Research Article

Thematic Content Analysis of Blended Learning Studies in the Field of Mathematics Education

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Article Info	Abstract
	The goal of this research is to examine the methodological trends and outputs of blended learning studies focusing on mathematics education. Accordingly, thematic content analysis was used in the current research. Studies were screened through electronic databases which include Web of Science, SCOPUS, ERIC (Education Resources Information Center), ULAKBIM (the Turkish Academic Network and Information Centre), DergiPark (JournalPark) and CoHE Thesis Center (the Council of Higher Education in Turkey). After the keywords and filters specified in the databases were searched, a total of 1299 research and 72 thesis studies were determined. Among these studies, the PRISMA method was used to select the studies to be included in the current research. At the end of all reviews, 11 articles and 4 theses were included in the current research. The results of studies emphasized that blended learning affected students' views, problem solving skills, self-regulation skills and more than half of the independent variables positively.

Introduction

Advantages such as the ability of students to access the course content independent of time and space and to repeat the prepared documents and videos as much as they want in online learning environments make online environments the best alternatives of face-to-face education (Hunma, 2018). Studies have shown that online learning environments and face-to-face learning environments can be parts of a system in time as well as being alternatives to each other (Soydaş-Çakır, & Akyazı, 2021). The flexible use of online environments, especially for theoretical subjects, enable the acquisition of theoretical knowledge to be obtained through face-to-face education without the need for a classroom environment. Thus, more time can be spent on face-to-face education for practice-based learning activities (Berry, 2019). However, studies highlight the quality of pedagogical practices rather than the tools used to improve the learning process (Arrosagaray, González-Peiteado, Rino-Juste &

Rodriguez-Lopez, 2019). The use of both face-to-face and online learning environments with different pedagogical approaches has revealed the blended learning approach.

Blended learning can be considered as an approach that combines various instructional technologies, especially web-based technologies, with pedagogical approaches and integrates them into the learning process (Driscoll, 2002). According to Garrison and Kanuka (2004), blended learning is defined as the integration of face-to-face learning experiences in the classroom with online learning experiences. According to Finn and Buceri (2004), blended learning is the use of more than one communication, technology, and method in harmony with each other in order to respond to the needs of the teaching process. In the literature, most definitions of the blended learning approach focus on the integration of online and face-to-face learning (Smith & Hill, 2019). Graham, Allen, and Ure (2005) divide the definitions of blended learning into three types:

1. Combining tools and knowledge transmission methods in the process of education,

2. Combining instructional methods,

3. Combining online and face-to-face instruction.

In the blended learning approach, different procedures can be followed according to the needs of students, course content and available resources. Blended learning helps students interact with each other more by increasing their communication skills, and it helps increase their self-awareness and have a positive experience in collaboration with their teachers and friends (Richardson & Ice, 2010). Besides, studies in the literature have reported that students can use their time more flexibly (Smith & Hill, 2019), student-student and teacher-student interactions are more efficient (Han & Ellis, 2019) and participation can be increased by using various learning materials (Mestan, 2019; Nyika & Modise, 2022). Many advantages of blended learning can also be considered such as providing feedback and process evaluation, facilitating students' access to the wealth of information resources and motivating students for the course (Smyth, Houghton, Cooney & Casey, 2012). To take advantage of these opportunities given by blended learning at a high level, it is important to support the opportunities of online learning and in-class communication provided by face-to-face learning (Garrison & Vaughan, 2008).

In accordance with the expressions in the literature, some activities and practices which are planned to be included in the learning process continue outside of the classroom environment while the traditional face-to-face courses in blended learning are continued.

Many different distance education practices can be used for out-of-class activities. Besides, Web 2.0 tools which have become increasingly popular in recent years can be used for out-of-class activities. In the blended learning approach, learning management systems are used, which are in distance education and enable the overall learning process to be managed. With learning management systems, the materials needed by students can be provided, the course flowchart can be planned and followed, students can communicate with their friends and teachers, discussion environments can be created, and feedback and evaluation processes can be completed. There are many learning management systems such as Moodle, Blackboard, Edmodo that can be used in blended learning. When the advantages and disadvantages of the blended learning approach are well known, the potential of supporting and improving the learning process will become clearer (Garrison & Kanuka, 2004).

