

Flipped Classroom with Interactive Videos Applied to Nursing Students in the Teaching of Biostatistics Knowledge: A Mixed-Method Study

Biyoistatistik Bilgisinin Öğretiminde Hemşirelik Öğrencilerine Uygulanan Etkileşimli Videolarla Ters Yüz Edilmiş Sınıf: Karma Yöntem Çalışması

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Geliş Tarihi/Received: 30.03.2022

Kabul Tarihi/Accepted: 20.10.2022

Yayın Tarihi/Publication Date:

29.12.2022

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Cite this article as: Ilgaz A. Flipped classroom with interactive videos in the teaching of biostatistics knowledge applied to nursing students: A mixed-method study. *J Nursology*. 2022;25(4):245-253.



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ABSTRACT

Objective: This study aimed to determine the effect of the flipped classroom with interactive videos on the teaching of biostatistics knowledge.

Methods: In this mixed-method research, quasi-experimental study was conducted with 128 nursing students between October and December 2020 in the first stage (intervention = 66, control = 62). And then, individual interviews were held with 12 students between January and February 2021 in the phenomenological qualitative research carried out in the second stage. In the quasi-experimental study, the knowledge levels of the students were evaluated. Semi-structured questions were used in in-depth interviews. Data was analysed using Statistical Package for Social Sciences version 24.0 and Nvivo program. Independent sample *t*-test and paired sample *t*-test were used.

Results: After the flipped classroom with interactive videos, knowledge score of the intervention group was found to be statistically significantly higher than that in the control group ($P < .001$). The post-tests were found to be significantly higher than the pre-test in both groups. However, the effect size in the intervention group is higher than that in the control group. In the phenomenological part of the study, 5 main themes were generated: contribution to learning, the learning environment, the advantage of the flipped classroom model, disadvantage of this model, and feedback for educators.

Conclusion: The flipped classroom practice increased the knowledge level of the students. It has been determined that this application has contributed to the learning of the students and the learning environment and has many advantages. In the future, it is recommended to evaluate the effects of the flipped classroom practice in other lessons and to evaluate the effects by adding different education methods to this method.

Keywords: Flipped classroom, interactive videos, nursing students, nurse education, mixed methods

ÖZ

Amaç: Bu çalışmada, etkileşimli videoların yer aldığı ters yüz sınıfın biyoistatistik bilgisinin öğretimine etkisinin belirlenmesi amaçlanmıştır.

Yöntemler: Karma yöntem ile yapılan bu çalışmada, ilk aşamada (girişim=66, kontrol=62) Ekim-Aralık 2020 tarihleri arasında 128 hemşirelik öğrencisi ile yarı deneysel bir çalışma yapılmıştır. Daha sonra ikinci aşamada yürütülen fenomenolojik nitel çalışmada, Ocak-Şubat 2021 tarihleri arasında 12 öğrenci ile bireysel görüşmeler yapılmıştır. Yarı deneysel çalışmada öğrencilerin bilgi düzeyleri değerlendirilmiştir. Derinlemesine görüşmelerde yarı yapılandırılmış sorular kullanılmıştır. Veriler, Statistical Package for Social Sciences 24.0 ve Nvivo programı kullanılarak analiz edilmiştir. Verilerin analizinde bağımsız gruplarda *t* testi ve bağımlı gruplarda *t* testi kullanılmıştır.

Bulgular: Etkileşimli videoların yer aldığı ters yüz sınıf uygulamasından sonra girişim grubunun bilgi puanı kontrol grubuna göre istatistiksel olarak anlamlı düzeyde yüksek bulunmuştur ($P < ,001$). Her iki grupta da son testler ön testlere göre anlamlı olarak yüksek bulunmuştur. Ancak girişim grubundaki etki büyüklüğü kontrol grubuna göre daha yüksektir. Çalışmanın fenomenolojik bölümünde, öğrenmeye katkı, öğrenme ortamı, ters yüz sınıf modelinin avantajı ve bu modelin dezavantajı ve eğitimcilere geri bildirim olmak üzere beş ana tema oluşturulmuştur.

Sonuç: Ters yüz sınıf uygulaması öğrencilerin bilgi düzeylerini artırmıştır. Bu uygulamanın öğrencilerin öğrenmelerine ve öğrenme ortamına katkı sağladığı ve birçok avantajı olduğu belirlenmiştir. Gelecekte diğer derslerde de ters yüz sınıf uygulamasının etkisinin değerlendirilmesi ve bu yönetime farklı eğitim yöntemleri eklenerek etkisinin değerlendirilmesi önerilmektedir.

