Turkish Journal of Teacher Education

Volume 13, Issue 2, 2024 e-ISSN: 2147-5156

The Comparison of Two Distance Education Practices on Middle School Students' Academic Success and Science Course Attitudes*

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Keywords

Distance Education, Academic Success, Material Development

Article History

Received
Oct 25, 2024
Revised
Dec 21, 2024
Accepted
Dec 29, 2024
Published
Dec 30, 2024

Abstract

This study aimed to compare the effects of two different distance education methods on students' learning outcomes: academic achievement and attitude toward science courses. One was the EBA system, which the Ministry of National Education established. The other was the distance education module we developed within the scope of the management approach to enrich the course content on cell and division. We used the semi-experimental study method. Our study group consisted of 7th-grade students. We provided EBA-supported courses in the control group and module-supported courses in the experimental group. We collected data using the academic success test and the attitude scale. We analyzed our data using tests suitable for normal distribution in the SPSS 20.0 program. The results showed that the experimental group did better in the questions at a high cognitive level. However, there was no statistical difference between the attitude scale results.

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*This paper was produced from a part of the second researcher's master thesis, which was conducted under the supervision of the first author.

Introduction

The Republic of Türkiye started to use some examples of distance education in the 1970s (Bozkurt, 2019). This year, research about distance education with different systems was carried out at the primary and secondary education levels. Türkiye has gained much experience in this field and has progressed over time. Due to the COVID-19 pandemic experienced in 2020 and 2021, distance education applications have become a part of daily life, starting from preschool to higher education. Face-to-face education in schools has left its place for distance education. It is necessary to design teaching design based on sound planning, good structuring, and active participation of students, not reducing their attention and motivation (Karabacak & Kucuk, 2016; Kucuk, 2022a; Kucuk, 2022b; Turkoglu, 2003). Education Information Network [EBA] has been widely used in Türkiye. This platform is free for individuals and is a social and online learning platform. However, from the past to the present, the effectiveness of distance education has been discussed many times (Burkaz Ekinci et al., 2022; Patan & Kucuk, 2022; Ulum, 2022). In addition to the rich content of EBA and its efficiency in terms of teacher-student, there are also some problems related to its use (Keskin Gecer, 2020).

Tuysuz and Cumen (2016) found out that the use of the EBA system by teachers and students is disrupted due to internet connection problems, educational videos sometimes are not opened, the student's participation is expressed due to the instant dropout of the students from the system, and the scores of the students are reset due to various infrastructure problems. Ates et al. (2015) examined the videos on the platform. They revealed that the video contents were not distributed equally according to the grade levels; some were unsuitable for the grade level and were often insufficient in duration and content. Ekici et al. (2016) also stated that sometimes technical difficulties were encountered in accessing the content on the platform. Kayahan and Ozduran (2016) examined students' attitudes toward the platform. They revealed that students' attitudes are both positive and negative. Tutar (2015) revealed that Turkish teachers have insufficient knowledge about EBA and rarely use it. This rapid transformation experienced in Turkiye and the world with the COVID-19 pandemic increased the need for innovations and reinforcements to enable students to get the highest efficiency from learning (Burkaz Ekinci et al., 2024). For these reasons, we tried to enrich children's learning experience during the pandemic. We developed animations and videos supported by worksheets and experiment sets related to the subject and integrated the teaching with Web 2.0 tools based on the constructivist learning approach.

Lewis et al. (2000) conducted a study with 482 students in the 9th and 11th grades to determine the students' knowledge levels about cell division. They concluded that there were mistakes in students' knowledge of subjects such as chromosome and genetic information transfer. Gencer (2006) developed a cell concept test consisting of 25 questions and applied it to 488 students to reveal the misconceptions of primary school 6th, 7th, and 8th-grade students about the cell subject. They discovered that the 6th, 7th, and 8th grades had misconceptions about this subject. For these reasons, we selected the science unit of "cell and divisions" from the seventh-year science teaching program (see Turkish National Ministry of Education [NMoE], 2018). It was also related to the science curriculum of the following year and forms the basis of the subjects covering the DNA and Genetic Code unit, which is the second unit of the eighth grade.