In recent years, blended learning has become widespread and has a wide range of applications, especially in higher education (Jonker, März, & Voogt, 2018). Derntl and Motschnig-Pitrik (2005) also state that focusing especially on instructional technologies in university education shows the importance of blended learning. In the literature, it is possible to find studies which examine blended learning in different dimensions (Poon, 2012) and investigate the effect of blended learning on various variables (Mestan, 2019). Also, it is possible to find studies which systematically examine research focusing on the blended learning approach by bringing them together. In one of these studies, Cirak-Kurt, Yildirim, and Cucuk (2018) have investigated the blended studies which examine students' academic success in Turkey by using the meta-analysis method. They have evaluated 32 experimental studies conducted between the years 2000-2016. In another study, Hebebci and Usta (2015) have also examined master's and doctoral theses about blended learning in Turkey. 27 master's and 17 doctoral studies between the years 2005-2014 in the National Thesis Center were evaluated. Batdı (2014) have also examined the experimental studies on blended learning carried out between the years 2009 and 2014. As a result of the searches in Google Scholar and the National Thesis Center, three articles and six theses have been examined. Due to the multidimensional frame of the blended learning approach, studies need to be synthesized and evaluated at regular intervals. Besides, Rasheed, Kamsin, and Abdullah (2020) indicate that literature is insufficient to reveal the difficulties in the online component of blended learning in detail. In this context, the current research will make important contributions to the literature. By considering the deficiencies in the literature, the goal of

this research is to examine the methodological trends and outputs of blended learning studies focusing on mathematics education. In line with the purpose of the research, the following research questions were investigated:

1. What are the methodological trends of blended learning studies focusing on mathematics education?

    1.1. What is the distribution of blended learning studies focusing on mathematics education by years?

    1.2. What is the distribution of methods used in blended learning studies focusing on mathematics education?

    1.3. What is the distribution of sample levels and intervals of blended learning studies focusing on mathematics education?

    1.4. What is the distribution of data collection tools used in blended learning studies focusing on mathematics education?

    1.5. What is the distribution of data analysis types in blended learning studies focusing on mathematics education?

    1.6. What are the online systems in blended learning studies focusing on mathematics education?

    1.7. What are the blended learning models used in blended learning studies focusing on mathematics education?

    1.8. Which variables are examined in blended learning studies focusing on mathematics education?

2. What are the outputs of blended learning studies focusing on mathematics education?

    2.1. What are the results of blended learning studies focusing on mathematics education?

    2.2. What are the recommendations of blended learning studies focusing on mathematics education?

Method

The goal of this research is to examine the methodological trends and outputs of blended learning studies focusing on mathematics education. Accordingly, the thematic content analysis method was used in the research. The reason is that the thematic content analysis provides a broad perspective for researchers as a result of synthesizing the studies in any field with a critical perspective by creating themes and templates (Çalık & Sözbilir, 2014).

Literature Review

In the research, international and national databases were searched to examine the methodological trends and outputs of blended learning studies focusing on Mathematics education. In accordance with the research purpose, studies were screened through electronic databases which include Web of Science, SCOPUS, ERIC (Education Resources Information Center), ULAKBIM (the Turkish Academic Network and Information Centre), DergiPark (JournalPark) and CoHE Thesis Center (the Council of Higher Education in Turkey). The searched databases, keywords and filters are as follows:

- In the Web of Science database, the keyword "blended learning or hybrid learning or mixed type learning" and the filters "Countries/Regions: Turkey, Document Types: Articles" were used.

- In the SCOPUS database, the keyword "blended learning or hybrid learning or mixed type learning and Turkey" was used.

- In the ERIC database, the keywords "blended learning and Turkey", "hybrid learning and Turkey" and "mixed type and Turkey" were used.

- In the ULAKBIM database, the keyword "harmanlanmış öğrenme veya hibrit öğrenme veya karma öğrenme" was used.

- In the Dergipark database, the keyword "harmanlanmış öğrenme OR karma öğrenme OR hibrit öğrenme" was used.

- In the CoHE Thesis Center database, the keyword "harmanlanmış öğrenme veya karma öğrenme veya hibrit öğrenme" was used.

No time filter was used for the searches. Searches were completed between October and December 2021. Also, studies being in the databases until the end of December 2021 were examined.

Selection of the Studies for the Research

After the keywords and filters specified in the databases were searched, a total of 1299 research and 72 thesis studies were determined. Among these studies, the PRISMA method was used to select the studies to be included in the current research. According to the PRISMA method, the titles, abstracts, and keywords of the studies found in the databases were firstly examined. As a result of the examination, 1274 articles and 46 theses were eliminated. Then, among the remaining 25 articles and 26 thesis studies, the repeated studies

