A blended learning approach for teaching computer science in high schools

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Abstract

The purpose of this research is to determine the proficiency levels of teachers giving computer education in high schools regarding blended learning. In this study, the competencies of teachers who give computer education in high schools regarding blended learning were handled in accordance with the survey model, which is one of the quantitative research methods. The study group of the research consists of 345 computer teachers who teach in high schools in the city of Almaty, Kazakhstan in the 2021–2022 academic year. The data of the study were collected with the blended learning proficiency scale developed by the researchers. As a result of the research, it was seen that the teachers giving computer education in high schools were high in the motivation sub-dimension of blended learning and moderate in the application sub-dimension. It has been determined that the blended learning competencies of the teachers are at a moderate level throughout the scale. Teachers' competencies in blended learning show a significant difference according to the gender variable. As a result of the research, it was determined that the blended learning competencies of female teachers were higher than male teachers. It was concluded that teachers' blended learning competencies did not show a significant difference according to the seniority variable. In-service training courses should be organised to increase the blended learning competencies of teachers giving computer education in high schools.

Keywords: Blended learning, learning technologies, teacher competencies;

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1. Introduction

The rapid developments in information and communication technologies in recent years have become indispensable in the field of education as well as in many areas of life because education is the most important factor that determines the life standard of a society and ensures the continuation of its existence (Lake & Ross, 2015). Education is a process and is necessary at every stage of life. Individuals cannot reach educational institutions at some points in their lives and may stay out of the education circle. For this reason, information and communication technologies in educational environments are frequently used in both distance education and formal education environments.

1.1. Theoretical and conceptual framework

Blended education, which is seen as the last point reached in distance education, has been defined in many ways. One of the commonly used definitions is blended education; it can be defined as an educational presentation model in which online education is combined with traditional education method (Collis & Moonen, 2012; Tuncay & Uzunboylu, 2012). According to Wilson and Smilanich (2004), blended learning generally means using two or more methods for learning needs. So blended learning is the use of the most effective learning styles applied to achieve the desired learning goals in line with certain purposes. Wang, Han, and Yang (2015) define blended learning as an adaptive, dynamic, self-organising and co-evolving complex system that seamlessly combines technology-mediated learning and face-to-face learning. In short, blended learning combines the features and possibilities of both to go beyond the individual capacities of face-to-face and online-only learning (Garrison & Vaughan, 2008; Hung & Chou, 2015).

Blended learning should be seen as a pedagogical approach in which socialisation opportunities created by classroom activities are combined with the opportunities of technology-supported learning (Pizzi, 2014; Waddoups, Hatch, & Butterworth, 2003). It should be handled in the form of creating environments that will support social learning in the classroom and guide the learning of the student in individual work (Garrison & Kanuka, 2004). Thus, the transition from teacher-centred teaching to a student-centred teaching process in which students are actively involved in the learning process will be ensured (Moskal, Lurie, & Cooper, 2004). In blended learning, the strengths of online education can be complemented by the strengths of face-to-face education (Law, Geng, & Li, 2019; Yapici & Akbayin, 2012). Therefore, the aim of blended learning approaches is to find the harmonious balance between online access to information and face-to-face interaction (Lim & Morris, 2009; Osguthorpe & Graham, 2003). Online educational activities in classrooms are combined with traditional teaching methods as part of the traditional method in order to better meet the learning needs of students in the classroom (Paechter, Maier, & Macher, 2010). The parts of the learning process that require direct communication with teachers can be carried out in the classroom environment and the rest can be organised in the electronic learning environment (Rowley, Bunker, & Cole, 2002).

However, there is no single and correct roadmap in terms of time and technology in the process of combining different features of different environments (Pye, Holt, Salzman, Bellucci, & Lombardi,

2015). Various variables such as topics covered in face-to-face and online environments, selected activities and frequency levels differ according to the instructors (Broadbent, 2017; Sajid, Laheji, Abothenain, Salam, AlJayar, & Obeidat, 2016). The most important purpose of blended teaching is to bring together the strengths of these two different environments and to offer an active, directable and flexible learning opportunity for students (Ranganathan, Negash, & Wilcox, 2007).

The integration of technology into schools with a blended learning approach has fundamentally changed the teaching strategies used in daily learning activities (Bonk, Olson, Wisher, & Orvis, 2002). Blended learning combines event-based activities designed to improve problem-solving and decision-making. The blended classroom is different from the traditional classroom and needs different strategies. Therefore, teachers need to implement new and effective strategies for effective blended classroom practices (Alonso, López, Manrique, & Viñes, 2005).

1.2. Related research

Riffell and Sibley (2004) designed a blended course by combining face-to-face teaching and online learning approaches in their study in which they investigated whether blended course designs would increase participation in environmental science undergraduate courses. According to the results of the study, it has been stated that the online homework completion rates are higher than the participation rate in traditional passive classes, and this difference increases as the grade level rises.