In this study, we designed a science course that differed from EBA and developed innovative teaching modules. There were many similar initiatives aimed at enriching children's learning experiences during the COVID-19 pandemic; one is the online education

for sustainable development (see Burkaz Ekinci et al., 2022). This paper aimed to investigate the reflections of the new course activities supported with technology-based activities, laboratory applications, animations, and worksheets on students' academic success and attitudes towards the science course.

Method

Research Model

We used a quasi-experimental study and a pre-test-post-test model. This is the most widely used experimental design, especially in educational research, when controlling all the variables is impossible (Cohen et al., 2000). We showed the research process in Table 1.

Table 1
Research Process

Groups	Pre -Test	Teaching Method	Post-Test
Control Group	Cell and Division Test Science Course Attitude Scale	Teaching by EBA Platform	Cell and Division Test Science Course Attitude Scale
Experiment Group		New Teaching Module	

Participants

The participants were 7th graders from a group of state and private schools. The class was randomly determined as the control group from the state school, consisting of 19 students (12 girls and seven boys). The class was determined to be an experimental group from a private school with 18 students (11 girls and seven boys). The applications were all completed during formal science course hours.

Data Collection Tools

We collected data via two measurement tools: (i) Cell and Divisions Test [C&DT] and (ii) Science Course Attitude Scale [SCAS].

(i) Cell and Divisions Test [C&DT]

Coskun (2019) developed the test. They administered it with 32 questions to 162 8th-grade students in two middle schools in the Antakya district of Hatay province. They found that the discrimination index of seven questions was below .30 and excluded those from the test. They also calculated the item difficulty indexes (pj), standard deviations (s), and discrimination indexes (rjx) of the items. For the final version of the test, item difficulty indexes ranged from .35 to .81. The questions in the test used to measure the student's academic success on the subject of Cell Division and Heredity were grouped according to subtopics. Then, the questions classified according to the subtopics were grouped according to learning outcomes. Then, the cognitive domain steps of the questions were named according to the distribution of the learning outcomes and question numbers. Cognitive domain steps are classified as lower— and upper-cognitive-level thinking skills (Sevim, 2007) in Table 2.

Table 2

Outcomes and Levels of Cognitive Thinking Skills of the Test Questions

Subject	Learning Outcomes	Question Numbers	Levels of Cognitive Thinking Skills
Cell	LO 1: F.7.2.1.1: Compares animal and plant cells in terms of their basic parts and functions	1,2,4	High Level
	LO 2: F.7.2.1.2: Discusses the views on the structure of the cell from past to present by relating them to technological developments	6,7	High Level
	LO3. F.7.2.1.3.: Explains the relationship between cell, tissue, organ, system, and organism	3,8	Low Level
Mitosis cell division	LO4: F.7.2.2.1: Explains the importance of mitosis for living organisms.	12,13	Low Level
	LO5: F.7.2.2.2: Explains that mitosis consists of successive different stages	10,14	Low Level
Meiosis cell division	LO6: F.7.2.3.1: Explains the importance of meiosis for living organisms	9,11,17	Low Level
	LO7: F.7.2.3.2 (a): Demonstrates how meiosis occurs in reproductive stem cells using a model	5,16,20,22	Low Level
	LO8: F.7.2.3.2 (b): Demonstrates how meiosis occurs in reproductive stem cells using a model	21,24	High Level
	LO9: F.7.2.3.3 (a): Compares the differences between meiosis and mitosis.	23	Low Level
	LO10: F.7.2.3.3 (b): Compares the differences between meiosis and mitosis.	15,18,19,25	High Level

*LO: Learning Outcomes

There are 25 questions about the cell, mitosis division, and meiosis division learning outcomes in Table 2. We matched appropriately with the question numbers in the cell and divisions test and then classified according to taxonomy by sub and high cognitive thinking skills. However, the questions covering the learning outcomes numbered F.7.2.3.2 and F.7.2.3.3 are discussed in two sections, "a and b," since they are included in the lower and upper cognitive levels. In this context, the number of more than one question covering an outcome may also vary. The findings on this subject were interpreted both in-group and between groups using Table 2.