were eliminated, and their full texts were examined. Later, 4 studies and 16 thesis studies were eliminated. In the third phase, 21 articles and 10 theses were examined in terms of suitability for the research purpose. As a result of the examination, 10 articles and 6 theses were eliminated. At the end of all phases, 11 articles and 4 theses were included in the current research. This process is summarized in Figure 1.
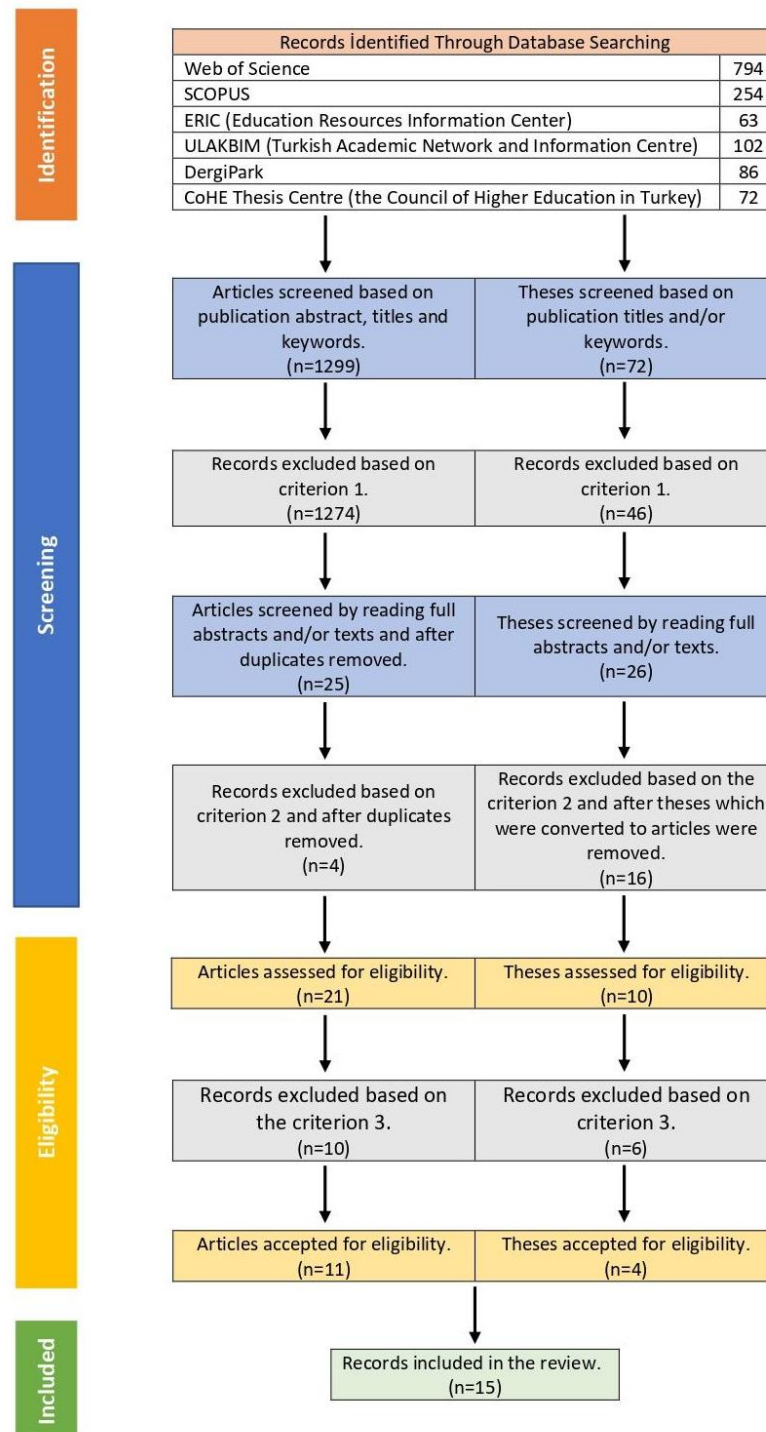

Figure 1. Selection of the studies for the research (PRISMA Flow Chart) (Moher et al., 2009)

Data Collection Tool

While the data of the studies included in the research were obtained, the publication review form developed by Göktaş et al. (2012) was used by adapting to the research. In this context, the year, method, sample level and number, data collection tools, data analysis, the used online system, the purpose of the studies, the examined variables, results, and recommendations were collected with the adapted data collection tool.

Data Analysis

In the research, 11 articles and 4 theses, which were determined as a result of the literature review, were analysed in order to examine the methodological trends and outputs of blended learning studies focusing on mathematics education. 11 themes were determined including the year, method, sample level and number, data collection tools, data analysis, the used online system, the purpose of the studies, the examined variables, results, and recommendations. The studies included in the research were examined according to the themes determined by using the data collection tool. An example review of a study is presented in Table 1.

Table 1. A sample analysis within the scope of the research

Themes	Codes
Year	2020
Method	Experimental
Sample Level	University students
Sample Size	163
Data Collection Tool	Achievement Test, Scale
Data Analysis	Descriptive, Predictive
Online System	Moodle
Purpose	The Effect on the Dependent Variable (E-learning (EL), The Effect of Blended Learning (BL) and Flipped Learning (FL) Approaches on Mathematics Achievement, Self-regulation, and Mathematics Self-efficacy
Examined Variables	Academic Success, Self-regulation, Mathematics Self-efficacy
Result	Significantly Positive Impact
Recommendations	Experimental Comparison of the Traditional FL Approach with the FL Designed According to Merrill's Principles.

Each of the 11 articles and 4 thesis studies included in the research was coded as seen in Table 1. In order to ensure the reliability of the codes, the results of the analysis were shared with two field experts and their feedback was received. The determined codes were examined together in cases where different opinions arose. The researcher and two field

experts reach a consensus. Thus, thematic analysis was completed by giving the final form to the codes created by examining the studies.