In another study, Rovai and Jordan (2004) examined the level of creating a sense of community among three learning environments that were traditional, blended and completely designed online. Using a causal comparative research model, the researchers found that blended courses evoked a stronger sense of community among students than traditional or purely online courses. Mosser (2010) examined the effect of interpersonal communication on academic achievement in his doctoral thesis. In the study, student–student interaction was carried out online and face-to-face, and student–teacher interaction was carried out on a weekly basis if the students wanted it. According to the results of the research, student–student interaction in the classroom was higher for academic participation than online interaction.

In Ruck's (2012) research, he made a descriptive analysis of the pedagogical characteristics of face-to-face and online teaching in blended learning environment. According to the results of the research, the teachers showed a more teacher-centred approach in the face-to-face part compared to the online part. The pedagogical beliefs of the teachers did not show similarity with their behaviour in the classroom.

McDonald (2012) examined adult learners and blended learning experiences. As a result of the research, three main structures emerged from the experiences of adult learners in blended learning. The first is contextual learning, participants emphasise more on the context of the subject; the second is interconnected learning, participants emphasise more blended learning process; and the third is adaptive learning, participants talk more about themselves. Rasmussen (2003) prepared a simultaneous blended learning environment with 11 students from Brigham Young University who participated face-to-face with distance education from 6 different regions in his doctoral study titled

the quality and quantity of human interaction in a simultaneous blended learning environment. In the research, it has been emphasised that textual communication is a necessary tool for a blended learning environment.

In the research conducted by Weibelzahl and Dowling (2007), one programming lesson was designed and implemented completely online for one group and blended with face-to-face learning for the other group. Researchers stated that face-to-face learning has a positive effect on the completion of the teaching process. However, in the comparison between the two groups in terms of academic success, it is stated that students who take the course completely online are more successful than those who take the course face-to-face. The researchers emphasised that this is a different result when compared to studies indicating the positive effect of blended learning on academic achievement.

1.3. Purpose of the research

The purpose of this research is to determine the proficiency levels of teachers giving computer education in high schools regarding blended learning. In this direction, the following sub-objectives have been determined:
1. What is the level of competence of teachers giving computer education in high schools regarding blended learning?
2. Do the competencies of teachers who give computer education in high schools regarding blended learning differ according to the gender variable?
3. Do high school computer teachers' competencies in blended learning differ according to the variable of professional seniority?

2. Method and materials

2.1. Research method

In this study, the competencies of teachers who give computer education in high schools regarding blended learning were handled in accordance with the survey model, which is one of the quantitative research methods. King and He define the descriptive survey method as a quantitative approach. Descriptive studies are studies in which the views of groups on any phenomenon or subject are described. In this direction, in this study, a descriptive survey model was applied in order to determine the competencies of teachers who give computer education in high schools regarding blended learning.

2.2. Participants

The study group of the research consists of 345 computer teachers who teach in high schools in the city of Almaty, Kazakhstan in the 2021–2022 academic year. In the research conducted with the teachers, the study group was chosen from among the volunteers. Information on the demographic characteristics of teachers giving computer education is included in the findings section.

2.3. Data collection tools

The data of the study were collected with the blended learning proficiency scale developed by the researchers. During the scale development phase, certain steps were followed and then a pilot application was made. While developing the scale, primarily an item pool was created and experts' opinion was taken. The 15 items that were thought to be included in the scale were presented to eight experts. According to the evaluation results from the experts, three items were removed from the draft scale and one item was rearranged. The draft scale, which was arranged with the remaining 12 items, was made ready for pilot application in the next stage. 281 teachers who gave computer education in high schools and agreed to participate in the research voluntarily participated in the pilot application. Of the teachers participating in the pilot scheme, 127 were female and 154 were male. Teachers who participated in the pilot application were excluded from the study group of the research. After the pilot application, two different programmes were used to analyse the data. SPSS 20.0 for exploratory factor analysis and SPSS Amos 25.0 for confirmatory factor analysis were used. By applying the Kaiser–Meyer–Olkin (KMO) coefficient and the Bartlett sphericity test, the suitability of the data for the analysis was tested. As a result of the test, the KMO value was found to be 0.882. As a result of the Bartlett test, it was found to be (0.000) <0.05. The data set was found suitable for factor analysis in line with the procedures carried out. Then, while performing factor analysis, the eigenvalue and variance ratios of the scale were taken. The cumulative distribution was found to be 89,562, and in the exploratory factor analysis, two factors with an eigenvalue greater than one were determined. Afterwards, confirmatory factor analysis was carried out. Goodness-of-fit index was calculated in confirmatory factor analysis. Acceptability value of the model CMIN/df (χ^2/df < 5) = 1.788, Goodness-of-fit Index GFI (>0.90) = 1.983, Comperative Fit Index CFI (>0.90) = 1.527, Normed Fit Index - Turker-Lewis Index NFI-TLI (>0.80) = 1.218–0.440 and Root Mean Square Error of Approximation RMSA (<0.07) = 0.035.