Anahtar Kelimeler: Ters yüz sınıf; etkileşimli videolar; hemşirelik öğrencileri; hemşire eğitimi; karma yöntem.

INTRODUCTION

Biostatistics is an indispensable element of health services and is important in terms of interpreting studies in the field of health, analyzing health problems, planning services, and evaluating the results of services provided. For this reason, biostatistics education, which concerns departments in the field of health sciences, has gained importance.^{1,2} Biostatistics has been an integral part of nursing practice and research, among other health sciences, since Florence Nightingale (1820-1910), known as the first nurse statistician and the founder of professional nursing. In order to reveal scientific and reliable results, nurses need at least basic statistical information.

It is necessary to facilitate the teaching of biostatistics knowledge and to make the knowledge permanent by including technology in the education system. Face-to-face lessons with traditional methods continued online with the pandemic. One of the recommended methods in order to enrich the learning environments with educational technologies in distance and face-to-face education and to make learning more effective and permanent is the flipped learning model.³⁻⁵

Flipped learning is a method that integrates technology into teaching processes and is thought to have positive contributions to teaching in terms of different variables such as academic success, student participation, and motivation. In this type of learning, the theoretical subjects are learned by the student at home before the lesson and by making plenty of practice during the lesson, and it is aimed to achieve more permanent, effective, and high-level learning. While the student learns at the appropriate time and pace outside the classroom, she learns in a more effective and collaborative environment during the lesson.^{4,6,7} In the flipped classroom, the teacher has a facilitating role. This learning model is student-centered, and the responsibility of learning is entirely on the student.⁷

In order for the flipped classroom model to be effective, it is necessary to plan an activity before the lesson. At this point, there are a wide variety of educational materials such as reading assignments from textbooks, clinical guides, protocols, reports, powerpoints, websites and blogs, and educational games.⁸⁻¹⁰ Among them, the most modern and best-simulated classroom lessons are the video lessons prepared by the trainers.⁷ Videos are often shared with students through a learning management system.¹¹

One of the most basic points in the flipped learning model is that students read and learn the lesson materials sent before attending the lesson. Since students come to the lesson by watching the videos, they have the chance to reinforce what they have learned and it is possible to complete the missing points.^{7,11,12} In

order to enable the pre-lesson videos to be watched, the videos can be made interactive by placing questions and comments.⁷ In interactive videos, there should be in-video questions (multiple choice, true, false questions), giving feedback (reinforcement for the correct answer), in-video links (directing the student to a different material by giving external links), and discussions (adding a comment or survey to a desired point of the video).^{6,13} In flipped learning, it is possible for the student to come to the lesson prepared and be active in the lesson with these videos.

In the studies, the flipped learning method has been used in different disciplines and it has been determined that it has positive results such as increasing students' desire to learn, satisfaction and course success, facilitating learning, increasing exam grades, providing permanent learning, and self-learning.^{5,12-15} In a study, students in the flipped classroom group stated that they were more motivated for flipped learning than those in the traditional course-based classroom group, and it was more beneficial for learning the course material and preparing for the exam.¹⁶ In a meta-analysis study, it was stated that the flipped classroom practice in nursing education increased the clinical skills, learning motivation, and self-efficacy of the students.¹⁷

The flipped learning model is a teaching method that allows the students to learn by themselves at home, discuss what they learned more with their teacher and friends, learn about the subject, and participate in the subject to be taught online more readily. For this reason, interactive videos can be useful in terms of facilitating students' learning, participating in the lesson ready, and having the opportunity to discuss when the teacher and students come together by taking the comments of the students in these videos.^{4,6,7,17}

To facilitate learning of biostatistics knowledge and to increase the attitude, motivation, and success toward the lesson, the students can participate in the lesson ready, and be active in the lesson, a flipped classroom method with interactive videos can be used.^{3-5,7} In the literature, there are studies in which the flipped learning model is applied in different health sciences such as medicine, pharmacy, dentistry, and nursing.^{5,10,18,19} However, no study has been found that evaluates the effectiveness of this method in teaching biostatistics. This study aimed to determine the effect of the flipped classroom accompanied by interactive videos on the teaching of biostatistics knowledge applied to nursing students.

METHODS

Design and Participants

This study is a mixed-method research in which both quantitative and qualitative data were collected. In the first stage, a

quasi-experimental study was carried out. In the second stage, phenomenological qualitative research was carried out.

