web-based courses, knowledge management methods. Along with this, this concept is used to describe learning that combines various types of educational activities, including face-to-face classroom training, online training and self-study in the workplace.

According to Wilson D., Smilanich E. M. (2005), blended learning usually involves the use of two or more methods depending on the purpose of the training. If so, blended learning is the use of a more effective learning style that is used to achieve learning goals defined according to the goals set. Also, based on the works of Singh H., Reed C. it can be said that blended learning focuses on the "right" independent learning approaches and learning goals that can be achieved using the "right" technologies to give the "right" person the "right" skills at the "right" time.

Research by Osguthorpe R. T., Graham C. R. (2003) states that when developing approaches to blended learning, there are similar and separate forms of learning elements both via the Internet and in traditional learning. Among the elements of learning, the distribution of educational material, interaction with educational material, interaction with the teacher and pupils, and many other interactions may differ. Here, a good design should be implemented in accordance with the basic elements.

Blended learning combines the capabilities of both to go beyond the individual capabilities of face-to-face and online learning (Garrison D. R., Vaughan N. D., 2008).

In fact, these are third-generation methods that need to be interpreted with the help of blended learning used in our modern education system. The methods of the first generation for teaching used methods that provide one-sided learning content, such as recording, radio, television. In the second generation methods, only computer or web content was used for training.

The third generation method - blended learning takes full advantage of the best advantages of face-to-face learning, and educational content is provided using various technologies. In other words, blended learning is the use of computer technology at the same time or at different times, for example, face-to-face training (So H. J., Brush T. A., 2008).

Due to the rapid changes in the world, being part of the educational system, mathematical education has also contributed to the development of the educational system and the structure of pupil-oriented education. Instead of memorizing the passive structure of traditional education, all the lessons of the system reflected a joint, critical, interrogative and active structure (Cekici E., Yildirim H., 2011). The method of blended learning is becoming increasingly important in mathematics, as in other courses. As a rule, math lessons are considered as difficult and incomprehensible lessons for pupils. When using the blended learning method, it is desirable to get rid of such an understanding. With this method, pupils can connect to lectures, course materials and course-related materials, not only in the school environment, but also where and when at their discretion. Pupils can learn math lessons not only by listening to one person, but also by using these methods in an online environment. A pupil can ask his teacher or friends what he did not understand in math class, either online or directly at school (Yildirim I., Vural O. F., 2016).

Kholifah N., et al, (2020) in their study tried to determine how the use of a blended learning model affects the educational motivation of vocational education pupils. The results of the study show that the use of the blended learning model has a significant impact on the motivation of pupils to vocational education. Attard C., Holmes K. (2020) explores the tendencies of teachers to use blended approaches to learning in their research. The study was conducted among teachers who taught mathematics in high school. The study shows that the use of technology enhances the ability of pupils to participate in the study of mathematics, offering a variety of ways and methods of achievement, and that they can use blended approaches to learning.

Charlier B., Platteaux H. (2005) investigated the influence of a blended learning environment on the pedagogical abilities of future teachers. As a result, pupils found this study very useful, and that future teachers acquired more pedagogical skills. On the other hand, Larsen A. J. (2013) in his study of blended learning argued that the ability of teachers to apply new technologies in the learning environment provides a student-centered learning environment. Acelajado M. J. (2011) compares blended learning methods and face-to-face learning methods in a study of university pupils. In addition, the study evaluates the impact of blended learning methods on the success of pupils in teaching mathematics and the attitude of pupils to the use of a blended learning environment in mathematics education. As a result of the study, it was found that the knowledge of pupils receiving a mathematical education using a blended method of teaching is more successful. In addition, results such as increased motivation, increased confidence in mathematics and their confidence in success were demonstrated to pupils studying with a blended learning method.

There are also some studies in the field of learning, such as the impact of blended learning on pupil academic performance (Uluyol A. G., Karadeniz S., 2009), pupil satisfaction with the types of interaction in a blended learning environment (Kuo Y. C., et al, 2014), the impact of a joint blended learning environment on teacher performance before the start of training (Heba E. D., Nouby A., 2008).

