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HOW DOES THE FLIPPED CLASSROOM MODEL AFFECT STUDENTS' MOTIVATION, PERFORMANCE AND ATTITUDE?*

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Abstract

The flipped classroom model, a type of blended learning, has become a promising model for building flexible and effective learning environments in higher education. Much of the experimental research on blended learning characterizes a treatment as an independent variable and compares it with a control group to identify a significant difference. However, this research utilized two treatment groups, a multimedia-enhanced flipped classroom model and a technology supported face-to-face (f2f) classroom model, instead of using only a control group. The study investigates the effects of these models on university students' instructional material motivation, performance, and attitude towards the subject. Following quantitative and qualitative research methods, we employed an explanatory sequential mixed method design. Twenty-six university students participated in two groups over four weeks. The results indicated that the instructional material motivation for the multimedia-enhanced flipped classroom model group was significantly higher than in the other group. Additionally, descriptive results showed an increase in learning performance and attitude scores for the multimedia-enhanced flipped classroom group; however, these did not reveal a significant difference in favor of this model. The results indicated that the multimedia-enhanced flipped classroom model significantly improved students' motivation for instructional materials. Various teaching strategies and interactive animations in this model may enhance student learning effectiveness. This study provides insights to aid researchers in designing teaching activities and interactive resources for the flipped classroom model.

Keywords: flipped classroom model; blended learning; higher education

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TERSYÜZ SINIF MODELİNİN MOTİVASYON, PERFORMANS VE TUTUMA ETKİSİ

Öz

Harmanlanmış öğrenmenin bir türü olan tersyüz sınıf modeli, yükseköğretimde esnek ve etkili öğrenme ortamları oluşturmayı teşvik etmektedir. Literatürde harmanlanmış öğrenme üzerine yapılan deneysel araştırmaların çoğu bir uygulamayı bağımsız bir değişken olarak tanımlar ve anlamlı bir farkı keşfetmek için çoğunlukla bir kontrol grubuyla karşılaştırır. Ancak bu araştırmada sadece bir kontrol grubu kullanmak yerine çoklu ortam destekli tersyüz sınıf modeli ve teknoloji destekli yüz yüze (f2f) sınıf modelinden oluşan iki grup kullanılmıştır. Bu çalışma, iki modelin üniversite öğrencilerinin öğretim materyali motivasyonu, performansı ve konuya yönelik tutumu üzerindeki etkilerini araştırmaktadır. Çalışmada, nicel ve nitel araştırma yöntemlerini takip eden açıklayıcı sıralı karma yöntem tasarımı kullanılmıştır. Çalışmaya toplam 26 üniversite öğrencisi, dört hafta boyunca katılmıştır. Bulgular, çoklu ortam destekli tersyüz sınıf modeli grubunun öğretim materyali motivasyon puanının diğer gruptan önemli ölçüde yüksek olduğunu göstermiştir. Ayrıca, betimsel sonuçlar çoklu ortam destekli tersyüz sınıf grubunun performans ve tutum puanında artış olduğunu gösterirken, yapılan istatistiksel analizlerde bu artışın anlamlı olmadığı belirlenmiştir. Genel olarak sonuçlar, çoklu ortam destekli tersyüz sınıf modelinin öğrencilerin öğretim materyali motivasyonunu önemli ölçüde artırdığını göstermiştir. Bu modeldeki çeşitli öğretim stratejileri ve etkileşimli animasyonlar öğrencilerin daha etkili öğrenmelerine yardımcı olabilir. Bu çalışma, araştırmacılara tersyüz sınıf modeli için öğretim etkinlikleri ve etkileşimli kaynaklar tasarlama konusunda yardımcı olacak bilgiler sunmaktadır.

Anahtar Kelimeler: tersyüz sınıf modeli; harmanlanmış öğrenme; yüksek öğretim

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Geniş Özet

Yükseköğretimde yüz yüze sınıf temelli derslerde öğrenme materyallerindeki ve öğrenciler arasındaki etkileşim eksikliği anlamlı ve etkili öğretim faaliyetlerinin gerçekleştirilmesinde halen bir engel olarak görülmektedir. Ayrıca acil uzaktan eğitim dönemleri, yüksek öğretimde daha esnek modellere olan ihtiyacı ortaya koymuştur. Bu ihtiyaçlara bir çözüm niteliğinde görülen harmanlanmış öğrenme yaklaşımlarından biri olan tersyüz sınıf model, teorik bilgiyi yüz yüze fiziksel sınıfların dışına taşımak için web teknolojilerini kullanırken, öğrenilen teorik bilginin uygulama bilgisi ise yüz yüze sınıf ortamında işbirlikli etkinliklerle yapılır (Strayer, 2012). Tersyüz sınıf modelinde, dersleri sınıf dışında uzaktan devam ettirmek için teknolojiden faydalanılırken, sınıfta ise konu ile ilgili öğrenme etkinlikleri kullanılır. Bu model, internet ve mobil teknolojilerin yardımıyla geleneksel eğitimdeki yüz yüze sınıf zamanının daha verimli kullanılmasını hedefler. Öğrenciler eğitmenleri, akranları ve ders içeriği ile yer ve zaman bağımsız olarak etkileşime geçebilirler (Fisher, 2009). Öğrenci merkezli bir model olan tersyüz sınıf modeli, öğrenci-öğrenci ve öğrenci-eğitmen arasındaki sosyal etkileşimin geliştirilmesine katkı sağlar (Kyei-Blankson ve ark., 2019; Nolan ve ark., 2021). Literatürde yapılan çalışmalar, bu modelin uygulandığı araştırmalarda öğrencilerin öğrenme performanslarının ve akademik başarılarının arttığını (Cormier ve Voisard, 2018; Ozpınar ve ark., 2016; Peterson, 2016; Polat ve Karabatak, 2022; Sun ve Wu, 2016; Unal ve Unal, 2017), öğrenci memnuniyetinin (Burke ve Fedorek, 2017;

Mikkelsen, 2015; Peterson, 2016; Polat ve Karabatak, 2022), motivasyonunun (Chao ve ark., 2015; Østerlie, 2018; Ozpınar ve ark., 2016) ve öğrencilerin derse yönelik tutumlarının geliştiğini göstermektedir (Chao ve ark., 2015; Entezari ve Javdan, 2016). Ayrıca tersyüz sınıf modelini araştıran birçok çalışmada modelin bir veya daha fazla yüzyüze sınıf ortamındaki eğitimle karşılaştırıldığı ya da uzaktan eğitim modelleri ile karşılaştırma yapılarak çalışmaların yürütüldüğü belirlenmiştir (Liu ve Zhang, 2022; Polat ve Karabatak, 2022). Çalışmalarda, deneysel modellerin uygulanmasındaki bazı eksiklikler (rastgele atamaların olmaması vb.) ve sınıf dışındaki bilginin sunumunda sıklıkla videoların kullanılması, tersyüz sınıf modelinin farklı modellerle ve çevrimiçi öğrenme araçları kullanılarak karşılaştırmalı uygulamasına ve alandaki gerçek etkisinin belirlenmesine yönelik daha fazla araştırma tabanlı çalışmaya ihtiyaç olduğunu göstermektedir.