Validity and Reliability

To ensure the validity and reliability of the research, credibility, transferability, consistency and confirmability by Lincoln and Guba (1985) were used. One of the methods used to increase credibility is expert review. According to Creswell (2012), expert review is the examination of the study in various dimensions by both field experts and people who have sufficient experience in qualitative research methods. In this context, necessary arrangements were made by taking the opinions of field experts in determining the keywords used in the literature review, adapting the data collection tool and determining the themes and codes. Sharts-Hopko (2002) emphasizes that details of how the sample is determined and how the data are collected should be explained to ensure transferability. In the research, both the selection of the studies to be included in the research and the process of data collection and data analysis were explained in detail. In order to ensure confirmability, the results obtained by researchers should be confirmed by comparing them with the raw data (Yıldırım & Şimşek, 2008). The selection process, codes and themes of the studies examined in the research were recorded at every stage of the research and controlled repeatedly. Shenton (2004) states that the results should not be affected by the personal comments of the researchers and should be based on research data in order to ensure consistency in studies. In the research, it was tried to ensure consistency by making the process of data collection and analysis systematic. Besides, it was tried to reveal the results to be reached at the end of the research based on the data by taking the opinions of field experts at many stages of the process of data collection and analysis.

Finding

Research results aiming to examine the methodological trends and outputs of blended learning studies focusing on mathematics education are presented within the framework of research questions.

The Methodological Trends of Blended Learning Studies Focusing on Mathematics Education

The first research question is to examine the methodological trends of blended learning studies focusing on mathematics education. In this context, the distribution of the studies by years was firstly examined and presented in Figure 2.
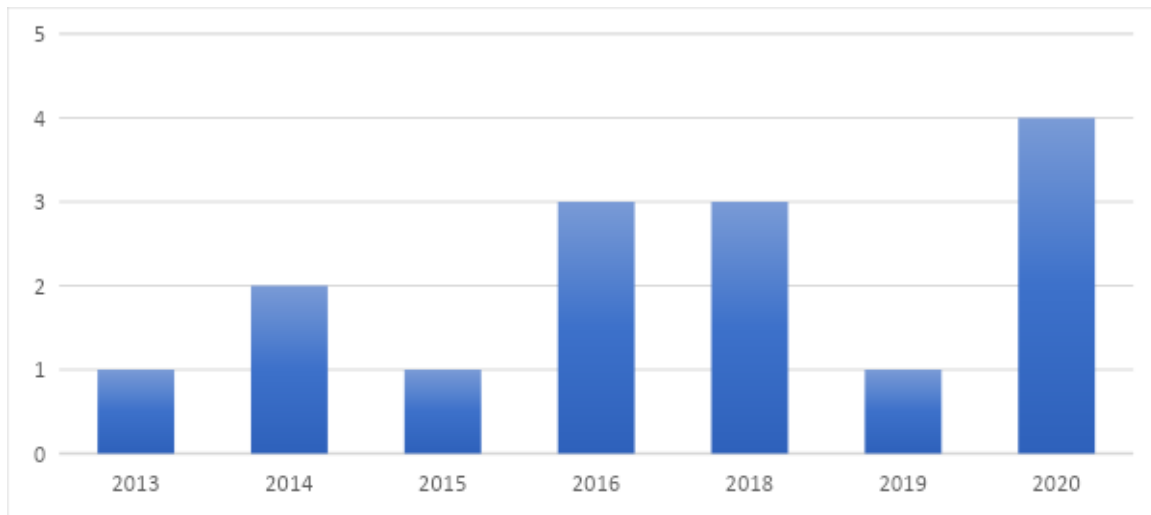

Figure 2. The distribution of the studies by years

In Figure 2, there are two of all the blended learning studies focusing on mathematics education in 2014, three of all the blended learning studies focusing on mathematics education between the years 2016-2018 and four of all the blended learning studies focusing on mathematics education in 2020. When considering the methods used in the studies, the experimental methods were preferred in most of them. The distribution of the methods used in the studies is presented in Figure 3.
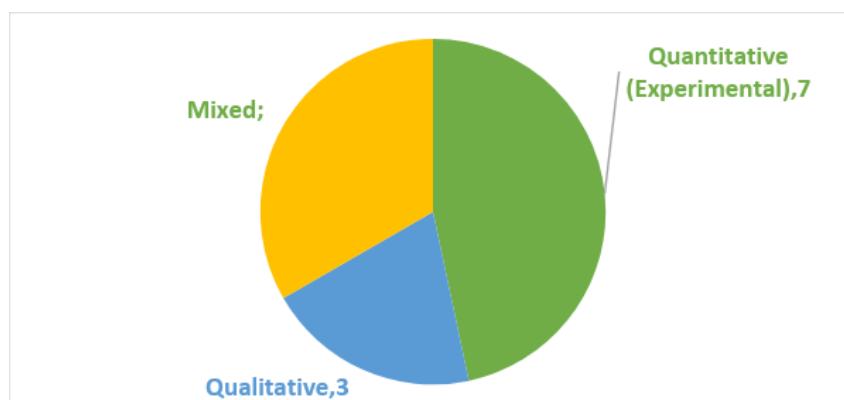