On the other hand, Yushau B. (2006) investigated the influence of a blended learning environment on the attitude of pupils studying mathematics courses at the university to mathematics and computer courses. The results of the study showed that the use of blended learning methods statistically reduces computer confusion and computer self-confidence among pupils.

The Purpose of The Study: The purpose of this study is to assess the impact of the use of blended learning technology in mathematical education on the effectiveness of teaching, taking into account the opinions of teachers.

In accordance with the purpose of the study, the following questions were asked:

1. How do math teachers evaluate pupils' attitude to math lessons and the use of technology?
2. What do mathematics teachers think about blended learning?
3. What are the views of mathematics teachers on the advantages and disadvantages of teaching mathematics in a blended learning environment?
4. What are the opinions of mathematics teachers about the disadvantages of teaching mathematics in a blended learning environment?

2. METHOD AND MATERIALS

This section explains the research methods, research team, process, data collection and analysis.

The Research Method: The opinions of mathematics teachers about the use of blended learning technology in teaching mathematics were evaluated by the case study method, which is one of the qualitative research methods. According to research by Creswell J. W., Poth C. N. (2016), case study is a qualitative research method in which a researcher examines one or more limited cases over time using data collection tools (observations, interviews, audiovisual materials, documents and reports) that cover multiple sources and identify situations and topics related to the situation. Case study is a method in which an individual situation or event is studied in detail in a sequential direction. The data is collected systematically and reflects what is happening in the real environment. The results obtained show why the event happened exactly this way and what should be paid attention to in future studies. In this direction, our study used the case study method to conduct in-depth analysis.

Participants. The working group created to evaluate the effectiveness of the use of blended learning technology, taking into account the opinions of teachers, consisted of math teachers who had previously used blended learning technology. The survey was attended by 126 math teachers working in various secondary schools in Kazakhstan, including 25 teachers from Shymkent.

The teachers who participated in the study were chosen voluntarily. Of the math teachers who participated in the study, 100 were women and 26 were men.

Data Collection Tools. The research data were collected using a pre-prepared semi-structured interview form and a survey form. When creating interview and survey forms, the opinions of three experts were taken into account to ensure the authenticity of the content of the form. Then it was applied to six mathematics teachers working in Shymkent. After the pre-tested version, the final form was created and the questionnaire was prepared for distribution via the Google form. The survey form contained five semi-open questions about the use of blended learning technology by mathematics teachers. Questions and answers to them in the form of a questionnaire are given below.

How do you approach the use of blended learning technology in school math education?

I have no idea about the technology of blended learning;

I've tried blended learning technology, but I don't think it's effective;

I used the technology of blended learning, which aroused the interest of pupils;

In connection with the use of this technology, there is a need to take a special course.

Other

Advantages of using blended learning technology in mathematical education:

A variety of teaching and learning methods, transfer of educational materials;

Provides learning flexibility;

Allows pupils to control themselves;

Motivates pupils to self-study;

Other

Disadvantages of using blended learning technology in mathematical education:

There are not enough programs needed for a blended learning environment;

The software and hardware used in the Online Course has disadvantages;

Teachers have low digital competence;

There are difficulties with the assessment of knowledge;

Other

How do you assess the pupils' approach to the new technologies used in teaching mathematics?

Recognizes the development of educational materials as an effective tool for working out;

Practical training is a tool that promotes rapid learning and has a high ability to;

Does not want to use various technological means;

Due to the presence of technical situations, the inefficiency of classes occurs;

Other

The impact of the use of blended learning technology in mathematical education on the effectiveness of training

It has a positive effect on the effectiveness of training;

Negatively affects the effectiveness of training;

Does not affect the effectiveness of training;
Other

Analysis of Data Collection: The study used a semi-structured form of preliminary interview and questionnaire. These studies were analyzed according to the method of descriptive analysis. The purpose of descriptive analysis is to systematize and interpret the data collected as a result of the study. In most descriptive analyses, data are classified according to pre-defined topics; conclusions related to classified data are summarized; and conclusions are interpreted taking into account the subjective knowledge of the researcher. In addition, the researcher establishes a causal relationship between the results and, if necessary, compares situations by analyzing structural differences (Marshall C., Rossman G. B., 2014). At the stage of interpretation, comparison and understanding of ordered data and certain statements, direct quotations were made from the answers of mathematics teachers.