Bu araştırmada temel olarak tersyüz sınıf modelinin öğrencilerin öğretim materyaline yönelik motivasyon, performans ve konuya yönelik tutumları üzerindeki etkisini incelemek amaçlanmıştır. Bu amaçla, iki grup oluşturulmuştur. Grup 1'e çoklu ortam destekli tersyüz sınıf modeli ile uygulama yapılırken; Grup 2'ye teknoloji destekli yüzyüze sınıf modeli uygulanmıştır. Grup 1'de teorik bilgiler öğrencilere Mayer'in çoklu ortamla öğrenme teorisine uygun olarak geliştirilen çevrimiçi öğrenme ortamıyla sunulmuş, teorik bilgilerin uygulaması ise sınıf içindeki yüz yüze öğrenme etkinlikleri ile gerçekleştirilmiştir. Grup 2'de ise öğretim materyali olarak teknoloji ile zenginleştirilmiş PowerPoint sunumları, geleneksel sınıf ortamında kullanılmış, bu grupta ders soru-cevap, düz anlatım ve tartışma yöntem ve teknikleri ile gerçekleştirilmiştir. Her iki grupta da ders içerikleri aynı olmakla birlikte, sadece uygulanan öğretim modelleri farklılaşmıştır. Literatürde tersyüz sınıf modeliyle ilgili yapılan birçok çalışmada uzaktan öğrenme sürecinde teorik bilginin öğretiminde videolar kullanılırken, bu çalışmada konuyla ilgili etkileşimli sayfalar, görseller ve uzman videoları gibi çeşitli öğretim materyalleri içeren çevrimiçi öğrenme ortamı kullanılmıştır. Çevrimiçi öğrenme ortamının geliştirilme sürecinde güvenilir ve etkili içerikler oluşturmak için uzman kişilerle çalışılmıştır.

Çalışmada karma yöntem araştırma türlerinden sıralı açıklayıcı tasarım kullanılmıştır. Araştırmada ağırlıklı olarak nicel araştırma yöntemleri kullanılırken, nitel araştırma yönteminden de faydalanılmıştır. Araştırma sürecinde toplanan nicel veriler analiz edildikten sonra, elde edilen bulguları açıklamak ve yorumlayabilmek için görüşme formu ve gözlem notları ile nitel veriler toplanmıştır. Araştırma iki farklı grupla, nicel araştırma yöntemlerinden öntest-sontest kontrol gruplu deneysel modelle desenlenmiştir. Araştırmanın çalışma grubunu bir devlet üniversitesinin Rehberlik ve Psikolojik Danışmanlık (RPD) bölümünde 3. sınıfta okuyan ve seçmeli olarak Cinsel Sağlık Bilgisi dersini alan 26 öğrenci ($n_{Grup\ 1}$=13; $n_{Grup\ 2}$ =13) oluşturmuştur. Öğrenciler gruplara rastgele olarak atanmıştır. Araştırmada nicel veriler ölçeklerle, nitel veriler ise görüşme ve gözlem notları ile toplanmıştır. Çalışma kapsamında dört hafta süresince iki gruba belirlenen modellerle ders anlatımı yapılmış, veri toplama süreci öntest, sontest ve kalıcılık testlerinin uygulanması ile sekiz hafta sürmüştür. Ayrıca, araştırma sürecinde toplanan nicel verilerin analizinde tekrarlı ölçümler için tek faktörlü ANOVA, İlişkili örneklemler için *t*-testi ve Bağımsız örneklemler için *t*-testi kullanılırken, nitel verilerin analizinde içerik analizi tekniği kullanılmıştır.

Araştırma sonucunda, çoklu ortam destekli tersyüz sınıf modeli uygulanan grubun öğretim materyaline yönelik motivasyon puanı diğer gruba göre anlamlı derecede yüksek bulunmuştur ($p<.05$). Fakat, performans ve konuya yönelik tutum puanları arasında gruplara göre anlamlı bir farklılık bulunmamıştır. Sonuçlar, tersyüz sınıf modelinin performans ve tutum üzerinde olumlu etkiye sahip olabileceğini fakat bu etkinin istatistiki olarak anlamlı olmadığını;

öğrencilerin öğretim materyaline yönelik motivasyonları üzerinde ise yüksek düzeyde olumlu bir etkiye sahip olduğunu göstermektedir. Nitel verilerden elde edilen sonuçlar bu bulguyu destekler nitelikte olup, etkileşimli çevrimiçi ortamların ve öğrencilerin konuya yönelik ilgilerinin motivasyon üzerinde etkili olduğunu göstermektedir. Ayrıca çevrimiçi öğrenme ortamında etkileşimli görsel kalitesinin artmasının, öğrencilerin ortamı daha etkileyici ve etkili bulmasını sağladığı ve öğrencilerin bu sayede ortamı daha çok ziyaret ettikleri tespit edilmiştir. Bu çalışma araştırmacılar ve uygulayıcılar için tersyüz sınıf modelinin sağlık eğitiminde kullanımına yönelik hem araştırma tabanlı bir örnek sunmakta hem de sınıf içindeki öğretim stratejilerine yönelik bilgiler içermektedir.

Introduction

In today's educational landscape, the flipped classroom model (FCM) stands out as a transformative teaching method. This model revolutionizes traditional classroom dynamics by enabling students to take charge of their learning, using class time for interactive participation and hands-on application. Technological developments have accelerated the shift from on-site learning to online environments. In the past, while online learning was an option for some groups of students, today we frequently witness the use of blending physical and online learning environments. By blending these environments, students can benefit from the advantages of both online and face-to-face environments. Although the impact of the FCM on the learning process considering various variables and subjects is widely investigated in the literature, studies specifically examining its effects on motivation, performance, and attitudes in health science courses in higher education remain scarce. Therefore, this paper explores the impacts of two teaching models- the multimedia-enhanced flipped classroom model (MFC) and the technology supported face-to-face (f2f) classroom model (TCM) on university students' instructional material motivation, performance, and attitudes toward the subject, employing a mixed method research design.