Figure 3. The distribution of the methods used in the studies

In Figure 3, 12 studies included in the research were conducted with 7 quantitative, 5 mixed and 3 qualitative methods. Another dimension of the studies examined in terms of

methods was sample sizes and levels. The sample levels of the studies included in the research are presented in Figure 4.
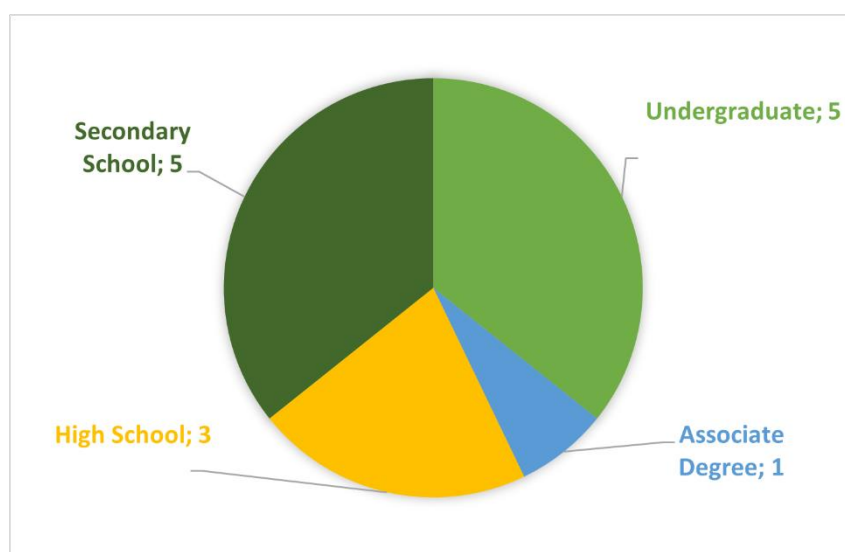

Figure 4. Sample levels of the studies

In terms of sample levels, 5 of the studies at bachelor's degree, 1 of the studies at associate degree, 3 of the studies at high school and 5 of the studies at secondary school level were carried out. The studies whose sample numbers were examined had sample numbers between 30 and 163. When the data collection tools and data analysis methods in the studies were examined, descriptive, predictive and content analysis were used as types of data analysis in which the achievement test and scales are in majority. The distribution of the data collection tools and data analysis methods in the studies are presented in Table 2.

Table 2. Data collection tools and data analysis methods in the studies

Data Collection Tools	f	Data Analysis Methods	f
Achievement Test	11	Predictive Analysis	11
Scale	8	Descriptive Analysis	10
Interview Form	8	Content Analysis	10
Observation Form	2		

When considering the online systems used in blended learning studies focusing on mathematics education, four studies include the Moodle system and one study includes the Maple, Edmodo, and Kahoot software. Besides, two studies included systems developed by the researchers. In some studies, the details of the used systems were also not mentioned.

The blended learning approach used in the studies was emphasized in only four studies and these studies included the flipped classroom approach.

The last dimension evaluated while examining the methodological trends of the studies was the dependent variables examined in these studies. The dependent variables examined in the studies are presented in Table 3.

Table 3. The examined variables in the studies

The Examined Variables	*f*
Academic Success	10
Students' Views	5
Problem-solving Skills	2
Attitude towards the Course	2
Self-regulation Skills	2
Mathematics Self-efficacy	1
Motivation	1
Perception of Success	1
Procedural Skills	1
Perception of Self-efficacy	1
Mathematics Anxiety Levels	1
Technology Attitude	1
Conceptual Understanding	1
Perception of Roles and Responsibilities	1

As shown in Tablo 3, the variable "academic success" was mostly examined in the studies. The variable "students' views" was ranked as the second. Additionally, the dependent variables such as problem-solving skills, attitude towards the course and self-regulation skills were examined in the studies.

What are the Outputs of Blended Learning Studies Focusing on Mathematics Education?

The second research question is to examine the outputs and recommendations of blended learning studies focusing on mathematics education. In this context, the results of the studies included in the research were firstly discussed. The results of the studies were analysed by the content analysis method. The codes and themes are presented in Table 4.