(ii) Science Course Attitude Scale [SCAS]

Nuhoglu (2008) developed the the scale. This scale measures primary school students' attitudes towards science lessons. Half of the 20 items on the scale were positive, and the other half consisted of negative items. The scale is a five-point Likert type. Nuhoglu reported the Cronbach Alpha reliability coefficient of the scale as .87. We administered it in both the experimental and control groups as a pretest and post-test. We calculated the Cronbach Alpha reliability coefficient of the scale as 0.62. This value also shows that the scale has an acceptable reliability.

Data Analysis

We have calculated each student's C&DT scores for pre and post-tests. Each correct answer was 1 point, and the highest score from the test was 25. We analyzed data using the

SPSS 20.0 statistical package program. We used the paired groups t-test technique to investigate the variation between the pretest and post-test of the students in the experimental and control groups. Then, the independent group t-test technique was used to test the significance of the difference between the two arithmetic means to compare the pretests and post-tests of the experimental and control group students for two mutually exclusive groups. The significance level was taken as .05 in the test, and we found that KR-20 reliability was .78. We also calculated each student's attitude scores toward the science course using SCAS for pre-and post-tests. We analyzed the data using the SPSS 20.0 statistical package program and used the same comparison tests.

Teaching Intervention

We conducted the distance education applications for experimental and control groups during school hours and official class times. In this context, we used equal durations for both groups. We started the applications by teaching the groups the Nearpod application, from which we would collect research data. Throughout the applications, we followed the processes instantly via the Zoom platform. The Nearpod application sent instant student responses to the teacher's system. In this way, we conducted the first applications of the two measurement tools. The fact that the Zoom application was open to students and researchers eliminated the risk of students getting help from their books. At the same time, we prevented potential problems related to the Nearpod application.

EBA. In this process, we shared the NMoE textbook screen with the students and performed the activities in the book after the lecture. In the control group, we started the instructional design by projecting the cell and organelles section of the NMoE book onto the screen. Then, at the end of the lesson, we completed the general evaluation of the students using the question-and-answer method and completed the activity sections in the NMoE book via screen sharing. To evaluate the achievements, it was suggested to solve the tests of different publications with the students via screen sharing, follow the lesson content videos on the EBA platform for repetition of the subject, and watch the relevant lesson contents on EBA TV. We observed that the participation of students in some lessons was relatively low and that immediate parent feedback about student absenteeism could not be given in this process. This situation partially reduced the efficiency of the distance education process. The instructional process for the control group students progressed similarly for the subjects of mitosis and meiosis cell division.

We gave the curriculum timetable to the students in the experimental group to be applied throughout the semester. We regularly checked the students' attendance. We occasionally made reminders to speed up the students' participation process in the lessons. These reminders worked and minimized the loss of time in the lessons. We prepared a list of materials to be used within the scope of the lesson module. Parents collected these materials from the school before the lesson. In this way, the experimental group students prepared before the lesson. We prepared lesson plans on cell and organelles, mitosis, and meiosis cell division for the experimental group. The lesson plans prepared for the experimental group students were implemented via the Zoom application instead of the EBA platform, unlike the control group students. We used school publications instead of textbooks. We added different videos and animations to the videos on the EBA platform, which would be helpful for the students. In addition, we added experiment videos and animations specific to each subject, which the students could actively watch and use in the process of structuring knowledge. We prepared activity sheets for these materials and gave them to the students.