Flipped Classroom Model in Higher Education

The flipped classroom model, a distinctive type of blended learning, serves as an innovative pedagogical approach amidst the digital transition in higher education (Cevikbas & Argun, 2017). The adoption of the flipped classroom model was influenced by technological advancements, digital transitions in educational contexts, varying student readiness in class, and the idea of maximizing face-to-face classroom time more effectively and actively. This model has been variously described in literature as an inverted classroom, flipped learning, flipped teaching, flipped instruction, flipped course, flipped class (Gong et al., 2023). It utilizes web technologies to transfer theoretical knowledge outside the traditional classroom setting. In contrast, practical application of this knowledge occurs within face-to-face class environments through instructor-led collaborative activities (Strayer, 2012). The flipped classroom model aims to optimize the use of classroom time in conventional education systems by leveraging internet and mobile technologies. Active learning techniques such as group work, case studies, and individual problem-solving are conducted in person, while theoretical learning often takes place through online or offline videos and web-based platforms, allowing students to interact with peers, instructors, and content asynchronously (Fisher, 2009). This student-centered approach enhances interpersonal interactions and social learning among students and instructors (Kyei-Blankson et al., 2019; Nolan et al., 2021).

Literature studies conducted within various teaching disciplines indicate that FCM can improve students' learning performance and academic achievement (Cormier & Voisard, 2018; Hew & Lo, 2018;Ozpınar et al., 2016; Peterson, 2016; Polat & Karabatak, 2022; Sun & Wu, 2016; Unal & Unal, 2017), student satisfaction (Burke & Fedorek, 2017; Mikkelsen, 2015; Peterson, 2016; Polat & Karabatak, 2022), collaboration (Strayer, 2012), student motivation (Chao et al., 2015; Østerlie, 2018; Ozpınar at al., 2016) and attitudes toward the lesson (Chao et al., 2015; Entezari & Javdan, 2016). However, some studies, such as research by Hew and Lo (2018), have reported minimal impact on academic performance. In a meta-analysis, Tutal and Yazar (2021) reviewed 177 studies on academic achievement, nine on learning retention, and 17 on attitudes toward courses, concluding that the flipped classroom model only modestly enhances achievement retention and attitudes compared to traditional lecture-based teaching. Many studies that have evaluated the FCM typically contrast it with conventional face-to-face classrooms or other distance education models (Liu & Zhang, 2022; Polat & Karabatak, 2022), often encountering methodological challenges like the random assignment of participants to treatment groups (Feldon et al., 2021). Consequently, Further empirical studies are needed to determine the true impact of this model across disciplines, samples, and experimental designs. This research utilised the flipped classroom model not only for its pedagogical benefits, but also to address the need to investigate the outcome of a different experimental design, including the comparison of the multimedia enhanced flipped classroom with the technology supported face-to-face (f2f) classroom.

The flipped classroom model has been employed across various disciplines, including Computer Science, Programming, Accounting, Chemistry, Physics, English, and health-related courses such as allied health microbiology, dosage calculation, and undergraduate health profession programs (Asıksoy & Ozdamlı, 2016; Basal, 2015; Cakıroglu & Ozturk, 2017; Cetinkaya, 2017; Yilmaz, 2017; Naing et al., 2023; Wolf, 2020; Vidal & Vidal, 2022). Its application in health science has been thoroughly explored in higher education. Research has identified several factors that contribute to the effectiveness of the flipped classroom, including student and teacher characteristics, implementation methods, task characteristics, and the nature of activities conducted inside and outside of the classroom (Oudbier et al., 2022). Studies have demonstrated that adopting the flipped classroom approach can significantly enhance academic performance and increase student satisfaction in undergraduate health professional programs (Naing et al., 2023). The integration of ICT platforms, web-based environments, and educational videos with the flipped classroom model can significantly boost academic achievement rates. This approach has improved learning outcomes, deepened subject understanding, and facilitated interactive teaching activities (Ajit, 2021). It promotes autonomy, self-directed study, and skill development through blended learning (Alnahdi et al., 2022). Overall, the flipped classroom model has the potential to improve the teaching-learning process in health science higher education by enabling active learning, allowing for thorough preparation, and leveraging technological resources (Vidal & Vidal, 2022). However, evidence regarding its effectiveness in sexual health courses is limited. There is a need for more research focused on the application of the flipped classroom model in sexual health education at the higher education level to assess its potential advantages and effectiveness. Considering this research gap, we included this topic in an elective course for university students and examined current online programs on this subject.

Multimedia Learning Theory in FCM

Multimedia learning environments leverage diverse formats—text, images, audio, and video—to engage learners and maintain their attention. By appealing to various learning styles and utilizing multiple sensory channels, these environments promote deeper comprehension and enhance knowledge transfer through real-world examples and simulations. Based on Mayer's theory, multimedia learning examines how integrating different media formats can improve understanding and knowledge retention. Mayer emphasizes coherence, ensuring clear presentations, and contiguity, aligning words and images. Effective design balances multimedia elements to manage cognitive load (Mayer, 2001). Understanding these principles improves educational materials and learning environments. Mayer's multimedia learning theory provides some principles for multimedia environment designers. These principles mainly multimedia, personalization, voice, coherence, signaling, spatial contiguity, temporal contiguity, redundancy, expectation, segmenting, pre-training, modality (Mayer, 2001). Mayer posits that adhering to these principles can significantly enhance learning outcomes. In designing web-based learning environments specifically in the FCM, multimedia learning principles can be followed to enhance the students' understanding and meaningful learning. Studies have demonstrated that integrating the flipped classroom model with multimedia elements can increase student performance in various subjects, including mathematics (Ali et al., 2022). Consequently, the combination of the flipped classroom model with a multimedia web environment holds the promise of creating an efficient and engaging educational experience for students.

Multimedia in flipped classrooms can significantly enhance student performance and satisfaction. A study by olde Scholtenhuis et al., (2021) compared the efficacy of flipped classes using short modular videos (microlectures) against traditional face-to-face (f2f) lectures. These videos adhered to Mayer and Fiorella's (2014) multimedia design principles, such as coherence, redundancy, and signaling, to minimize cognitive overload. Results show that flipped microlecture classes positively impact student performance and satisfaction. Incorporating multimedia elements into the flipped classroom offers several benefits. Firstly, it boosts students' motivation to learn and their readiness to engage in class activities (Putri et al., 2023). Second, it gives students more control over their learning experiences, encouraging self-directed learning. Thirdly, it extends learning time outside the classroom by allowing them to access and review multimedia resources at their own speed (Lai & Hwang, 2016). Moreover, multimedia tools enable the illustration of complicated concepts and theories simplifying comprehension and learning. Additionally, multimedia elements in the flipped classroom support a student-centered approach and creativity. However, utilizing multimedia materials in the flipped classroom model (FCM) presents certain challenges. These include the time-consuming process of producing instructional materials for teachers (Desa & Abd Halim, 2022) and teachers' lack of technological abilities (Li, 2018). Concerns about students' motivation to engage with pre-class videos may also arise (Lee & Butler, 2022), along with difficulties in accessing the provided information. Another challenge is the need for enhanced computer literacy training for both educators and students (Sanders & Altman, 2023). Preparing materials for the flipped classroom can be time-consuming, and the increased use of multimedia content may lead to a greater cognitive load for students.