The biostatistics lesson, which takes place in the fall semester in the education of nursing students, consists of 15 weeks and 2 hours of training per week. In the 2020-2021 academic years, this lesson was opened as 2 groups. Students choose any of these groups. Half of the students enroll in one group and the other half in the second group. This lesson was given to the intervention group for 2 hours on Monday and to the control group for 2 hours on Friday, to third-year nursing students and was conducted in the Teams program.

The universe of the research consists of third-year nursing students who took the biostatistics lesson in the fall semester of 2020-2021. Purposive sampling method was used in the study, the sample was not selected, and students who volunteered to participate in the study were included. The inclusion criteria are third-year nursing students taking the biostatistics lesson for the first time. Those who took the biostatistics lesson for the second or third time were not included in the study. Students who did not attend two-thirds of the lesson were excluded from the study (Figure 1).

Data Collection

In the quasi-experimental part of the study, before starting the first lesson, the students were informed about the study, and

the pre-tests from the intervention and control groups were collected via Google forms. At the end of 12 weeks, the intervention and control groups were filled in the post-test via Google forms. In terms of ethics, the same education model was applied to the control group during the remaining lesson period (3 weeks) right after the post-tests were collected. Therefore, no follow-up was made.

As a pre-test before the intervention, the knowledge score of the students was evaluated with 20 questions. The post-test was applied with the same questions to determine the change in the knowledge score of the students after the training. A total of 100 points are taken from 20 multiple-choice questions. The questions prepared for the pre-test and post-test were not included in the exam questions of the lesson.

For phenomenological qualitative research, students who were trained in the flipped classroom model were informed about the qualitative study by sending a message in the Teams program, and those who wanted to participate in the study were asked to return. Video interviews and observations were made online with those who volunteered to participate in the qualitative research. The video interview was recorded by informing the students and obtaining permission in the Zoom program. Qualitative research data were collected with the questions below after the students

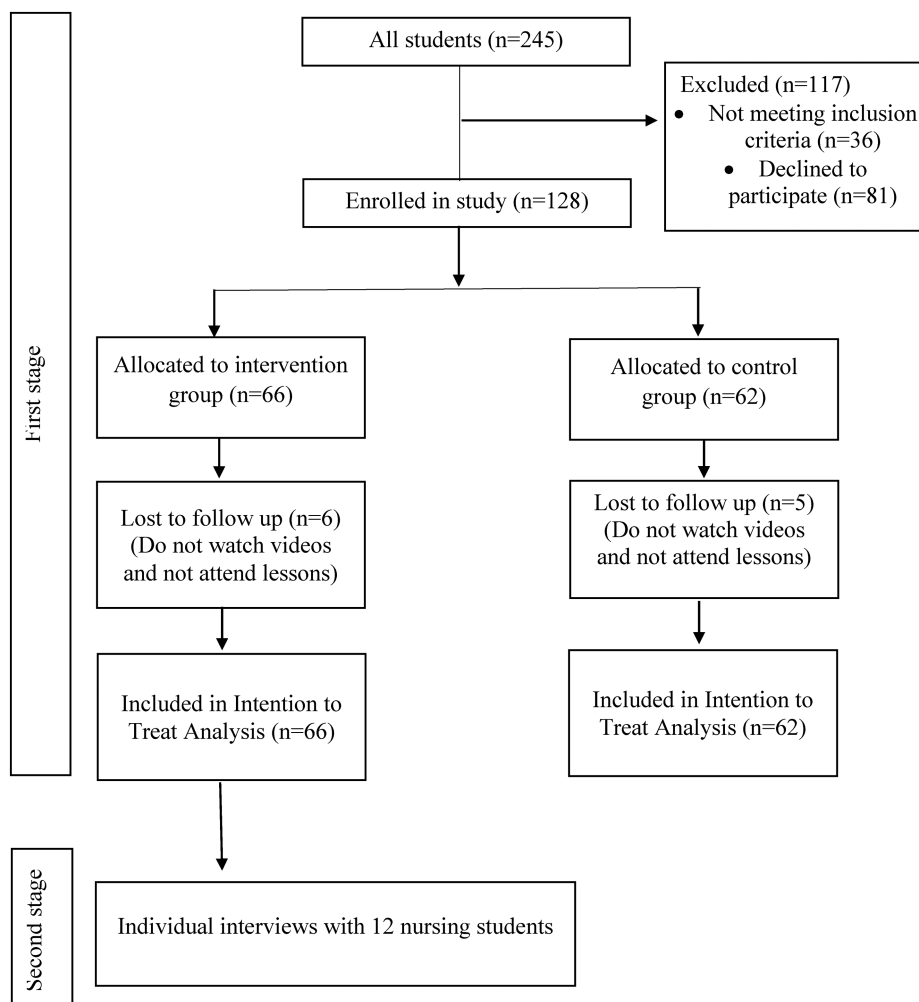


Figure 1. Flowchart of the study.

finished their exams. Semi-structured interview questions were prepared in line with the literature review and expert's opinion was taken (Table 1).²⁰⁻²² Each interview lasted between 20 and 25 minutes.