In the calculations, it was determined that the goodness-of-fit index of the scale was at a good level. After the exploratory and confirmatory factor analyses were carried out, the Cronbach alpha internal consistency coefficient was calculated for the sub-dimensions and the overall scale. Two sub-dimensions were determined for the scale. They are 'Motivation' and 'Practice'. The internal consistency coefficient for the motivation sub-dimension was 0.83, and the internal consistency coefficient for the application sub-dimension was 0.78. The internal consistency coefficient of the blended learning proficiency scale was found to be 0.81. The blended learning proficiency scale was made ready for application by making its final adjustments after the pilot application. The scale was prepared in a 5-point Likert type. 'Very high' was determined as 5 points, 'high' as 4 points, 'medium' as 3 points, 'low' as 2 points and 'very low' as 1 point. Item score ranges were considered equal, with 5.00–4.20 = very high, 4.19–3.40 = high, 3.39–2.60 = medium, 2.59–1.80 = low and 1.79–1.00 = very low. The blended learning proficiency scale used in the research is given in Table 1.

Table 1. Blended Learning Competency Scale

Blended learning proficiency scale
Dimension 1: Motivation
I am willing to use the blended learning environment in education

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I am willing to improve myself while using the blended learning environment in education.

I am willing to use materials related to blended learning

I am willing to learn blended learning methods and techniques

I am willing to use blended learning methods and techniques

I am eager to achieve success when I teach in a blended learning environment.

Dimension 2: Application

I am proficient in using the blended learning environment in education

I am proficient in methods and techniques related to blended learning environment

I am proficient in using materials in a blended learning environment

I am proficient in developing materials in a blended learning environment

I am competent in measuring and evaluating student achievement in a blended learning environment.
I am sufficient in terms of providing maximum benefit to the student in the education given in the blended learning environment.

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[a]Items in the scale were measured with a 5-point Likert scale in the range of 1 = very low to 5 = very high.

2.4. Data collection process

Data were obtained after two application processes, namely the developed blended learning proficiency scale, pilot application and research application. The scale development phase took approximately 1 month, i.e., it took about 1 month to apply the scale to the study group to obtain the data after the application and to convert it into findings. Accordingly, it is possible to express the data collection process as an average of 2 months.

2.5. Data collection analysis

After the blended learning proficiency scale was applied to the study group, the data obtained were analysed with the SPSS 20.0 programme. While starting the analyses with the SPSS 20.0 programme, the Kolmogorov–Smirnov normality test was calculated in the first stage. Since $p > 0.05$ was found in the Kolmogorov–Smirnov normality test result, it was understood that the data set showed a normal distribution. Accordingly, it was found appropriate to apply parametric tests. Research findings, frequency, percentage and *t*-test results are given.

3. Results

In Table 2, demographic information about the gender and seniority of the teachers who participated in the research and who gave computer education in high schools are given.

Table 2. Gender and seniority distribution of teachers

Gender	F	%
Female	127	36.8
Male	218	63.2
Sum	345	100
Seniority	F	%

Less than 10 years	161	46.6
More than 10 years	184	53.4
Sum	345	100

In Table 2, the gender and seniority distribution of the teachers participating in the research are given. 36.8% of the teachers are female and 63.2% are male. 46.6% of the teachers who participated in the study and gave computer education in high schools have less than 10 years of experience and 53.4% of them have more than 10 years of experience. The total number of teachers participating in the research is 345.

In Table 3, the blended learning scale sub-dimensions of the teachers participating in the research and the mean and standard deviations of the overall scale are given.

Table 3. Blended Learning Scale and its sub-dimensions

	X	SS
Motivation sub-dimension	3.46	0.568
Application sub-dimension	3.07	0.228
Overall scale	3.26	0.670

In Table 3, the blended learning competencies of the teachers participating in the research were evaluated through the blended learning competency scale and its sub-dimensions. It has been determined that teachers have a high level of motivation regarding blended learning in the motivation sub-dimension. In the application sub-dimension of the teachers, it was determined that they had moderate proficiency in blended learning. In the blended learning scale, teacher competencies were found to be moderate.

In Table 4, blended learning proficiency scale scores of the teachers participating in the research are given according to the gender variable. Teachers' blended learning competencies are given by calculating the *t*-inverse result according to gender distribution.