Table 4. The outputs of the studies

Themes	Codes	*f*
Positive Effect	Students' academic success increased	7
	Students' views were positively affected	4
	Students' problem-solving skills increased	2
	Students' self-regulation skills increased	2
	Traditional learning activities changed (in-class & out-of-class activities)	1

	The role of teachers and students in the learning process changed	1
	Teacher-student and student-student interaction changed	1
	Students' conceptual understanding skills increased	1
	Students' procedural skills increased	1
	Students' active participation in the course increased	1
	Students' positive attitudes towards the course increased	1
	Mathematics self-efficacy increased	1
	Students' mathematics anxiety level decreased	1
	Students' positive attitudes towards technology increased	1
Ineffective	Students' attitudes towards the course did not change	1
	Students' perceptions of self-efficacy did not change	1
	Students' motivation did no changed	1
	Students' views did not change	1
	Students' academic success did not change	3
Negative Effect	Students' perception of success decreased	1

As shown in Table 4, the blended learning approach has different effects on dependent variables. Although the results of the studies report the positive effects of the blended learning approach more, there are also studies that cannot detect any significant effects or that detect negative effects. The most frequently mentioned result in the results of the studies structured within the framework of dependent variables was related to academic success. According to the results of the studies, seven studies showed that the blended learning approach increased students' academic success. Besides, three studies reported that the blended learning approach did not reveal a significant difference in students' academic success. Additionally, the results of studies emphasized that blended learning affected students' views, problem solving skills, self-regulation skills and more than half of the independent variables positively.

Another part of the second research question is to examine the recommendations of blended learning studies focusing on mathematics education. In this context, the recommendations of the studies were examined by the content analysis method. The results are given in Table 5.

Table 5. Recommendations of the studies

Themes	Codes
	The traditional FL approach can be experimentally compared with FL designed according to Merrill's principles
For Researchers	New experimental studies can be conducted by increasing the frequency of feedback
	The Flipped Classroom Model and Flipped Mastery Classroom Model can be compared experimentally

	Contributions can be made to improvements by collecting more data through the system used in experimental studies
	The different size of images and contents can be used on the online system
	Students' views on adaptive software programs can be examined
	Interaction can be increased by enriching the content used
	Preferring students with different characteristics when creating groups in classroom activities can prevent problems in group activities
	Gamification can be used with the blended learning approach
	Interesting technological innovations such as augmented reality and virtual reality can be used in the blended learning approach
	The pilot activities before the actual application stage can be conducted with students who do not have any blended learning experience
For Educators	The use of the blended learning approach at different levels except for a bachelor's degree can contribute to the learning process
	Social media tools can be used in the blended learning approach
	Technical units can be established to provide technical support to teachers and students
	The blended learning approach can be used in different levels of special education by combining it with gamification activities
	The different software can be integrated into the blended learning approach
	The blended learning approach can be used in different subject areas of mathematics and in different disciplines.

As shown in Table 5, recommendations are generally for researchers and educators. For researchers, it is clear that recommendations are given in relation to the experimental studies that can be about the blended learning approach and the points to be considered in these studies. It is seen that there are recommendations in the experimental process for increasing the frequency of feedback, using different models and approaches, and using images and content. For educators, recommendations are also given about the points to be considered when using the blended learning approach. Recommendations for conducting pilot studies for students who do not have experience with the blended learning approach, using social media tools in the actual application stage, and using technologies such as augmented reality and virtual reality are some of these.

Discussion and Conclusion

The goal of this research is to examine the methodological trends and outputs of blended learning studies focusing on mathematics education. In this context, the methodological trends of the studies were discussed in the first research question.

When blended learning studies focusing on mathematics education are examined, it is seen that they have been carried out in recent years (Demir, 2020). When considering the global impact of COVID-19 on distance education, it can be said that blended learning

studies, thus, will become increasingly widespread. Of the preferred methods in the studies, the quantitative method was adopted more (Yorganci, 2020). It can be seen as a result of the preference of experimental studies. The different levels were preferred as the sample level and the diversity was provided. In the studies, different online systems such as Maple, Edmodo, and Kahoot, especially moodle, were used (Öner, Yıldırım & Bars, 2014; Yıldırım & Vural, 2016). Achievement tests, scales and interview forms were used as data collection tools. Of the variables, academic success was ranked as first. Additionally, students' views, problem-solving skills, attitudes towards the course and self-regulation skills were among the examined variables (Akkuş, 2014).

The second research question is to examine the outputs and recommendations of blended learning studies focusing on mathematics education. In this context, the results of the studies were examined, and the results were grouped under three themes as positive effect, negative effect and ineffective. The positive results showed that academic success increased (Demir, 2020), students' views were positively affected (Dürnel, 2018), problem-solving (Şimşek & Jale, 2016) and self-regulation skills increased (Yorganci, 2020). Similarly, Richardson and Ice (2010) indicates that the blended learning approach increases students' communication skills and helps students interact with their teachers and friends more by increasing their communication skills, and accordingly they experience a positive learning process. In the blended learning approach, it is important to create a learning environment that encourages students to cooperate with their peers and teachers, besides using instructional technologies (Johnson, Hornik & Salas, 2008). Furthermore, the fact that online learning environments being a part of blended learning allow an unlimited number of repetitions and access to course content may be one of the reasons why students develop a positive opinion about the blended learning approach (Kim, 2012).