3. RESULTS

When analyzing the interview conducted during the study, the identified reasoned words and the main general parameters were identified, according to which the questionnaire questions and answers to them were prepared.

The general opinions of teachers who participated in the study of pupils' attitudes to the math lesson are as follows:

Schoolchildren are often biased towards math lessons. They have no confidence that they will be able to learn this lesson. This leads to the disappearance of interest in them.

Schoolchildren think that they cannot master this subject. In fact, this is due to the fact that they have a negative attitude towards the subject in advance. In addition, pupils feel fear, they are able to both understand the lesson and successfully conduct the lesson.

Stereotypical ideas about lessons negatively affect their learning. They find the course difficult and do not think how to study, how to succeed.

Some pupils like math class. They also succeed when they spend the time they need to learn. Such pupils come to classes with love. But there are not many of them.

After analyzing the responses received during the survey conducted as a result of the study, we found that the majority of math teachers indicated that pupils have a low interest in math lessons.

In addition, the answers of mathematics teachers to the questionnaire were evaluated by creating tables with frequency and percentage indicators.

Table 1 presents the opinions of mathematics teachers who participated in the study on the use of blended learning technology in mathematics education at school.

This question was answered by 126 respondents who took part in the survey, and 111 respondents answered the remaining questions. Since 15 teachers did not know about blended learning.

Table 1: Teachers' Assessment of The Use of Blended Learning Technology

Categories	F	%
I have no idea about the technology of blended learning;	15	11.9%
I've tried blended learning technology, but I don't think it's effective;	18	14.3%
I used the technology of blended learning, which aroused the interest of pupils;	57	45.2%
In connection with the use of this technology, there is a need to take a special course.	78	61.9%
I have a message about blended learning technology, but I haven't tried it	36	28.6%

Thus, according to Table 1, 11.9% of the teachers surveyed noted that they have no idea about the technology of blended learning, 28.6% did not use it, although they had a message about blended learning, 14.3% used the technology of blended learning, but do not consider it effective, and 45.2% noted that in the process of applying the technology of blended learning, pupils' interest in mathematics increases. In addition, 61.9% of teachers indicated the need to take a special course related to the use of blended learning technology.

Table 2 presents the opinions of the interviewed teachers on the advantages of using blended learning technology in mathematical education.

Table 2: Teachers' Assessment of The Advantages of Using Blended Learning Technology in Mathematical Education

Categories	F	%
Variety of teaching and learning methods, transfer of educational materials	30	27,3
Provides learning flexibility	33	30
Allows pupils to control themselves	45	40.9
Motivates pupils to self-study	44	40

Thus, according to Table 2, 27.3% of teachers surveyed called the diversity of teaching and learning methods, as well as the provision of educational materials, an advantage, 30% noted that they achieve learning flexibility as an advantage, and 40.9% indicated that this advantage allows students to control themselves. In addition, 40% of teachers called the week of blended learning an incentive for students to study independently.

Table 3 presents the opinions of the interviewed teachers about the disadvantages of using blended learning technology in mathematical education.

Table 3: Teachers' Reflection of The Shortcomings Found in The Use of Blended Learning Technology in Mathematical Education

Categories	F	%
There are not enough programs required for a blended learning environment.	48	43,6
The software and hardware used in the Online Course has disadvantages	30	27,3
Teachers have low digital competence	33	30
There are difficulties with the assessment of knowledge	30	27,3

Thus, according to Table 3, 43.6% of the teachers surveyed pointed to the inadequacy of the programs necessary for teaching in this environment as a disadvantage of blended learning, 27.3% indicated that the online course reveals software and hardware deficiencies, and 30% indicated that the low digital competence of teachers is a disadvantage in using the specified technology. At the same time, 27.3% of teachers called the difficulties encountered in assessing students' knowledge a disadvantage of blended learning.