Intervention

In the study, one group was chosen as the intervention group and the other as the control group. The flipped classroom model with interactive videos was applied to the intervention group online for 2 hours (1 day) for 12 weeks. Interactive videos and lesson documents prepared by the researcher were sent to the students in the initiative group a week ago.

During the lesson, the students and the instructor had a discussion about the interactive videos sent online, and the parts that the students did not understand were discussed. The control group was trained for 12 weeks, 2 hours a week, using the traditional method in an online environment where the instructor and students came together in a synchronized way. After the post-tests, due to ethical principles, the biostatistics lesson was conducted with the flipped classroom model with interactive videos for the last 3 weeks in the control group.

Interactive videos are prepared in the Edpuzzle program. In-video questions (multiple choice, true, false questions) were added to these videos, and feedback (reinforcement for the correct answer) was used. In-video links (directing the student to a different material by giving external links) have been added.⁶ Each video is prepared as 12-15 minutes. Each video contains 5-10 questions. The link to the video (edpuzzle website) was sent to the students every week via the Teams program, the lesson documents were uploaded to this program, and the students were informed.

Data Analysis

IBM Statistical Package for Social Sciences (SPSS) Statistics version 24.0 was used in the analysis of the data. For the analysis of quantitative data, multiple imputation method was used to complete the missing data from both groups in the post-tests. After the missing data were completed, paired-sample *t*-test was used for the comparison of within-group, and the independent sample *t*-test was used in the analysis of the difference between

the knowledge scores between the groups. The effect sizes and CIs of the tests are presented in Table 2.

The records of the individual interviews made online face to face were transferred to the Nvivo program and the data were analyzed. The data obtained were coded by the author, and the codes created from the records and data were checked by an independent expert. Content analysis was conducted to explore the relationships between themes. This analysis includes reading individuals' statements line by line and identifying initial ideas, generating initial codes across the dataset, identifying relationships between codes and combining them to form themes, reviewing themes and ensuring they are relevant to the generated codes, reviewing themes and sub-themes by other experts, and declaring themes using quotations as examples. Main themes and sub-themes were evaluated by 2 independent experts and kappa analysis was performed. Cohen's kappa coefficient was determined to be 0.92, indicating a perfect fit for internal consistency.²³

Ethical Considerations

Ethical approval was obtained from the ethics committee to conduct the study (date: 01.10.2020; number: 70904504/650). Institutional permission was obtained from the school where the students studied. For the quantitative research, the students' informed consent was obtained online through Google forms. The students who wanted to participate in the qualitative research were informed before the study, they were asked if they wanted to participate in the study, and it was stated that the interview would be recorded. The students who volunteered to participate in the study were asked to repeat their consent after the registration started, and it was recorded.

RESULTS

The mean age of nursing students is 20.6 ± 3.8 , and 78.9% of them are women. In the beginning, there was no difference between the pre-test knowledge scores of the students in the intervention group. In the post-test after the intervention, this score of the intervention group was found to be statistically significantly higher than the control group ($P < .001$). When the pre-intervention and post-intervention groups were compared, the post-tests were found to be significantly higher than the pre-test in both groups. However, the effect size of the intervention group is higher than the control group (Table 2).

In the phenomenological part of the study, 5 main themes were formed from the findings obtained from individual interviews. Main themes emerged as (i) contribution to learning, (ii) the learning environment, (iii) the advantage of the flipped classroom model, (iv) disadvantage of this model, and (v) feedback for educators (Table 3). In addition to this finding, a metaphorical analysis based on the metaphorical images produced by the participants was conducted to interpret the participants' feelings and thoughts about the flipped classroom model with interactive videos.

Theme 1: Contribution to Learning

Nursing students stated that using the flipped classroom model with interactive videos contributed to learning in many ways. Sub-themes are beneficial and useful, facilitating learning, reinforcing knowledge/making knowledge permanent, grasping/understanding the subject, increasing research skills, and strengthening motivation. All the students participating in the study stated that the flipped classroom model was a very useful

Table 1. Semi-structured Interview Questions

You received training in the classroom where the flipped classroom application was made. Can you explain your experience in this class to me?
What do you think about the flipped classroom practice and interactive videos used in your classroom?
When you compare the traditional learning method with the flipped classroom application, what are the advantages and disadvantages of these methods?
What are the advantages and disadvantages of the applied flipped classroom practice and interactive videos?
How does your teacher use the flipped classroom and interactive video application and how does this application contribute to your learning? Can you explain?
What do you think your teacher could have done to make your learning easier?
If you could liken interactive videos and flipped classroom practice to something, what would it be? Why is that?