Besides, it was reported that the examined variables in the results of the studies were not affected positively or negatively. Attitudes towards the course (Şimşek & Jale, 2016), perception of self-efficacy (Akkuş, 2014), self-regulation skills (Dürnel, 2018), motivations and academic success (Akkuş, 2014) were included. As seen in the results of the studies, the only negative effect was on the students' perception of success (Yıldırım & Vural, 2016).

As for recommendations, it was seen that they were for researchers and educators. For researchers, these are about the methods to be used in the future studies, software (Çakır, Teker & Can Aybek, 2015) and content (Yıldırım & Vural, 2016) and the use of the flipped

classroom model (Yorganci, 2020). For educators, attention was drawn to some points that should be considered when using the blended learning approach in courses. For instance, recommendations such as conducting pilot activities for students without blended learning experience (Yıldırım & Vural, 2016), including social media tools (Akkuş, 2014) and choosing different approaches such as gamification (Demir, 2020) in classroom activities were included in the research.

Limitations and Future Studies

The current research, which aims to examine the methodological trends and outputs of blended learning studies focusing on mathematics education, has important results for the literature, but it has notable limitations. When considering these limitations, it is important to evaluate the research results. First of all, this research has limitations of the content analysis method. Additionally, the research is limited because studies were scanned via electronic databases which include Web of Science, SCOPUS, ERIC (Education Resources Information Center), ULAKBIM (the Turkish Academic Network and Information Centre), DergiPark (JournalPark) and CoHE Thesis Center (the Council of Higher Education in Turkey). For future studies, the scope of the research can be expanded by adding different databases. The research is also limited to 1299 studies and 72 thesis studies. Besides, studies originating from Turkey were included in the study. In this context, different countries may be included in the studies to be carried out.

Acknowledgement

Due to the scope and method of the study, ethics committee permission was not required.

Author Contribution Statement

Seda AKTI ASLAN: *Literature review, determination of the problem situation, determining the method, selection of the studies for the research, collecting data, analyzing data, creating conclusion and discussion sections, reporting, writing, auditing and editing processes.*

References

Akkuş, M. (2001). *Diferansiyel denklemler öğretimi için harmanlanmış öğrenme yöntemi* (Doktora Tezi) [Blended learning method for teaching differential equations (PhD Thesis)]. Selçuk Üniversitesi, Konya.

Arrosagaray, M., González-Peiteado, M., Pino-Juste, M., & Rodríguez-López, B. (2019). A comparative study of Spanish adult students' attitudes to ICT in classroom, blended and distance language learning modes. *Computers & Education*, *134*, 31-40.

Batdı, V. (2014). Harmanlanmış öğrenme ortamlarının öğrencilerin akademik başarılarına etkisi: Bir meta-analiz çalışması [The effect of blended learning environments on students' academic achievement: A meta-analysis study]. *Çankırı Karatekin Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *5*(1), 287-302.

Berry, S. (2019). Professional development for online faculty: instructors' perspectives on cultivating technical, pedagogical and content knowledge in a distance program. *Journal of Computing in Higher Education*, *31*(1), 121-136.

Cakir, O., Teker, E., & Can Aybek, E. (2015). The effect of adaptive learning environment in teaching the number concept to students with intellectual disabilities. *Croatian Journal of Education*, *17*(Sp. Ed. 4), 199-221.

Cirak-Kurt, S., Yildirim, I., & Cucuk, E. (2018). The effects of blended learning on student achievement: A meta-analysis study. *Hacettepe Unıversıty Journal of Educatıon*, *33*(3), 776-802.

Creswell, J. W. (2012). *Educational research: planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Boston: Pearson.

Çalık, M., & Sözbilir, M. (2014). İçerik analizinin parametreleri [Parameters of content analysis]. *Eğitim ve Bilim*, *39*(174).

Demir, Ü. (2020). An examination of the impact of game-based geometric shapes education software usage on the education of students with intellectual disabilities. *ECNU Review of Education*, 2096531120940721.

Derntl, M., & Motschnig-Pitrik, R. (2005). The role of structure, patterns, and people in blended learning. *The Internet and Higher Education*, *8*(2), 111-130.

Driscoll, M. (2002). Blended learning: Let's get beyond the hype. *E-learning*, *1*(4), 1-4.

Dürnel, A. (2018). *5. sınıf matematik dersinin harmanlanmış öğrenme ortamında işlenmesi: Bir durum çalışması* (Yüksek lisans Tezi) [*Processing of 5th grade mathematics course in blended learning environment: A case study* (Master's Thesis)]. Bahçeşehir Üniversitesi, İstanbul.

Finn, A., & Bucceri, M. (2004). A case study approach to blended learning. *Los Angeles: Centra Software.*

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The internet and higher education*, *7*(2), 95-105.

Garrison, D. R., & Vaughan, N. D. (2008). *Blended learning in higher education: Framework, principles, and guidelines*. John Wiley & Sons.