Adapting the curriculum to this model and increasing screen time can also pose challenges. Thus, it is crucial to address these issues when designing and using multimedia materials in the FCM. In this study, the researchers incorporated Mayer's multimedia learning design principles into the design of the online environment for the FCM (OIPTW), as detailed in the methodology section of the paper.

The aim of the study

Despite growing interest and adoption of this flipped classroom model across various disciplines, empirical evidence regarding its efficacy, particularly in specialized subject areas such as sexual health education, remains limited. In addition, the prior studies indicated that students lack sufficient information about sexual health subject (Gungor et al., 2013; Kulkarni, 2018). This study can contribute to reducing the lack of information or misinformation related to it with the information obtained from reliable sources, and the attitudes of the students towards this subject will be improved positively. Overall, this study seeks to address this gap by investigating the impact of the flipped classroom model on university students' instructional material motivation, performance, and attitude in an elective sexual health course. Following this purpose, the main problem sentence of the study is "Is there a difference between two groups regarding the university students' instructional material motivation, performance, and attitude toward the subject?"

Research questions (RQ) were determined as follows:

RQ1: Does the mean score of instructional material motivation for the posttest and retention test differ between the two groups?

RQ 2: Does the mean score of IKT performance for the pretest, posttest, and retention test differ between the two groups?

RQ 3: Does the mean score of attitudes toward the subject for the pretest, posttest, and retention test differ between the two groups?

RQ 4: What are the learning experiences of students in the MFC and TCM groups?

Methodology

This study employed an explanatory sequential mixed method design (Creswell & Clark, 2017) to evaluate the efficacy of two instructional models - the multimedia-enhanced flipped classroom model (MFC) and technology supported f2f classroom model (TCM), on university students' instructional material motivation, performance, and attitude. Initially, a repeated measures design was applied, with participants randomly assigned to either the MFC (n=13) or the TCM (n=13). The MFC group engaged in both in-class face-to-face exercises and online theoretical learning facilitated by the Online Infertility Prevention Training Website (OIPTW). In contrast, the TCM group received traditional teacher-centered lectures using interactive multimedia presentations on an interactive board. Over four weeks, both groups underwent the instructional interventions, and participants' scores on the Instructional Material Motivation Scale (IMMS), the Infertility Knowledge Test (IKT), and Attitudes toward Infertility Scale (ATIS) were recorded before and after the interventions. The pretest assessment was conducted two weeks prior to the start of the interventions, while the post-test was

administered one week after the interventions concluded. Additionally, a retention test was conducted nine weeks post-intervention to assess the durability of the acquired knowledge, attitudes, and motivation.

Moreover, qualitative data were collected in the following phase to supplement and enhance the quantitative findings. This qualitative investigation aimed to offer a more explanation of the observed outcomes, thereby enhancing the overall validity of the study. We explored the complexities and contextual factors underlying the quantitative results through the semi-structured interviews, opinion forms, and observation notes. Ethics committee approval for the research was obtained from the Dokuz Eylul University, Educational Sciences Ethics Committee on October 26, 2017, under approval document number 11.

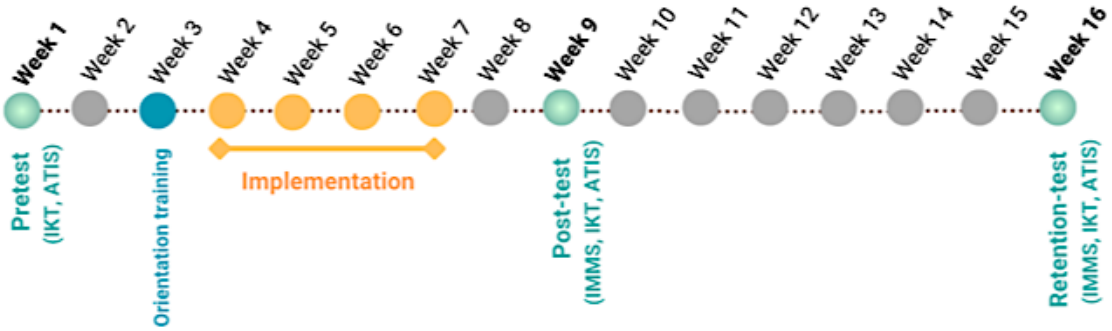

Figure 1. Timeline of the implementation process of the tests

The participants

The study of the study consisted of 26 third-grade university students who were studying in the Department of Guidance and Psychological Counseling and took the elective "Sexual Health Knowledge" course voluntarily. Before the experimental procedure, the equivalence status of the groups was examined with the pretest measurement, and the groups were found to be similar in terms of knowledge ($t(24) = -.819$, $p > .05$) and attitude ($t(24) = .782$, $p > .05$) scores. Characteristics of both groups have presented in Table 1.

Table 1. Students' characteristics in groups

Characteristics of students		MFC		TCM		TOTAL	
		f	%	f	%	f	%
Gender	Female	10	77	9	69	19	73
	Male	3	23	4	31	7	27
Age	20	6	46	7	54	13	50
	21	7	54	6	46	13	50
Accommodation	Dormitory	8	62	6	46	14	54
	Shared flat (with friends)	3	23	4	31	7	27
	Family home	2	15	3	23	5	19
Internet access at residence	Yes	13	100	12	92	25	96
	No	0	0	1	8	1	4
Device type used for Internet access	Mobile phone	7	54	9	69	16	62
	Computer (laptop etc.) & mobile phone	6	46	4	31	10	38
Mobile phone OS	Android	11	85	8	62	19	73
	IOS	2	15	5	38	7	27
Perceived infertility knowledge level	Sufficient	2	15	5	38	7	27
	Insufficient	11	85	8	62	19	73

Instructional content and material

The same content knowledge was taught to both groups in this study (Table 2). The content analysis was carried out with two reproductive health experts working in a hospital and one sexual health education expert working as an academic in a university.

Table 2. Content knowledge of the weekly lessons in both groups

Weeks	Week 1	Week 2	Week 3	Week 4
Content knowledge	Female reproductive system Female reproductive organs Menstruation Menopause Male reproductive system Male reproductive organs	Infertility Infertility treatment methods Myths on infertility Factors affecting infertility (Biological factors, Preventable factors) Age Timing Body Mass Index (BMI)	Factors affecting infertility Preventable factors • STD* • Effects of STD Prevention methods Myths on prevention methods	Factors affecting infertility Preventable factors • Substance use • Other factors • Cancer • Vocational conditions & Wearing tight clothing • Stress • Exposure to chemicals, heavy metals, and radiation

STD: Sexually Transmitted Diseases

The teaching materials and methods were different, although the course content knowledge was the same in both groups. The following sub-headings provide more detailed information about this.