We used simulation methods for the achievements that the students were not sufficiently familiar with (e.g., cell organelles). We also integrated many technology-supported materials, such as Quiver Vision and Nearpod applications, into the appropriate sections of the lesson plans for the students' use. In this way, we ensured the active participation of the students in the lessons. The activity sheets included animations that the students would use and different teaching tools and materials. These materials included simple light microscopes suitable for home use, worksheets, lecture notes, and materials the students were asked to procure themselves.

We made the lesson connections via Zoom. To attract the students' attention regarding cell achievements, we showed them a cell model in the lesson and asked them to take notes in the relevant areas of the activity sheets. Then, we introduced the microscope and its sections with camera images. After these procedures, we asked the students what they observed. After receiving the answers, we added animations accessible from different sources for each subject to the process and the lesson videos on the EBA platform. We supported this with activity sheets. After completing this process with the students, we made explanations using the lesson sheets and teacher notes used in the school. While structuring the achievements of the relevant subject, we allowed the students to examine the cell in three dimensions on their smartphones after learning each cell section with virtual reality applications. Additionally, as homework, we asked the students to create their cell models.

We supported the students with school resources and applications during the evaluation process. In the homework follow-up process, each page of the relevant books was checked individually for each student via the messaging application. All the questions the students could not answer in the homework were solved individually with the screen-sharing feature. This process was supported by animations, teacher notes, and lesson-based games played during the lessons on mitosis and meiosis cell division, and the active participation of the experimental group students was ensured. After these procedures, we applied the attitude scales and achievement tests as a post-test by establishing a Zoom connection with the students and having them follow us in the Nearpod application.

Results

Table 3 compares the experiment and control group students' "cell and divisions success test" results.

Table 3
Pretest Results for C&DT

Groups	*N*	X	s	*t*	*p*
Experiment	18	21,11	11,12	,31	,75
Control	19	19.78	14,26		

Based on the results of Table 3, we concluded that there was no statistically significant difference between the groups (t = 31; p > 05). This shows no difference between the experimental and control group students' prior knowledge of the subject.

Table 4
Frequency Range of Correct Answers to the C&DT

Question No	Control Group (n:19)		*Range*	Experiment Group (n:18)		*Range*
	Pre (f)	Post (f)		Pre (f)	Post (f)	
1*	7	11	*4*	8	18	*10*
2*	0	13	*13*	0	18	*10*
3	3	13	*10*	5	18	*13*
4*	0	15	*15*	0	18	*18*
5	17	15	*-2*	14	18	*4*
6*	1	12	*11*	3	16	*13*
7*	12	3	*-9*	9	13	*4*
8	12	16	*4*	12	18	*6*
9	0	11	*11*	0	17	*17*
10	12	13	*1*	12	16	*4*
11	0	14	*14*	4	18	*14*
12	4	5	*1*	0	18	*18*
13	0	13	*13*	1	16	*15*
14	0	11	*11*	0	16	*16*
15*	0	5	*5*	0	17	*17*
16	0	10	*10*	0	17	*17*
17	1	11	*10*	3	17	*14*
18*	0	7	*7*	0	17	*17*
19*	3	9	*6*	0	17	*17*
20	5	11	*6*	10	15	*5*
21*	0	10	*10*	0	17	*17*
22	3	8	*5*	0	16	*16*
23	8	10	*2*	10	15	*5*
24*	5	7	*2*	0	15	*15*
25*	0	10	*10*	0	14	*14*

*High Cognitive Level Question

Based on the results of Table 4, we concluded that the correct answer rates for the questions at the higher cognitive levels 1, 2, and 4 are very low. Likewise, the experimental and control groups could not answer correctly to the questions of higher cognitive thinking (see 15, 18, and 19). This table also reveals that although similar results were obtained in the experimental and control groups for questions at a low cognitive learning level (see 3, 8, 11, 13, 17, and 20), the difference was in favor of the experimental group for questions at a high cognitive level (see 1,15,18, 19, 21, 24 and 25).