Göktaş, Y., Küçük, S., Aydemir, M., Telli, E., Arpacık, Ö., Yıldırım, G., & Reisoğlu, İ. (2012). Türkiye'de eğitim teknolojileri araştırmalarındaki eğilimler: 2000-2009 dönemi makalelerinin içerik analizi [Educational technology research trends in Turkey: A content analysis of the 2000-2009 decade]. *Kuram ve Uygulamada Eğitim Bilimleri Dergisi*, *12*(1), 177-199.

Graham, C. R., Allen, S., & Ure, D. (2005). Benefits and challenges of blended learning environments. In *Encyclopedia of Information Science and Technology, First Edition* (pp. 253-259). IGI Global.

Han, F., & Ellis, R. A. (2019). Identifying consistent patterns of quality learning discussions in blended learning. *The Internet and Higher Education*, *40*, 12-19.

Hebebci, M. T., & Ertuğrul, U. (2015). Türkiye'de harmanlanmış öğrenme eğilimleri: Bir literatür çalışması [Blended learning trends in Turkey: A literature review study]. *Adıyaman Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, (19), 195-219.

Hunma, A. (2018). Students make history every day just by sitting on these steps: Performative spaces and re-genring in the South. *Education as Change*, *22*(1), 1-25.

Johnson, R. D., Hornik, S., & Salas, E. (2008). An empirical examination of factors contributing to the creation of successful e-learning environments. *International Journal of Human-Computer Studies*, *66*(5), 356-369.

Jonker, H., März, V., & Voogt, J. (2018). Teacher educators' professional identity under construction: The transition from teaching face-to-face to a blended curriculum. *Teaching and Teacher Education*, 71,120-133

Kim, J. Y. (2012). A study on learners' perceptional typology and relationships among the learner's types, characteristics, and academic achievement in a blended e-education environment. *Computers & Education, 59*(2), 304–315.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage.

Mestan, K. (2019). Create a fine blend: An examination of institutional transition to blended learning. *Australasian Journal of Educational Technology*, *35*(1), 70-84.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group*. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of Internal Medicine*, *151*(4), 264-269.

Nyika, R., & Modise, M.A. (2022). Experiences and challenges of adapting to online learning during covid-19 induced lockdown: The case of gweru urban tertiary students in Zimbabwe. *International e-Journal of Educational Studies*, *6* (12), 272-281. https://doi.org/10.31458/iejes.1164927

Öner, G., Yıldırım, İ., & Bars, M. (2014). The effect of blended learning on students' achievement for the topic of quadratic equation in mathematics education. *Journal of Computer and Education Research*, *2*(4), 152-165.

Poon, J. (2012). Use of blended learning to enhance the student learning experience and engagement in property education. *Property Management*, *30*(2), 129-156.

Rasheed, R. A., Kamsin, A., & Abdullah, N. A. (2020). Challenges in the online component of blended learning: A systematic review. *Computers & Education*, *144*, 103701.

Richardson, J. C., & Ice, P. (2010). Investigating students' level of critical thinking across instructional strategies in online discussions. *The Internet and Higher Education*, *13*(1), 52–59.

Sharts-Hopko, N. C. (2002). Assessing rigor in qualitative research. *Journal of the Association of Nurses in AIDS Care*, *4*(13), 84-86.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information*, *22*(2), 63-75.

Smith, K., & Hill, J. (2019). Defining the nature of blended learning through its depiction in current research. *Higher Education Research & Development*, *38*(2), 383-397.

Smyth, S., Houghton, C., Cooney, A., & Casey, D. (2012). Students' experiences of blended learning across a range of postgraduate programmes. *Nurse Education Today*, *32*(4), 464-468.

Soydaş-Çakır, H. & Akyazı, E. (2021). Interaction increasing factors: Research on e-learning content design. *International e-Journal of Educational Studies (IEJES), 5* (9), 25-40. https://doi.org/10.31458/iejes.786457

Şimşek, K., & Jale, İ. (2016). Harmanlanmış öğrenme ortamlarında bilgisayar cebiri sistemlerinin akademik başarıya etkisi [Effects of computer algebra systems on academic success in blended learning environments]. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi*, *13*(2), 651-679.

Yıldırım, A., & Şimşek, H. (2008). *Sosyal bilimlerde nitel araştırma yöntemleri* [*Qualitative research methods in the social sciences*] (6th ed.). Ankara: Seçkin Yayınevi.

Yıldırım, İ., & Vural, Ö. F. (2016). Matematik öğretimine entegre edilmiş harmanlanmış öğrenme süreci hakkındaki öğrenci görüşleri [Students' views about blended learning process integrated to mathematics education]. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi, 17*(2), 1-15.

Yorganci, S. (2020). Implementing flipped learning approach based on 'first principles of instruction'in mathematics courses. *Journal of Computer Assisted Learning*, *36*(5), 763-779.