Table 4 evaluates the opinions of mathematics teachers who participated in the study on the attitude of students to the use of technology in education.

Table 4: Teachers' Opinions on Pupils' Attitude to The Use of Educational Technologies

Categories		Subcategories	F	%	Total	
					F	%
Positive	Effective training	An effective tool for practicing the assimilation of educational materials	50	45	80	72
	Fast Learning	Hands-on learning is considered a tool to facilitate rapid learning	30	27		
Negative	Lack of knowledge in the field of technology	Does not want to use various technological means	11	9,9	31	28
	Unwillingness of the technical situation	Due to technical conditions, the inefficiency of classes occurs	20	18		

Teachers assessed students' attitudes to the use of technology in education from the point of view of students with positive and negative attitudes. According to Table 4, 72% of teachers consider the propensity of students to use educational technologies positive, and the remaining 28% consider it negative. 45% of teachers noted a positive approach to the use of educational technologies of students from the point of view of an effective tool for practicing the assimilation of educational material. 27% of teachers noted that blended learning is a tool that promotes rapid learning with a high ability for practical learning, which is a positive attitude of students to rapid learning. 9.9% of teachers stated that they do not want students to use various technological tools, and that this is a negative attitude caused by a lack of students' knowledge about technology. Finally, 18% of teachers stated that the lack of technical knowledge is one of the reasons for the negative attitude of students to the technical situation caused by the reluctance to attend them.

Thus, the answers to all the questions were analyzed and presented in the form of a single diagram for the purpose of comparison (Figure 1).

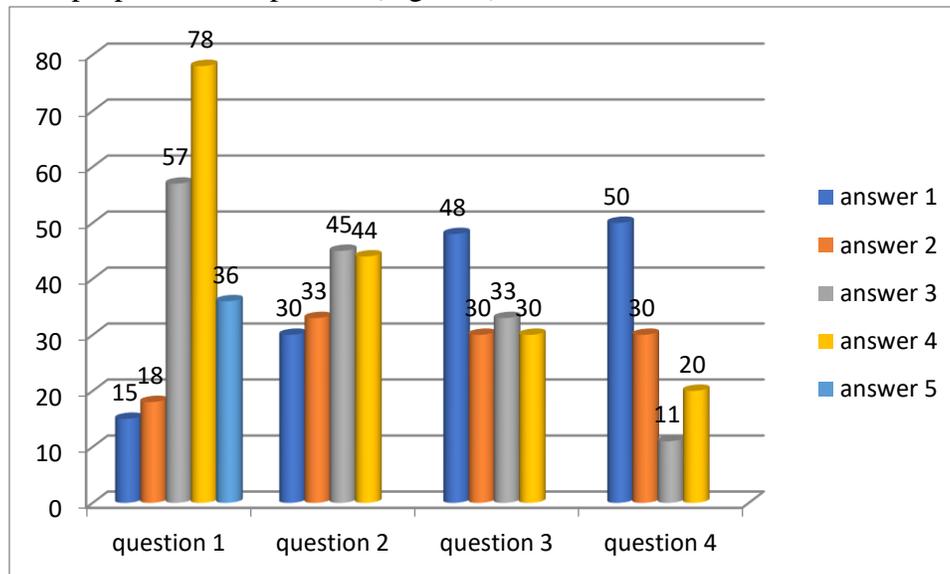


Figure 1: Chart of Answers to The Questions of the Questionnaire

Thus, the impact of the use of blended learning technology in mathematics education on the teaching effectiveness of teachers who participated in the survey is presented in Table 5, and its diagram is in Figure 2.