Table 5
Posttest Results for C&DT

Groups	*N*	X	s	*t*	*p*
Experiment	18	91,11	13,48	4,78	,00
Control	19	57,05	27,18		

Based on the results of Table 5, we concluded that there was a statistically significant difference between the groups ($t = 4.784$; $p < .05$). These results reveal that the difference

between the learning of the experimental and control groups at the end of the subject has widened considerably.

Table 7
Comparison of the Pretest and Post-Test Results of the Control Group

Groups	*N*	X	s	*t*	*p*
Control (Pretest)	19	19.78	14,26	-10,22	,00
Control (Post-test)	19	57.05	27,18		

Based on the results of Table 7, we concluded that there was a statistically significant difference between the tests (t=-10.22; p <.05).

Table 8
Comparison of the Pretest and Post-Test Results of the Experimental Group

Groups	*N*	X	s	*t*	*p*
Experiment (Pretest)	18	21,11	11,12	-22,91	,00
Experiment (Post-test)	19	91,11	13,48		

Based on the results of Table 8, we concluded that there was a statistically significant difference between the tests (t=-22.91; p<.05).

SCAS Results

Table 9
Pretest Results for Scale

Groups	*N*	X	s	*t*	*p*
Experiment	18	86.09	4.11		
Control	19	90.36	3.96	,79	,426

Based on the results of Table 9, we concluded that there was no statistically significant difference between the scale results (t=.79; p>.05).

Table 10
Post-Test Results for Scale

Groups	*N*	X	s	*t*	*p*
Experiment	18	87.05	4.16	,80	,42
Control	19	90.56	4.01		

Based on the results of Table 10, we concluded that there was no statistically significant difference between the scale results (t=.80; p>.05).

Discussion

Firstly, our research is not the first to compare the outcomes of face-to-face teaching and distance learning. For example, using the EBA platform, Kavak (2021) researched and compared the students' academic success in face-to-face and distance learning. They found out that all the students, even those who go to private educational institutions for additional support, participated in the EBA live course platform, and most of them finished their

homework. However, despite all these learning efforts, they concluded that the students did not get enough efficiency from distance education. There are some known reasons why distance education is incompatible with the developmental stages of the students (Mouratidis et al., 2021), reluctance to the lessons (Erkoca, 2021), problems related to technological elements (Kara Keser, 2022), and also teachers did not receive the necessary consultancy support (Basaran et al., 2022; Kucuk & Bahcekapili, 2011).

Firstly, we want to explain the question, *"What is the effect of the course activities based on the EBA platform on students' academic success in the teaching subject?"*. There was a statistically significant difference between the pretest and post-test results of a control group of students' success (t=-.22; p<.05) (see Table 7). However, this typical result shows itself mainly with the questions about low-cognitive thinking skills (see Table 8). When we look at the distribution of answers given to high cognitive level questions in Table 8, we see no difference in the last test. In this case, we revealed that an EBA-supported education could increase the student's academic success in terms of the total scores. However, it does not affect their metacognitive learning. For example, this conclusion can be reached when the change in the rate of correct answers in the first two questions covering low-level cognitive thinking skills and the change in the last two questions are examined. For example, the increase in the rate of correct answers in some questions of high cognitive thinking skills (for example, 21 and 24) was observed to be less than the pretest average compared to the post-test. Likewise, the frequency change for questions some other questions, 15 (0 to 5), 18 (0 to 7), 19 (3 to 9), 23 (8 to 10), and 25 (0 to 10), is low (see Table 4). The partial increase in academic success in higher cognitive questions was because the learning, which was usually teacher-centered, was active. Interactive applications may have also been practical in this process.