Table 2. Pre-test and Post-test Knowledge Scores of the Students in the Intervention and Control Groups

	Intervention	Control	t test	P	d (95% GA)
	Mean (SD)	Mean (SD)			
Pre-test	28.78(11.83)	30.00(11.30)	-0.55	.555	
Post-test	89.92(9.13)	76.61(12.80)	6.70	<.001	1.20 (0.79-1.60)
R	0.369	0.084			
t test	-41.43	22.35			
P	<.001	<.001			
d (95% CI)	5.10 (4.19-5.99)	2.84 (2.28-3.40)			

SD, standard deviation.

application in terms of learning and reinforced their knowledge. One student shared "SPSS seemed like a very complicated. It would be more understandable when you explained" (Student 5). Many participants stated that the permanence of the information was ensured with the flipped classroom. In addition, some students stated that they contributed to the development of their research skills (Student 4), and their motivation to learn increased (Student 8). Table 3 demonstrates quotes reflecting the identified main themes and sub-themes.

Theme 2: Learning Environment

The learning environment was positively affected by the flipped classroom model. Three sub-themes related to the learning environment were identified. Sub-themes were more active participation of students in the lesson, more time to discuss in class, and reduced anxiety and interaction between educator and student. One student stated that he/she should attend the class every week (Student 9). The other student expressed that with this method, there was more opportunity for discussion, and the lesson was more effective with examples (Student 11). Also, some students emphasized that there is more active communication with the teacher (Table 3).

Theme 3: The Advantage of the Flipped Classroom Model

Participants stated that the flipped classroom model has many advantages. The sub-themes were coming to the lesson prepared, a fun/educational method, love/devotion to the lesson, and being useful for preparing for the exam. Many students stated that they came to the lesson knowing the subject and they were familiar with the subject. One student explained that the flipped classroom is both visually and emotionally catchy (Student 11). All students shared that they liked this lesson very much and that they were very satisfied with the education method. They said that "it was very valuable for us to prepare videos and put in effort." Also, many students shared that this flipped classroom method is very useful for exam preparation (Table 3).

Theme 4: The Disadvantage of the Flipped Classroom Model

Two sub-themes of this theme were identified: internet cost and time wasting. Only 1 or 2 students explained that they needed an extra internet package to watch the videos. Many students stated that watching videos and coming to class prepared are not a waste of time. However, a few students argued that this method requires extra time (Table 3).

Theme 5: Feedback to Educators

Two sub-themes of the main theme of feedback to educators were determined: the method for other lessons and video content. All students suggested using the flipped classroom practice and interactive videos in other lessons as well. Regarding the

video content, many students stated that their videos were of high quality and that the content was sufficient. However, a few students stated that a question or 2 and a few more notes could be added to the videos (Table 3).

Metaphors for Using the Flipped Classroom Model with Interactive Videos

Students' opinions about the flipped classroom were as follows:

- like a television or computer (Student 1, 3),
- a very fast car (Student 2),
- comprehensive test books (Student 4),
- as we always prepare our bags according to the curriculum in primary school (Student 5),
- a full, solid bike with all its equipment (Student 6),
- like a puzzle (Student 7),
- a fun game (Student 8),
- like television and internet (Student 9),
- like going by plane instead of going by car (Student 10),
- simulation or virtual reality (Student 11), and
- like a child preparing for an exam (Student 12).

DISCUSSION

During the pandemic process, education in universities in Turkey has been continued with distance education. In order to facilitate the teaching of the biostatistics lesson in the distance education process, it was thought that the flipped classroom would be effective. However, it is a very effective training method in face-to-face education. Student success increases when methods in which students are active are applied in biostatistics teaching.²⁴ Using the flipped classroom with interactive videos enables students to be active before and during the lesson. In the current study, the effects of the flipped classroom with interactive videos in the biostatistics teaching of nursing students studying at the university were tried to be revealed with quantitative and qualitative data.