Table 5: Demonstration by Teachers of The Impact of The Use of Blended Learning Technology in Mathematical Education on The Effectiveness of Training

Categories	F	%
It has a positive effect on the effectiveness of training;	82	73,9
Negatively affects the effectiveness of training;	16	14,4
Does not affect the effectiveness of training.	13	11,7

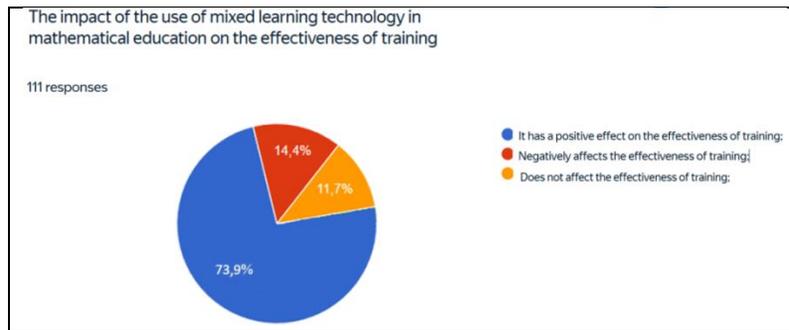


Figure 2: Effect of Using Blended Learning Technology

Thus, according to Table 5, 73.9% of teachers showed that the use of blended learning technology in mathematics education has a positive effect on the effectiveness of learning, 14.4% negatively, and 11.7% noted that they believe that the use of blended learning technology does not affect the effectiveness of learning.

As a result of the survey, math teachers were identified who had no idea about blended learning at all. It is also noted that it is necessary to take a special course related to the use of blended learning technology.

4. ANALYSIS

Most of the teachers who participated in the study said that pupils are less interested in mathematics, but have a more positive approach to the use of educational technologies. Teachers stated that the effectiveness of teaching and rapid learning play a crucial role in the positive attitude of pupils to the use of educational technologies. The pupils' approach to integrating technology into education and the pupils' approach to using technology in math lessons have shown that pupils who have a positive attitude to technology succeed in blended learning (Barkatsas A. T., et al., 2009; Fogarty G., 2001; Reed H. C., et al., 2010).

In addition, teachers take into account the advantages of teaching mathematics in a blended learning environment. They consider pedagogical skills, the integration of technology into education, the provision of an active learning environment that allows pupils to control their learning and increase motivation for classes as flexibility in learning situations.

During the analysis of studies in the literature, it was noted that there are studies indicating the high quality of knowledge obtained in a blended learning environment (Carman J. M. 2002; Lilje O., Peat M., 2012; Cavalli E., et al.2007).

Osguthorpe R. T., Graham C. R. (2003) classified the benefits of blended learning as facilitating access to information, facilitating social interaction, and ensuring the enrichment of pedagogy with technology.

Most of the teachers who participated in the study stated that the inadequate programs they provide for blended learning, the vulnerability of the software and hardware used in the course, as well as the inability to use technology effectively, are disadvantages of teaching mathematics in a blended learning environment. Emphasizing the low subjective competence of teachers and pupils and difficulties in measuring and evaluating, technical problems as shortcomings, they cannot be solved quickly. Graham C. R. (2006) said in his research that the effectiveness of a blended learning environment depends on the development of pupils' subjective competencies.

Oh E., Park S. (2009) stated in their study that one of the main disadvantages of a blended learning environment is the lack of evaluation criteria. On the one hand, Kim K., Baylor A. L. (2008) argued that the use of the Internet in a blended learning environment leads to limitations in the use of teaching methods. On the other hand, teachers claimed that the attitude of pupils to the use of technology in education was positive.

5. CONCLUSION

As in all spheres of life, the influence of technology affects the field of education, and the use of technology in education has become a necessity in our century. The blended learning resulting from the integration of face-to-face and online education offers pupils new educational opportunities.

Therefore, in this study, the impact of the use of blended learning technology in mathematical education on the effectiveness of teaching was evaluated taking into account the opinions of teachers. As a result of the study, the majority of mathematics teachers noted that the use of blended learning technology has a positive effect on the effectiveness of learning. Most of the teachers who participated in the study noted the diversity of the provision of educational materials, access to various teaching methods that allow pupils to manage themselves and encourage them to study independently, as an advantage of using blended learning technology in teaching mathematics. And as a disadvantage, the insufficient software of the blended learning environment, the vulnerability of the software and hardware of online learning, as well as the inability of teachers to use technology effectively, showed. Therefore, it was revealed the need to take special advanced training courses that teach methods of applying the technology of blended learning in mathematical education.