Secondly, we want to explain the question, "*What is the impact of course activities developed as an alternative to EBA on the students' success?"*. There was a statistically significant difference between the pretest and post-test results of the experimental groups of students (t= -22,91; p <,05). We found that this difference was due to questions at both high cognitive and low cognitive levels. For example, the highest increase is in questions 15 (0 to 17), 16 (0 to 17), 20 (10 to 15), and 22 (0 to 16). We saw that the increase in these questions was considerably higher than the control group. There is a need to discuss the reason for this difference. The students were more active in the new course compared to the other. More importantly, students' taking responsibility for their learning process and active participation in student-centered activities brought success, as evidenced in another study by Deve and Kucuk (2016).

In high cognitive-level questions (e.g., 1, 2, and 4), the change in incorrect answers in the experimental group was 100%, while the change in the control group was 55%, 68%, and 78%, respectively. We also found similar results for questions 6 and 7 at a high cognitive level. We found similar results for the low cognitive level questions in the test (see Table 4). Considering these results, we realize that the new distance education application implemented in the experimental group contributed more to the subject studied and academic success. This success was different from the classical EBA platform-based teaching in that the students in the experimental group answered the high cognitive level questions in the test correctly. In short, the instruction provided to the control group through the enrichment of the content provided by EBA did not sufficiently enable the students to obtain high cognitive level learning products. Bas and Sevim (2020) showed that students' academic success has been moved to higher levels by removing traditional education and integrating technology and constructivist approaches into lesson plans, even for students of different age groups in other papers. Gencer et al. (2021) have reached important conclusions in their studies on qualified

learning outcomes in distance education. They revealed that teachers must be focused and involved in the distance education system to achieve healthy functioning. This was also supported by the Turkish Ministry of National Education [NMoE], 2013). Teachers must primarily focus on the distance education process to create effective lesson plans and increase students' academic success. There is also a need for support training to increase student and teacher motivation and for teachers to use the distance education process intensively.

Moore (1991), on the other hand, adopts distance education as an education far from school, entirely outside the school. In addition, when he mentions distance education, he remembers the concepts of distance and autonomy. He refers to the school as the place where learning takes place. According to Moore, the increase in students' academic success with distance education results from teacher-student interaction. In this research, we designed the experiments and activities supporting student-teacher interaction. The fact that each individual's development, ability, interest, intelligence, and readiness levels are different shows the necessity of teaching lessons by considering individual differences in education. Kettanurak et al. (2001) believed that individual differences can disappear when rich materials and environments are created. In this research, we also used experiments, virtual reality applications, various activities, animations, and various worksheets used with animations. This way, students could answer more questions requiring higher cognitive thinking skills.

Thirdly, we want to explain the question, "*How do course activities organized using the EBA platform and new teaching affect students' attitudes toward science courses*?". The pretest scale average of the experimental group students was lower than the control group (see Table 9). There was no statistically significant difference. Likewise, the post-test scale average of the experimental group students was lower than the control group (see Table 10). There was no statistically significant difference. In this case, expecting attitudes toward science classes to change quickly was incorrect.

Conclusion

The animations on the EBA platform can be supported by the worksheets prepared by the teacher during the lesson instead of watching the students after the lesson, and it can be ensured that the students are active during the lessons. The materials can be provided for students according to the lesson plans in distance education. In addition, videos and animations can be added to the EBA platform. However, the teacher's content can be included in structuring the students' knowledge and the videos that give lectures. It may be challenging to provide an experimental environment for students. However, some experiments and activities that can be applied in the virtual environment can be added to the EBA platform to support the active participation of students in the learning process. Interactive applications with students contribute more to academic success. In their study, Yadigar (2010) stated that since the needs of students should be taken into consideration while developing the content in distance education programs, applications that will improve the communication dimension, which is one of the most significant shortcomings of distance education, should be included when designing distance education programs, the attitude and motivation towards the course that may arise from the continuous individual study of the student in distance education. He mentioned that measures should be used to increase students' attitudes and motivations. In this case, distance education with more extended modules may be possible to provide students with different learning outcomes and structure their attitudes. Finally, our research is limited to the subject we studied. Therefore, we claim that studies on other science subjects can confirm our results.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

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