Multimedia-enhanced flipped classroom model (MFC): *MFC had two main components: 1) Online theoretical learning out of the class and 2) Face-to-face interactive activities within the class.* The out-of-class theoretical learning was facilitated using the Online Infertility Prevention Training Website - OIPTW- http://infertiliteyionleme.deu.edu.tr/course/ - as shown in Figure 2. To design this online environment and avoid cognitive overload, the researchers applied Mayer's multimedia learning design principles, which include segmenting, signaling, coherence, redundancy, spatial and temporal contiguity, pre-training, modality, multimedia, and voice (Baran et al., 2022). For instance, the content was structured into four weekly segments to minimize cognitive load (segmenting principle). Visuals relevant to the topic were used in weekly content (multimedia, coherence principles) and the related text was closely aligned with corresponding images to facilitate spatial contiguity (spatial contiguity principle). Additionally, human voice was used to enrich the auditory component of the learning materials (voice principle). In essence, the OIPTW was designed in accordance with Mayer's multimedia principles. It is important to note that this paper does not delve into the detailed application of all these multimedia design principles in the OIPTW; such specifics are discussed in another study (Baran et al., 2022).

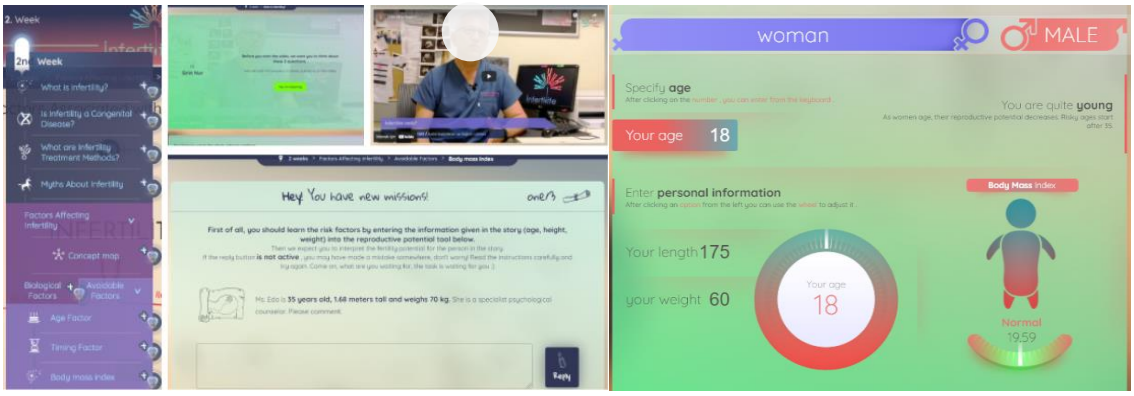

Figure 2. Three screenshots at the 2nd week content and some activities in the OIPTW

The f2f activities in class included interactive teaching methods and techniques such as question-answer, games, group study, fishbone, and augmented reality applications, etc., (Baran et al., 2020). None of the students had prior knowledge of the MFC. Therefore, an orientation training was arranged for both MFC and TCM separately. The orientation included information about the weekly teaching content, the flipped classroom method, and the use the OIPTW.

Table 3. Weekly teaching methods and activities in the MFC group

Weeks	Online theoretical learning out of class	F2f activities in class
Week 1	Conceptual teaching of reproductive systems with text, visual, and audio materials; fill-in-the-blank activity; drag-and-drop activity; educational video activity via the website	Brainstorming, Question-answer, Augmented Reality application, Reproductive systems card game
Week 2	Teaching activities with expert videos; true-false activities; concept maps; presentations and Body Mass Index (BMI) tool activity via the website	Brainstorming, Question-answer, Poster Activity
Week 3	Conceptual teaching of sexually transmitted diseases through crossword and word search puzzle activities; expert video; presentation pages; quiz activity	Brainstorming, Question-answer, Fishbone technique, and Quiz activity
Week 4	Case study activity; expert video; presentation pages; drag and drop activity in a concept map, via the website	Brainstorming, Question-answer, A game titled "Where do you stand"

Technology supported f2f classroom model (TCM): Traditional teaching is defined as the method where the teacher lectures directly and the students remain passive. It is likely that a study comparing this method with a multimedia-centered/supported course will reveal a significant difference, as numerous studies have shown. Today, however, teacher-centred education has changed direction. It has evolved into a classroom atmosphere where teachers benefit from digital presentations and use teaching methods such as question and answer with their students. Therefore, this study compares MFC with technology supported f2f classroom model. In this model, the teacher lectured to the class using digital presentations including multimedia and use interactive board with the interaction with students. The teacher acted as the primary source of knowledge and used only the question-answer technique in class. Students participated in the learning process through class discussions.

Data Collection Tools

The Infertility Knowledge Test (IKT) developed by Seymenler (2017), the Attitudes toward Infertility Scale (ATIS) by Siyez et al. (2018), and the Instructional Material Motivation Scale (IMMS) by Keller (1983), adapted into Turkish by Acar (2009) were used to collect quantitative data. Motivation is a key factor often scrutinized in learning processes. In this research study, which delves into the impact of animated and interactive videos employed in flipped learning on the motivation of participants, one of the variables with the capacity to influence learning is the students' level of motivation towards the instructional materials utilized. Therefore, instructional material motivation was also evaluated during this study. The IKT scale consists of 33 items with responses formatted as 'true', 'false', or 'I don't know'. An initial review of literature and expert feedback led to a 34-item trial version of the IKT, which was administered to 443 university students to assess its validity and reliability, yielding an average difficulty level of 0.49. An item that decreased the reliability coefficient was identified

and removed, resulting in a final reliability coefficient of 0.77, confirming the scale's reliability. The ATIS scale consists of 12 items with responses formatted as 'totally disagree', 'disagree', 'undecided', 'agree', and 'totally agree.' Two studies involving university students were conducted to test the validity and reliability of the ATIS Scale. Study 1 (n = 443) included item analysis, EFA, discriminant validity, and internal reliability calculations; Study 2 (n = 309) focused on CFA and internal reliability. Study 1 revealed a 12-item single-factor structure, while Study 2 validated the model's adequacy. Both studies have high Cronbach's alpha coefficients (.85 and.83), indicating that the scale is reliable and valid. Keller (2006) reported the reliability coefficient of the IMMS as 0.96, highlighting its high reliability. The Turkish version, adapted by Acar (2009), contains 36 items rated on a scale from 1 (Not True) to 5 (Very True). After translation to Turkish and expert review, a pilot study with 65 participants found a reliability coefficient (Cronbach's Alpha) of 0.92 for the Turkish version of the IMMS, further underscoring its reliability.

Semi-structured interview form (SSIF), Opinion form (OF), and weekly observation notes (ON) have been used to investigate the dynamics of MFC (Table 4). During the development of the SSIF and OF, two field experts provided feedback. The observation notes contain qualitative, subjective observations made by both the researcher and an observer within the classroom setting for MFC and TCM groups.