Therefore, based on the above, it can be concluded that the use of blended learning technology in mathematical education is effective for increasing the interest of pupils, the effectiveness of learning and, thus, improves the quality of education.

6. RECOMMENDATIONS

In the course of the study, the approaches of mathematics teachers to the impact of the use of blended learning technology in school mathematics on the effectiveness of teaching revealed the problems faced by blended learning environments. The following recommendations were made in this direction:

1. Before starting work in a blended learning environment, teachers must take special refresher courses on this issue.
2. Educational institutions should ensure the elimination of software and hardware deficiencies and technical deficiencies necessary for the application of blended learning.
3. To develop a methodology for the use of blended learning technology to increase the motivation of pupils to study mathematics, the effectiveness of learning effectiveness.

REFERENCES

- Acelajado, M. J. (2011). Blended learning: a strategy for improving the mathematics achievement of pupils in a bridging program. *Electronic Journal of Mathematics and Technology*, 5(3), 342-352. Blended learning: a strategy for improving the mathematics achievement of pupils in a bridging program - Document - Gale Academic OneFile
- Attard, C., & Holmes, K. (2020). An exploration of teacher and student perceptions of blended learning in four secondary mathematics classrooms. *Mathematics Education Research Journal*, 1-22. <https://link.springer.com/article/10.1007/s13394-020-00359-2>
- Barkatsas, A. T., Kasimatis, K., & Gialamas, V. (2009). Learning secondary mathematics with technology: Exploring the complex interrelationship between pupils' attitudes, engagement, gender and achievement. *Computers & Education*, 52(3), 562-570. <https://doi.org/10.1016/j.compedu.2008.11.001>
- Bonk C. J., Graham, C. R. (2006). *Handbook of blended learning: Global perspectives, local designs*. San Francisco, CA: Pfeiffer Publishing
- Carman, J. M. (2002). Blended learning design: Five key ingredients. https://www.it.iitb.ac.in/~s1000brains/rswork/dokuwiki/media/5_ingredientsofblended_learning_design.pdf
- Cavalli, E., Gnudi, A., Iovino, D., Lorenzi, A., & Malvisi, L. (2007, June). Lecturer perception of the effectiveness of blended learning and institutional support mechanisms. In EDEN 2007 Annual Conference. <https://lorenzi.info/doc/EdenNaples07.pdf>
- Cekici, E., & Yildirim, H. (2011). A review on mathematics education. *Marmara University Journal of Economics and Administrative Sciences*, 31(2), 175-196. <https://dergipark.org.tr/en/pub/muiibd/issue/498/4452>
- Charlier, B., & Platteaux, H. (2005). Effects of a blended learning system for university teachers training. *Journal of Educational Research*, 19(3), 276-300. https://www.unifr.ch/nle/fr/assets/public/files/publications_scientifiques/EARLI2005_Article_BCHP_V32.pdf
- Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications. Poth - Google Kitaplar