At the end of the 12-week intervention, there was an increase in the knowledge levels of the students in the intervention and control groups. However, the effect of the increase in the level of knowledge in the intervention group is higher than in the control group (effect size of intervention group=5.10 and control group=2.85, Table 2). In addition, it is expected that there will be an increase in the control group trained with the traditional method. Because the control group, who did not know the biostatistics information questions in the first week of the lesson, learned the subject after the lesson taught with the traditional method and their knowledge level increased. In a meta-analysis study, it was found that the flipped classroom was more effective than the traditional

Table 3. Illustrative Quotations from Themes

Subtheme	Illustrative Quotes
Theme 1: Contribution to learning	
Beneficial and useful	<p>"I mean, I really benefited from it. It made it easier for me to understand the subject. We were completing the missing parts in the lesson. Useful application. (S1)"</p> <p>"SPSS program is in English and I'm not an English proficient person but when it overlapped with your videos on edpuzzle for example I was beginning to understand how I could at least do something. It was very useful, useful for me. (S4)"</p>
Facilitating learning	<p>"It made learning easier, so I think it made learning easier because the videos gave shorter concise information... those little notes and the questions in between were instructive for us. For example, do we understand the place you explained until the question in the 2nd minute, we reinforce this. (S3)"</p> <p>"SPSS seemed like a very complicated thing to us. When you explained it there, it would be more understandable when you explained the steps one by one. (S5)"</p> <p>"Discussing the sample articles and analyses in the articles facilitated the learning. (S8)"</p> <p>"So, if the analyzes we do and the results come up, I know what it means in that test. this is very important to me. Your teaching method made it easier for me to learn biostatistics. (S9)"</p>
Reinforcement of information and ensuring the permanence of information	<p>"I think we started the lesson consciously. I was watching the videos, examining the lecture notes, taking notes, then I think that the information is more permanent since we have already reinforced it in the lesson. (S2)"</p> <p>"The subjects of the lesson were very complex, so I had a hard time understanding it. Thanks to the videos, it was actually reinforcing and useful for me. (S3)"</p> <p>"I like learning more with videos with questions and answers, it is more memorable. (S5)"</p> <p>When there is a slide, there is always a slide in other lessons, read the slide, read it. In other words, from a certain point, a lesson of 100 slides becomes the subject for you. I'm bored of reading. I mean, you don't understand anymore, I'm bored of reading, but since it's a video, you tell it so well, I think it's more on my mind. (S11)"</p>
Grasp/understand the subject	<p>"The traditional method of learning seems more boring to us. When I watch reverse videos, I think I'm good when I get it right and I understand the places so far. When I make a mistake, I say that there is a disconnect somewhere. (S1)"</p> <p>"The topics in the lesson were abstract, but they became concrete for me on the reverse, especially with the videos. (S5)"</p> <p>"I think that having something visual makes my learning more effective, I understand the subject. (S7)"</p> <p>"We were staying in the videos until we understood that question. Of course, we were understanding the subject and it was very good that we had the chance to watch it again and again (S8)"</p> <p>"We were doing the analysis results in SPSS in the lesson, but watching the video first and then seeing it in the lesson allowed us to have more information about SPSS. (S10)"</p> <p>"The topics were too foreign. I just didn't understand when I read it from the slide. I've seen the benefits of the videos. Giving examples and notes in the lesson and in the videos made the subject understandable. (S12)"</p>
Increasing in researcher skills	<p>"I watched all the videos. In this way, I both liked and wanted to research, and now I started to research other things that I did not understand. I loved this lesson thanks to your explanations and watching the videos answering those questions. (S4)"</p> <p>"I was answering the questions after taking such papers in front of me and noting what you said. I was looking at the other links in the videos. (S7)"</p>
Improving motivation	<p>"We cannot ensure continuous participation in the lesson in distance education... we sit in the lesson and then 5 minutes later, the doorbell rings or something else happens. We have to leave the classroom. But I wanted to take your class. When I watched the videos, I was even more motivated. It was very enjoyable to watch the 12-15 minute videos. (S8)"</p> <p>"I was especially careful with questions. There is a question in the 1st minute, there is a question in the 5th minute. I used to be ambitious, so that I could take a better look at the issues before those questions and answer the question correctly. In order to answer the questions correctly. (S10)"</p>
Theme 2: Learning environment	
Active participation to the lesson	<p>"I really liked the flipped classroom implementation. Because it allowed me to attend the class prepared. I thought I should attend the lesson by examining the videos and lecture notes before each lesson, and I applied this every week. (S9)"</p> <p>"Not just by watching videos. We had to take notes there, solve the questions on the screen one by one, and participate actively in the lesson. I have never been this active in previous lessons. (S10)"</p>

(Continued)

Table 3. Illustrative Quotations from Themes (Continued)