Table 4. Data collection tools of the study

Group	Implementation			Interview	Observation
	Pretest	Posttest	Retention test		
MFC	IKT, ATIS	IKT, ATIS, IMMS	IKT, ATIS, IMMS	OF, SSIF	ON
TCM	IKT, ATIS	IKT, ATIS, IMMS	IKT, ATIS, IMMS		

Data Analysis

Descriptive analysis, one-way ANOVA for repeated measures, paired-samples t-test, independent samples t-test, and post-hoc tests were utilized to analyze the quantitative data. Prior to applying these parametric tests, prerequisites such as normal distribution and homogeneity of variance were verified. Only when these conditions were satisfied were the tests performed. Additionally, the critical alpha value was set at .025 by Bonferroni Adjustment (.05 / 2 = .025) to reduce the risk of Type 1 Error in the measurements, with values below .025 deemed significant. Each statistical test was selected for its specific utility in analyzing the data: Descriptive analysis provided an overall snapshot of the dataset; one-way ANOVA for repeated measures evaluated differences across multiple time points within the same group; Paired-sample t-tests compared means before and after an intervention within participants; Independent samples t-tests analyzed differences between the means of the two groups; Post-hoc tests helped confirm significant differences and offered deeper insights into particular comparisons. These methods were chosen to thoroughly scrutinize the data, identify trends, and formulate valid conclusions related to the research hypotheses.

To gather qualitative data from the MFC group, interviews were conducted with ten volunteer students over a period of four weeks to explore their perspectives on the MFC and

OIPTW. These interviews were scheduled with four students in the first week, two in the second, three in the third, and two in the fourth week. Alongside the interviews, qualitative observation notes were compiled weekly by both an observer and the researcher. Following the data collection phase, the Opinion Form (OF) was administered to the students to solicit their feedback on the process. The qualitative data thus collected were transcribed using Microsoft Word and subsequently analyzed through content analysis.

Results

Quantitative Results

Research Question 1: "Does the mean score of instructional material motivation for the posttest and retention test differ between the two groups?"

An independent samples t-test was conducted to evaluate the mean scores of the instructional material motivation posttest and retention test between two groups (Table 5).

Table 5. Independent samples t-test result between groups for motivation (IMMS) scores

Time	Group	N	$\overline{X}$	SS	sd	t	p
Posttest	MFC	13	4.42	.35	24	2.666	.014*
	TCM	13	4.03	.41			
Retention test	MFC	13	4.60	.36	24	3.481	.002*
	TCM	13	4.11	.37			

**p< .025*

The mean scores of the students' IMMS posttest and retention scores showed a significant difference between groups, [t (24) = 2.666, p< .025; t (24) = 3.481, p< .025]. The IMMS score of MFC towards the instructional material was higher than TCM in the implementation of posttest and retention, ($\bar{X}_{\text{mfc, posttest}}$=4.42, $\bar{X}_{\text{tcm, posttest}}$=4.03; $\bar{X}_{\text{mfc, retention}}$=4.60, $\bar{X}_{\text{tcm, retention}}$=4.11).

Research Question 2: "Does the mean score of IKT performance for the pretest, posttest, and retention test differ between the two groups?"

A one-way between-subjects ANOVA was conducted to compare and evaluate the mean scores of the IKT pretest, posttest, and retention test between the groups. ANOVA results showed a significant time effect according to the groups, [$F_{(1.185, 28.44)}$ = 7.259, p< .05, partial η2=.232]. Polynomial contrasts showed that there was a significant linear relationship according to the groups, [$F_{(1, 24)}$ = 7.575, p<.05, partial η2=.240]. Moreover, the increase in IKT mean scores between the pretest and posttest was found to be higher for students in the MFC group compared to those in the TCM group (Table 6).

Table 6. IKT pretest, posttest, and retention test scores by groups

Time	Group	$\bar{X}$	SS
Pretest	MFC	.46	.13
	TCM	.50	.13
Posttest	MFC	.91	.04
	TCM	.83	.12
Retention test	MFC	.89	.05
	TCM	.80	.13

Since the IKT pretests did not indicate a significant difference in the analyses, an independent samples t-test was conducted to evaluate if the mean scores of IKT differ between groups (Table 7). As a result, a significant difference between groups was not found according to the IKT posttest and retention test scores, [*t* (24) = 2.275, p> .025; *t* (24) = 2.238, p>.025].

Table 7. Independent samples t-test result between groups for IKT test scores

Time	Group	*N*	$\bar{X}$	SS	sd	*t*	p
Posttest	MFC	13	.91	.04	24	2.275	.032
	TCM	13	.83	.12			
Retention test	MFC	13	.89	.05	24	2.238	.035
	TCM	13	.80	.13			

Research Question 3*:* "Does the mean score of attitudes toward the subject for the pretest, posttest, and retention test differ between the two groups?"

A one-way between-subjects ANOVA was conducted to compare and evaluate the mean scores of attitudes toward the subject across the pretest, posttest, and retention test between the groups. Means and standard deviations for ATIS scores by groups are presented in Table 8. ANOVA results showed a significant time effect based on the groups, [$F_{(2, 48)} = 6.245$, $p<.05$, partial $\eta 2=.206$]. Moreover, polynomial contrasts showed that there was a significant linear relationship, [$F_{(1, 24)} = 7.844$, $p< .05$, partial $\eta 2=.246$]. However, while there were significant differences between ATIS scores in the analyses, significant differences between groups were not found, [$F_{(2, 48)} = 1.255$, $p> .05$, partial $\eta 2=.050$].

Table 8. ATIS pretest, posttest, and retention test scores by groups

Time	Group	$\bar{X}$	SS
Pretest	MFC	4.08	.33
	TCM	3.97	.38
Posttest	MFC	4.36	.45
	TCM	4.06	.32
Retention test	MFC	4.31	.43
	TCM	4.10	.24

Qualitative Results

Research Question 4: What are the learning experiences of students in the MFC and TCM groups?

The student views about MFC and the online learning environment (OIPTW) are presented in Table 9 and Table 10.