Table 4. *t*-test results of teachers' blended learning competencies by gender variable

Gender	N	X	SS	F	p
Female	127	3.43	0.872	16.409	0.000*
Male	218	3.16	0.793		

* $p < 0.005$

In Table 4, the blended learning competencies of the teachers participating in the research are given together with the *t*-inverse result according to the gender variable. It is seen that teacher competencies ($F = 16.182$, $p < 0.005$) make a significant difference according to the gender variable. It is seen that the significant difference is in favour of female teachers.

In Table 5, the blended learning proficiency scale scores of the teachers participating in the research are given according to the seniority variable. Blended learning competencies of teachers are given by calculating the *t*-inverse result according to the distribution of seniority.

Table 5. *t*-test results of teachers' blended learning competencies by seniority variable

Seniority	N	X	SS	F	p
Less than 10 years	161	3.25	0.892	11.489	0.361
More than 10 years	184	3.27	0.814		

In Table 5, the blended learning competencies of the teachers participating in the research are given together with the *t*-inverse result according to the seniority variable. It is seen that teacher competencies ($F = 11.489$, $p > 0.05$) do not make a significant difference according to the variable of seniority.

4. Discussion

It was seen that the teachers who participated in the research and gave computer education in high schools were high in the motivation sub-dimension of blended learning and moderate in the application sub-dimension. It has been determined that the blended learning competencies of the teachers are at a moderate level throughout the scale.

In their study, Erbil and Kocabas (2019) examined teachers' views on the use of technology in education, reversed classroom and collaborative learning. In this study, it was observed that most of the teachers for the reversed classroom did not know about this model, but they stated that they thought it would be beneficial for students' learning when explained. Rasheed, Kamsin, and Abdullah (2020) also stated in their research that the inclusion of technology, which is one of the components of blended learning, in teaching causes some difficulties for teachers.

The competencies of the teachers participating in the research, who give computer education in high schools, regarding blended learning show a significant difference according to the gender variable. As a result of the research, it was determined that the blended learning competencies of female teachers were higher than male teachers. Akyildiz and Altun (2018) also concluded in their study that the technology use proficiency of female teacher candidates is higher than that of male teacher candidates. While the results of this research show that the blended learning competencies of female teachers are higher than male teachers, some studies in the field have revealed that male teachers are more successful than female teachers in the use of technology. Shapka and Ferrari (2003) stated in their study that teacher candidates' attitudes and behaviours towards computers differ according to gender and this difference is in favour of males. Tweed (2013), on the other hand, concluded in his study that there is no significant difference between gender and technology use.

It was determined that there was no significant difference in the blended learning competencies of the teachers who participated in the study and who gave computer education in high schools, according to the seniority variable. So and Kim (2009) stated in their study that pre-service teachers effectively explained how to integrate technology and their skills in using technology, but they could not apply this knowledge and skills while teaching in the classroom environment due to similar

reasons. Windschitl and Sahl (2002) found that teachers use computers etc. Although they stated that technologies contribute to learning and should be used for this purpose, they determined that they do not use technology based on constructivism or in a way that contributes to students' learning. With the course they designed for teachers, Bath and Bourke (2011) aimed to evaluate their knowledge and skills on blended learning from their instructional design. As a result of the study, there was an increase in the knowledge and skills of all participants about blended learning, and the participants stated that they were more confident in their knowledge and skills about blended learning designs.

5. Conclusion

It cannot be ignored that technology-supported education approaches have become much more important both in terms of the many potential benefits it provides to education processes in normal times and in terms of ensuring the continuity of education when faced with natural disasters such as epidemics, earthquakes and floods. Therefore, in order not to be caught unprepared for new crisis possibilities and to continue education under all conditions, more flexible approaches that blend face-to-face education and distance education have started to come to the fore. The idea of integrating technology with the face-to-face teaching process has become increasingly interesting for educational scientists. Starting from here, in this research, in this study, it was aimed to determine the proficiency levels of teachers giving computer education in high schools regarding blended learning. As a result of the research, it was seen that the teachers giving computer education in high schools were high in the motivation sub-dimension of blended learning and moderate in the application sub-dimension. It has been determined that the blended learning competencies of the teachers are at a moderate level throughout the scale. Teachers' competencies in blended learning show a significant difference according to the gender variable. As a result of the research, it was determined that the blended learning competencies of female teachers were higher than male teachers. It was concluded that teachers' blended learning competencies did not show a significant difference according to the seniority variable.

6. Recommendations
The following recommendations were made:
1. In-service training courses should be organised to increase the blended learning competencies of teachers giving computer education in high schools.
2. Seminars and conferences should be organised to increase the blended learning motivation of teachers who give computer education in high schools.
3. Conferences and seminars should be organised to enable high school computer teachers to acquire knowledge and skills regarding blended learning practices.
4. The content of courses on blended learning practices in teacher training programmes of universities should be increased.

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