Subtheme	Illustrative Quotes
Having more time to discuss in class	"I was taking some notes while watching the video. I was entering the class by examining the lecture notes. You explained by discussing in more detail in the lesson, we had more time to discuss. The lesson was more effective with examples (S11)"
Interaction between educator and student	"I think that this method increases the interaction between students and teachers. you give examples and you want us to give examples. We discuss analysis results. (S7)" "It was an application that pushed us to learn. We had a more active communication with the teacher, we were conducting the lesson by mutual discussion and giving examples. (S12)"
Reducing anxiety	"I wanted to ask you a question, when I watched the videos, sometimes there were points that I did not understand. I wanted to learn them right away.... but I had to wait for the lesson. I was afraid to ask questions in other lessons. But I did not feel any discomfort in this lesson. On the contrary, I wanted to ask and learn. (S9)" "I didn't ask questions before in classes. I was hesitant to ask questions. With the reverse and edpuzzle, I started to ask my teacher, I did not understand this. (S11)"
Theme 3: The advantage of the flipped classroom model	
Coming to class prepared/knowledgeable	"The disadvantage of the traditional learning method is that I come to the lesson unprepared, for example, if the teacher did not give the slide of the lesson beforehand, we are completely unprepared. When the teacher asks a question, I falter a lot. I have to have studied it before or I need to have some knowledge of it. However, with this application you made, this problem was solved for me. (S1)" "I come to class knowingly, I wonder what the teacher says when I come to class without knowing anything.. When we watch the videos beforehand, when we look at the lecture notes, of course, we know what you are going to tell or we were more in command of the lesson. (S3)"
A fun/educational training method	"Just your telling and our listening comes down to some passive learning techniques. so it was an active, fun and instructive application. (S8)" "The flipped classroom application is a catchy application both visually and emotionally. (S11)"
Love/devotion to the lesson	"This lesson was the one I studied with the most pleasure... it became one of my favorite lessons in distance education. (S4)" "I started the lesson with a bias... After watching these videos, I liked the lesson and had a curiosity. (S6)"
Useful for exam preparation	Obviously, it's easy for students to watch these short videos before the exam. We could easily remember the subjects. (S7)" "In other lessons, lesson recordings take 40-50 minutes, a lot of time is lost. The videos in Edpuzzle were very good for us, like 12-15 minutes. (S9)" "We could easily remember the topics by watching these short videos before the exam. (S12)"
Theme 4: The disadvantage of the flipped classroom model	
Internet cost	"When we consider today's conditions, not everyone's conditions are the same. people's internet may be limited. Watching the videos is a bit of an additional expense. (S1)" "Extra internet package may be needed to watch videos. (S11)"
Time wasting	"Taking extra time for both the teacher and the learner outside the classroom (S2)"
Theme 5: Feedback to educators	
Using this method in other lessons	"I wish it could be in other classes. Normally, before the lesson, of course, it is more useful in general. When I watch it after the lesson, it is a reminder especially before the exam. I can easily remember places I forgot. (S2)" "I wish such an application was available in other lessons in distance education, especially in applied lessons. The notes in the videos were very good, a few more notes could have been added. (S4)"
Video content	"A few notes or questions can be added to interactive videos. (S11)"

method in the education of health professionals.⁴ In a study conducted with nursing students, it was determined that the flipped classroom integrated with scenario simulation was more beneficial than the traditional flipped classroom and improved long-term memory in symptom assessment.⁵ In this study, instead of the traditional flipped classroom, a flipped classroom with interactive videos was used and it was found to be effective (Table 2). In addition, qualitative findings supporting the quantitative findings were obtained in this study.

Nursing students stated that using the flipped classroom model with interactive videos contributed in many ways such as being a useful and beneficial practice, facilitating learning, ensuring that

the information is permanent, and strengthening research skills and motivation (Table 3). In a study in which the flipped teaching model was used to support problem-based learning, it is stated that videos increase students' interest and motivation, are useful, have a great role in learning, and strengthen self-efficacy and self-directed learning.²² Another study showed that the flipped classroom model helped students improve themselves. It has been instrumental in raising grades, increasing interactions with teachers and peers, and developing students' problem-solving and critical analysis skills while developing them toward better learning experiences.²⁵ In a study with nursing students, it was found that students increased their motivation to learn and had

better learning outcomes.²⁶ These findings and study results show how effective the flipped learning model is in learning.