Table 9. The MFC students' views about flipped classroom model

Theme	Students' views
Opportunity for independency: Students could organize learning time and learning place	
Independent of a place	*I think we can study with this method anywhere or in any environment. I don't have transportation problems, but I can study with headphones on the bus or subway, I think it is workable (G1, K3).*
Independent of time and time saving	*It was possible for me to take lessons anytime or anywhere during the week whenever I was appropriate. It was much better for me to be able to sit comfortably at home or in the cafe or even on my sofa while listening to them…*(ÇGF, Q3)
Active Multimedia Learning: Students could have a chance to manage their learning with experienced-based meaningful learning opportunities far from rote learning	
Multimedia learning	*I think it was very nice, to support learning with a video and an activity that contains words.* (G1, K7) *It became more effective. I think supporting the lessons with visuals has increased the permanence of knowledge.* (ÇGF, K1)
Active learning	*I think the online education that we get before coming to the class provided more meaningful learning through games and group activities in the classroom.* (ÇGF, K11)
Motivation: Students could evaluate FCM as useful, attractive, interactive, and enjoyable, and FCM changed their negative attitudes toward tech-supported learning to positive	
Useful	*F2f instruction in addition to online helped us a lot when we had questions or needed more detailed information on a subject.* (ÇGF, K11)
Attention	*The website is interesting, especially the placement of the videos, you know that game style matchmaking, and so on. You had worked on the reproductive system carefully. You can see the system's parts from every angle. I think it's a good application.* (G1, K11)
Enjoyable	*This is the 3rd week in the lesson, I never had a thought like I got so bored, or I wish it ended sooner thus far.* (G3, K13)

Willing to repeat the content again and again	*I wanted to enter the website again and again. For example, when I was doing the 3rd-week activities on the website yesterday, I went back to the 1st and 2nd weeks and looked at what I did again. I mean, content, games, videos, etc. are attractive*. (G3, K13)
Interactive	*I don't think it is very useful when I study the lesson alone at home. However, it was more useful to study it at home and then come here (the class), choose here with games, then say, look at those visuals from that application (AR application). I comprehended the lesson better when supported by what we did in the classroom.* (G1, K7)
Confidence	*I think the application that encourages learning more*. (ÇGF, K9)
Satisfaction with the learning	*Preparing for the f2f lesson can be difficult for me. I get bored while trying to read the subject from the book and feel sleepy. But I can prepare for lessons more easily with online instruction. The videos make me more willing to learn. Overall, I am satisfied with being able to do something in the lesson.* (G2, Q2)
Changing negative opinions about technology	*It has enabled me to deal with technology a little more. I am a person who is far from computers and technology. However, thanks to this project, I understood how easy the applications are and this made me happy. I can say that it destroyed my negative thoughts about it.* (G4, K10)

Table 10. The MFC students' negative views of the learning environment

Theme	Student views
Lack of feedback	*I generally expect something like "You have completed all the activities, you can log out" when I complete all the activities because when I don't get that feedback, I wonder if something is missing*. (G3, K12)
Some activities are not mobile compatibility	*I couldn't complete some activities on the Android OS phone. It can be more compatible with it.* (ÇGF, K3) *The first week, I had a problem in that I couldn't scroll over the activities on the website, there was such a problem.* (G3, K9)

Based on qualitative observation notes collected during onsite teaching by both the researcher and an observer, the distribution of time spent (in minutes) on onsite learning for both groups are presented (Table 11). Furthermore, the students' learning experiences from the observer's perspective are detailed in Table 13. Additionally, Table 12 represents the completion rates MFC group students completed learning activities about the content of the week in the online learning environment.

Table 11. Distribution of the time spent (in minutes) during onsite learning for both groups

Group	Week 1	Week 2	Week 3	Week 4	Total
MFC	75	65	75	55	270 minutes
TCM	60	40	45	41	186 minutes

Table 12. Completion rates of MFC group for week 4 activities on the OIPTW

	Substance use		Number of video views			User Stay Time on Page (seconds)	
Participant(P)	Case1*	Case2	Cancer	Occupational conditions	Stress	Chemicals (seconds)	Number of completions of Concept Map Activity
P1	+	-	3	1	2	50	1
P2	+	+	1	1	1	80	1
P3	+	+	1	1	1	20	1
P4	+	-	1	1	1	79	1
P5	+	+	2	1	1	15	1
P6	+	+	1	1	1	12	2
P7	+	+	1	1	1	32	1
P8	+	+	2	3	3	19	1
P9	+	+	1	1	1	41	1
P10	+	+	2	1	1	37	1
P11	+	+	2	1	1	18	1
P12	+	+	1	1	1	19	1
P13	-	-	1	1	1	14	1

**The (+) symbol indicates that the user completed the activity on the relevant page, and (-) indicates he/she did not.*

Table 13. Both group students' views about the teaching process

Theme	Students' views
Active participation	*"It was a good and fun activity, evident from the fact that the participants were active and engaged, communicating with each other and laughing. Participants also asked questions that arose in their minds during the course..."* (Observer, MFC group, Week 1) *"...The preparation time for the activity resulted in very colorful cardboard presentations and narratives. It was nice to see the courage of the students to share their knowledge..."* (Observer, MFC group, Week 2) "*Students actively participated in the lesson, frequently asking questions about the subject..."* (Researcher, TCM group, Week 1) "*During the lecture, some students shared the cases they had witnessed in their life related to infertility. The lesson continued with discussion and question-answer activity until all the items were finished..."* (Researcher, TCM group, Week 4)
Motivation (enjoyable, interesting, curiosity, etc.)	*"It was a good and fun activity, evident from the fact that the participants were active and engaged, communicating with each other and laughing..."* (Observer, MFC group, Week 1) *"Afterwards, a quiz was given to the students. The students had a lot of fun and wanted to do it again, but it could not be implemented due to lack of time..."* (Observer, MFC group, Week 3) *"During the lesson, some students took notes, even at the beginning of the PowerPoint presentation, students said that they could not keep up because they were taking notes and asked for a slower pace..."* (Researcher, TCM group, Week 1) *"Students asked some questions during the presentation: "Does wearing tight clothes affect fertility in women?". The teacher answered the students' questions..."* (Researcher, TCM group, Week 4)

Discussion

The aim of the study was to compare two models: the multimedia-enhanced flipped classroom model (MFC) and technology supported f2f classroom model (TCM), considering the university students' instructional material motivation (IMMS), performance (IKT), and attitudes towards the subject (ATIS). For this purpose, an explanatory sequential mixed method design was followed, and students were randomly assigned to two groups. The MFC group was taught according to the flipped classroom model including both online and onsite learning. In the TCM group, the teacher taught the students using multimedia presentations on the interactive board. The implementation took place in an elective sexual health course at a public university. Therefore, the sample size was limited to 26 students who opted for the course. The results indicated that instructional material motivation score for the posttest and

retention test measurements in the MFC group was higher than in the TCM group. However, the study found no significant differences between the groups in terms of performance and attitude towards the subject. These findings are discussed in more detail below.