- Fogarty, G., Cretchley, P., Harman, C., Ellerton, N., & Konki, N. (2001). Validation of a questionnaire to measure mathematics confidence, computer confidence, and attitudes towards the use of technology for learning mathematics. *Mathematics Education Research Journal*, 13(2), 154-160. <https://link.springer.com/article/10.1007/BF03217104>
- Friesen N. (2012). Defining Blended Learning [Отчет] https://www.normfriesen.info/papers/Defining_Blended_Learning_NF.pdf
- Garrison, D. R., & Vaughan, N. D. (2008). *Blended learning in higher education: Framework, principles, and guidelines*. John Wiley & Sons. <https://doi.org/10.1002/9781118269558>
- Graham, C. R. (2006). Blended learning systems. *The handbook of blended learning: Global perspectives, local designs*, 1, 3-21. *The Handbook of Blended Learning: Global Perspectives, Local Designs* - Curtis J. Bonk, Charles R. Graham - Google Kitaplar
- Heba, E. D., & Nouby, A. (2008). Effectiveness of a blended e-learning cooperative approach in an Egyptian teacher education programme. *Computers & Education*, 51(3), 988-1006. <https://doi.org/10.1016/j.compedu.2007.10.001>
- Kholifah, N., Sudira, P., Rachmadtullah, R., Nurtanto, M., & Suyitno, S. (2020). The effectiveness of using blended learning models against vocational education student learning motivation. *International Journal*, 9(5), 7964-7968. <https://doi.org/10.30534/ijatcse/2020/151952020>
- Kim, C., & Baylor, A. L. (2008). A virtual change agent: Motivating pre-service teachers to integrate technology in their future classrooms. *Journal of Educational Technology & Society*, 11(2), 309-321. <https://eric.ed.gov/?id=EJ814111>
- Kuo, Y. C., Walker, A. E., Belland, B. R., Schroder, K. E., & Kuo, Y. T. (2014). A case study of integrating Interwise: Interaction, internet self-efficacy, and satisfaction in synchronous online learning environments. *International Review of Research in Open and Distributed Learning*, 15(1), 161-181. <https://doi.org/10.19173/irrodl.v15i1.1664>
- Larsen, A. J. (2013). *Experiencing a flipped mathematics class* (Doctoral dissertation, Education: Faculty of Education). <http://summit.sfu.ca/item/13608>
- Marshall, C., & Rossman, G. B. (2014). *Designing qualitative research*. Sage publications. *Designing Qualitative Research* - Catherine Marshall, Gretchen B. Rossman - Google Kitaplar
- Lilje, O., & Peat, M. (2012). Use of traditional and elearning components in a blended learning environment. In *Proceedings of The Australian Conference on Science and Mathematics Education*. <https://openjournals.library.usyd.edu.au/index.php/IISME/articleview/6369>
- Oh, E., & Park, S. (2009). How are universities involved in blended instruction?. *Journal of Educational Technology & Society*, 12(3), 327-342. <https://eric.ed.gov/?id=EJ857449>
- Osguthorpe, R. T., & Graham, C. R. (2003). Blended learning environments: Definitions and directions. *Quarterly review of distance education*, 4(3), 227-33. <https://www.learntechlib.org/p/97576/>
- Purnima V. (2002). *Blended Learning Models*. Published: August, 2002. URL: <https://www.purnima-valiathan.com/wp-content/uploads/2015/09/Blended-Learning-Models-2002-ASTD.pdf>
- Reed, H. C., Drijvers, P., & Kirschner, P. A. (2010). Effects of attitudes and behaviours on learning mathematics with computer tools. *Computers & education*, 55(1), 1-15. <https://doi.org/10.1016/j.compedu.2009.11.012>
- So, H. J., & Brush, T. A. (2008). Student perceptions of collaborative learning, social presence and satisfaction in a blended learning environment: Relationships and critical factors. *Computers & education*, 51(1), 318-336. <https://doi.org/10.1016/j.compedu.2007.05.009>

- Singh, H., & Reed, C. (2001). A white paper: Achieving success with blended learning. Centra software, 1, 1-11. <http://www.leerbeleving.nl/wbts/wbt2014/blend-ce.pdf>
- Uluyol, A. G. C., & Karadeniz, S. (2009). An example of a blended learning environment, student achievement and opinions. Centennial University Journal of the Faculty of Education, 6(1), 60-84. <https://dergipark.org.tr/en/pub/yyuefd/issue/13711/165995>
- Wilson, D., & Smilanich, E. M. (2005). The other blended learning: a classroom-centered approach. John Wiley & Sons. <https://docs.edtechhub.org/lib/Z3R5NFEU>
- Yildirim, İ., & Vural, O. F. (2016). Student views on the blended learning process integrated into mathematics teaching. Journal of Ahi Evran University Kirsehir Education Faculty, 17(2), 1-15. <https://dergipark.org.tr/en/pub/kefad/issue/59426/853554>
- Yushau, B. (2006). The effects of blended e-learning on mathematics and computer attitudes in pre-calculus algebra. The mathematics enthusiast, 3(2), 176-183. <https://scholarworks.umt.edu/tme/vol3/iss2/5/>