The flipped classroom practice had a positive impact on the learning environment. The group in which the initiative was conducted was a more active group. There is a situation where students participate more actively in the lesson, students come prepared to the lesson, so there is more time to discuss in the lesson, the interaction between the student and the teacher increases, and the anxiety decreases (Table 3). In a study in which the flipped classroom was made, it is stated that there is a positive learning experience and a high rate of participation in the lessons, the learning environment improves, the feeling of safety increases, the relationship between the instructor and the student improves, the learning with peers increases, and the situation of using videos to learn new content.²¹ Flipped classroom is a useful teaching method in terms of improving students' knowledge, motivation, success, and self-efficacy, and it is important for students to attend the lesson prepared and to strengthen the interaction between both the learner and the teacher.^{3-5,7}

The flipped classroom model was advantageous in many ways, such as being prepared for the lesson, being a fun educational method, increasing love/devotion to the lesson, and being useful for preparing for the exam according to the participants (Table 3). In a study, the advantages of the flipped classroom were the flexibility of learning from videos, better understanding of the content, coming to the class prepared, and motivation to learn.²⁷ In a study conducted with university students, it was found that the flipped classroom was more effective than the traditional method in terms of using more detailed learning strategies and increasing cognitive and emotional interaction.²⁸ The meta-analysis studies have stated that the flipped classroom practice in the education of health professionals and nurses has a great contribution and advantages in learning.^{4,17} In the current study, all students stated that it was very valuable for us that you prepared a video and put your effort into it. This statement reveals how important this education method is.

A few students considered the disadvantage of the flipped classroom method as internet cost and time loss. However, many students point out that there is no disadvantage to the flipped classroom with interactive videos (Table 3). In a study, the disadvantages of the flipped classroom were technical problems, internet, software, etc.²⁷ In order to meet the need for an internet package, students can use the internet networks of universities free of charge to watch videos and access other lesson materials.

All of the participants suggested that this practice be done in other lessons as well. There was a suggestion to develop the video content as questions and notes (Table 3). In studies conducted in many fields of science, it has been found that the flipped classroom is effective and it is recommended to be used in lessons in every field of education.^{5,10,18,19} While many students liked the content of the videos, a few students liked learning with notes and questions and suggested adding a few more of each. Another point that students like is that the videos in this study give feedback after the answers to the questions.

In qualitative research methods, metaphor is often used to describe the situation under consideration. The metaphors of the students regarding the flipped classroom method were technological devices such as television, computer, internet, simulation

or technological devices, a fast-moving car or plane, a solid bicycle, a fun game, a comprehensive test book, preparing a bag according to the puzzle or curriculum, or a child preparing for an exam. In a study examining the metaphors of flipped classroom practice, metaphors for this method are rainbow, raindrop, a technological journey, treasure chest, dolls, imaginary world, and worksheet.²⁹

Flipped learning is a method that integrates technology into teaching processes and has positive contributions to teaching in terms of different variables such as academic success, student participation, and motivation. In this study, it was tried to enrich learning by including technology in the flipped classroom practice. The flipped classroom application with interactive videos is more advantageous than the traditional learning method in many ways. In this study, it was determined that the flipped classroom application is an effective teaching method because it increases the learning motivation of the students in the distance education process and facilitates learning. It is recommended to evaluate the effects of the flipped classroom model, which can be used in every field in both distance education and face-to-face education, especially in applied theoretical courses of nursing. In addition, this method can be enriched with different training methods and its effects can be evaluated.

Limitations of the Study

The limitation of the study is the lack of randomization. This research is limited to 3rd year nursing students in the fall semester of 2020-2021. Although the effectiveness of the education was evaluated in a single lesson, this education model was applied by including all the topics of the biostatistics lesson.

Ethics Committee Approval: Ethics committee approval was received from the Akdeniz University Clinical Research Ethics Committee (Date: 01.10.2020, No: 70904504/650).

Informed Consent: Nursing students' informed consent was obtained online through Google forms.

Peer-review: Externally peer-reviewed.

Declaration of Interests: The authors declare that they have no competing interest.

Funding: The authors declare that this study had received no financial support.

Etik Komite Onayı: Bu çalışma için etik komite onayı Akdeniz Üniversitesi Klinik Araştırmalar Etik Kurulundan (Tarih: 01.10.2020, Sayı: 70904504/650) alınmıştır.

Bilgilendirilmiş Onay: Yazılı bilgilendirilmiş onay bu çalışmanın katılımcılarından alınmıştır.

Hakem Değerlendirmesi: Dış bağımsız.

Çıkar Çatışması: Yazarlar çıkar çatışması bildirmemişlerdir.

Finansal Destek: Yazarlar, bu çalışma için finansal destek almadıklarını beyan etmişlerdir.

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