The results of the first research question indicated a significant difference between groups in terms of students' IMMS posttest and retention scores. In other words, the material motivation scores of the students in the MFC group from the post-test and the retention test are higher than the scores of the students in the TCM group. The several reports have shown that studies in which the FCM has a positive effect on students' motivation (Chao et al., 2015; Chung & Lee, 2018; Davies et al., 2013; McLaughlin et al., 2014; Østerlie, 2018; Ozpınar et al., 2016; Sırakaya, 2015). Asıksoy and Ozdamlı (2016) found that the motivation score of the flipped classroom approach group adapted to the ARCS motivation model was significantly higher than the traditional method group in the Physics course. The reason for this finding was attributed to the fact that the FCM adapted to the ARCS motivation model made the Physics course attractive, the students were active in the classroom discussion activities, the examples from daily life about the subject, and the use of simulations. Active learning activities improve students' participation in the lesson and allow students to work collaboratively. Day and Foley (2006) stated that active learning is one of the effective ways to increase motivation. Moreover, multimedia learning environments tend to motivate students more than traditional learning environments (Clark & Feldon, 2005, p.101). These platforms allow interaction among teachers, students, or content. Interaction between learners and content is a crucial factor in determining student satisfaction (Alqurashi, 2019). According to a study (Kyei-Blankson et al., 2019), students prioritize instructor-learner and learner-content interactions over learner-learner interactions for their learning. As described in more detail in the method section, a slightly different comparison group to the traditional classroom model group used in prior studies was used as the control group in this study. The TCM group, which is the comparison group, used the same multimedia-based materials with interactive board support similar to the experimental group (the MFC). In this study, as two groups used products developed according to Mayer's multimedia learning theory, it can be said that the groups approached each other in terms of teaching materials. In the comparison where the Bonferroni correction was used, there was still a significant difference between the experimental group (MFC) and the comparison group (TCM), indicating that there is strong evidence for the use of the flipped classroom model in increasing motivation for the teaching material. The qualitative findings revealed a difference between the groups: students in the MFC group, the web-based learning activities could be watched or completed repeatedly (see Table 12), while students in the TCM group, the content was accessible only during the lesson. This difference likely contributed to the higher instructional material motivation score observed in the MFC group.

In the second research question, students in the MFC and TCM groups were compared according to their post-test and retention test scores on the Infertility Knowledge Test. Although the test results showed a significant difference in performance in favor of the MFC experimental group (for $p = 0.05$), the more conservative results of the Bonferroni approach, which reduces the possibility of making Type 1 errors, produced the result that there was no significant difference between the MFC and TCM. Many studies show that Flipped Classroom Model has a positive effect on student achievement (Baepler et al., 2014; Cormier & Voisard, 2018; Davies et al., 2013; McLaughlin et al., 2014; Peterson, 2016; Ozpınar et al, 2016; Sun & Wu, 2016; Talley & Scherer, 2013; Tune et al., 2013; Unal & Unal, 2017). Unlike, Shiau et al.

(2018) compared the average scores of the 150 graduate students in the traditional classroom and the FCM. In the research, while the traditional classroom was applied to the control group (f2f lectures, discussion, and homework), the FCM (lesson at home, f2f discussion, and evaluation) was applied to the experimental group. As a result of the research, no statistically significant difference was found between groups in the scores or the evaluation. Our study also indicated no significance difference in infertility knowledge test between groups. A possible explanation for the similar IKT scores for MFC and TCM may be related to the design of the courses (teaching methods and strategies) and the nature of the course content knowledge. The same multimedia materials with different teaching methods were used in the groups. The TCM group utilized the interactive board to display learning materials, encouraged hands-on engagement from students, and fostered active classroom discussions during lectures. In contrast, the MFC group utilized on the OIPTW website to deliver highly interactive multimedia materials. Qualitative findings have indicated that TCM group students taking notes during the lesson, asking frequent questions about the subject, and sharing with peers and teachers related to the subject can be interpreted as active participation in the learning process. Learning environments enriched with technology attract more attention from students and make teaching easier and more enjoyable (Ozpınar et al., 2016). According to a study conducted by the National Teacher Training Institute (2011), it was determined that including videos in lessons increases information retention, helps students understand learning material faster, and provides a common learning experience for all students. In addition, students who use interactive video or tools reach considerably higher levels of learning success and learner satisfaction than those who do not use non-interactive video and classroom environments (Zhang et al., 2006). Therefore, we concluded these findings that, the qualitative results indicated dense use rates for the materials and interactive discussion environments for both groups. When the students' performance scores on infertility are examined by group, the high scores in both groups indicate that the knowledge about infertility, which is the subject of the course, has been gained. Qualitative results show that students in both groups are interested in the course content. In conclusion, based on the results of this study, it can be interpreted that the perception of the course content as interesting and the utilization of similar interactive multimedia-enriched methods in both the experimental and comparison groups have minimized the discrepancies between the groups.

The last question is whether the mean score of attitudes toward the subject for the pretest, posttest, and retention test differ between the two groups. Students' attitudes towards the subject did not differ significantly between the MFC and TCM groups in the post-test and retention test. In the literature, several reports have shown that studies in which the FCM improves students' attitudes toward the lesson (Chao et al., 2015; Chung & Lee, 2018; Du et al., 2014; Entezari & Javdan, 2016). However, in the study conducted by Guc (2017), no statistically significant difference was found in the attitude toward the lesson between the groups (flipped classroom and traditional lesson model). Many literature studies are showing that instructive video podcasts have a positive effect on students' attitudes (Hill & Nelson, 2011; Holbrook & Dupont, 2010; Lonn & Teasley, 2009). One notable aspect to consider is that attitudes are tendencies with both personal and social dimensions, shaped by diverse factors including family, environment, mass media, and religious authority. In this study, the influence of family and environment is responsible for the development of prior attitudes towards sexual health. This research showed that attitudes towards the subject were high in the pretest context, regardless of the groups. This high level of attitude did not differ significantly between the groups, regardless of the experimental manipulation. Studies have shown that

attitudes can change over time, although it is generally accepted that when information about a subject change, so do attitudes towards it. In this study, the fact that there was no change in attitude may be because there was no significant difference in knowledge. It can also take time and require complex procedures. The scope of this study was limited in terms of sexual health subject, which is an important topic that includes biological, psychological, social, and cultural dimensions (IKGV, 2006; Sezgin & Hocaoglu, 2014). For further studies, we suggest that researchers can conduct more self-reflective activities to change students' attitudes.

In conclusion, the results of this study show that the multimedia-enhanced flipped classroom model has a significant effect on instructional material motivation, but not on the performance and attitudes of university students. Therefore, we believe that the multimedia-enhanced flipped classroom model can be strongly used to develop learners' instructional material motivation when we compare to the technology-supported face-to-face model. However, in the context of teaching sexual health knowledge content, both multimedia-enhanced flipped classroom models and technology-supported face-to-face models can be used to develop performance scores and attitudes. Finally, the study has some limitations that should be acknowledged. One of the limitations is the sample size. For this study, the number of students was determined based on the limitations of the elective course. Replication of the study with larger groups could be beneficial. Additional recommendations include the use of varying experimental groups in future investigations. It is essential to compare the flipped classroom model with different teaching approaches to gain deeper insights into its effective implementation and foster future experimental research efforts.

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