PERIÓDICO TCHÊ QUÍMICA
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O EFEITO DE DIFERENTES TIPOS DE VÍDEO DE AULA NO DESEMPENHO DOS ALUNOS EM SOLUÇÕES AQUOSAS NO MODELO DE APRENDIZAGEM

THE EFFECT OF DIFFERENT LECTURE VIDEO TYPES ON STUDENTS' PERFORMANCE IN AQUEOUS SOLUTIONS IN FLIPPED LEARNING

TERS YÜZ ÖĞRENME MODELİNDE FARKLI DERS VİDEOSU TÜRLERİNİN ÖĞRENCİLERİN SULU ÇÖZELTİLER KONUSUNDAKİ PERFORMANSLARINA ETKİSİ

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RESUMO

Introdução: A rápida expansão da compreensão da educação a distância com a pandemia levou à preferência por modelos de aprendizagem híbrida. O modelo de aprendizagem invertida é um dos modelos de aprendizagem híbrida usados com frequência. No modelo de aprendizagem invertida, os vídeos de palestras são usados com frequência, especialmente como atividade pré-aula. **Objetivo:** Neste estudo, o objetivo foi determinar o efeito de diferentes tipos de vídeos de palestras enviados como atividade pré-aula sobre o desempenho dos alunos em soluções aquosas e a opinião dos alunos sobre os vídeos. **Métodos:** Os métodos de pesquisa qualitativa e quantitativa foram usados em conjunto para responder aos problemas da pesquisa. Os participantes foram 38 alunos matriculados no curso de Química Geral do Departamento de Educação em Biologia, Faculdade de Educação, uma universidade estadual da Turquia. **Resultados e Discussão:** Os alunos de ambos os grupos de vídeo demonstraram melhorias significativas no desempenho ($p<0.05$), sem diferenças estatisticamente significativas entre os tipos de vídeo ($p=.569$). Todos os alunos expressaram opiniões positivas sobre os vídeos de palestras, e suas opiniões sobre os tipos de vídeos de palestras variaram de acordo com suas situações de aprendizado. O fato de haver perguntas embutidas nos vídeos de palestras e de os alunos de ambos os grupos terem assistido aos vídeos com muita eficiência para responder a essas perguntas pode ser o motivo do aumento nas pontuações de aproveitamento dos alunos. No entanto, acredita-se que a razão pela qual não houve diferença estatisticamente significativa entre as pontuações do teste de aproveitamento dos grupos em soluções aquosas pode ser o fato de que as atividades de aula expositiva e de resolução de questões foram incluídas em ambos os tipos de vídeo. Os dados obtidos nas entrevistas mostram que as preferências dos alunos quanto ao tipo de vídeo foram influenciadas pela compreensão que eles tinham de seus próprios processos de aprendizagem e da estrutura do curso que estavam aprendendo. **Conclusões:** O desempenho dos alunos foi maior no grupo com slides do instrutor, embora isso não tenha sido estatisticamente significativo. Para melhorar a compreensão, é importante monitorar comportamentos, como quando os alunos pausam e retrocedem os vídeos e o tempo gasto para assisti-los.

Palavras-chave: *ensino de química, modelo de aprendizado invertido, tipos de vídeo de aula*

ABSTRACT

Background: The rapidly expanding understanding of distance education with the pandemic has led to the preference of hybrid learning models. The flipped learning model is one of the frequently used hybrid learning models. In the flipped learning model, lecture videos are frequently used, especially as a pre-class activity. **Aims:** In this study, it was aimed to determine the effect of different types of lecture videos sent as a pre-class activity on students' achievement in Aqueous Solutions and students' opinions about videos. **Methods:** Qualitative and quantitative research methods were used together to answer the research problems. The participants were 38 students enrolled in the General Chemistry course at the Department of Biology Education, Faculty of Education, a state university in Turkey. **Results:** Students in both video groups demonstrated significant performance

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improvements (p<0.05), with no statistically significant differences between video types (p=.569). All students expressed positive opinions about lecture videos, and their opinions about the types of lecture videos varied according to their learning situations. **Discussion:** The fact that there were embedded questions in the lecture videos and that the students in both groups watched the videos very effectively in order to answer these questions may be the reason for the increase in the achievement scores of the students. However, it is thought that the reason why there was no statistically significant difference between the achievement test scores of the groups in aqueous solutions may be that both lecture and question solving activities were included in both video types.The data obtained from the interviews show that students' preferences for the type of video were influenced by their understanding of their own learning processes and the structure of the course they were learning. **Conclusions:** Os resultados mostram que as pontuações médias do teste de aproveitamento dos alunos do grupo de vídeo do tipo palestra com slides do instrutor foram maiores do que as pontuações médias dos alunos do grupo de vídeo do tipo anotações de voz do instrutor. Entretanto, quando as pontuações dos alunos no pós-teste foram analisadas, essa diferença não foi estatisticamente significativa (p=.569). Em pesquisas futuras, para entender melhor as atividades de assistir a vídeos dos alunos, recomenda-se monitorar comportamentos como quais partes dos vídeos os alunos pausam e retrocedem, o tempo que passam assistindo aos vídeos, sua frequência e desenvolver ferramentas de coleta de dados nesse sentido.

Keywords: *chemistry education, flipped learning model, lecture video types*

ÖZET

Giriş: Pandemi ile birlikte hızla yaygınlaşan uzaktan eğitim anlayışı özellikle hibrit öğrenme modellerinin daha tercih edilir olmasına yol açmıştır. Ters yüz öğrenme modeli de sıklıkla kullanılan hibrit öğrenme modellerinden biridir. Ters yüz öğrenme modelinde özellikle ders öncesi etkinliği olarak sıklıkla ders videoları kullanılmaktadır. **Amaç:** Bu çalışmada, öğrencilere ders öncesi etkinliği olarak gönderilen eğitmen- sesli notlar konu anlatım video türü ile eğitmen-slaytlar konu anlatım video türündeki ders videolarının öğrencilerin sulu çözeltiler konusundaki başarılarına etkisinin ve öğrencilerin ders videolarına yönelik görüşlerinin belirlenmesi amaçlanmıştır. **Yöntem:** Araştırma problemlerine cevap aramak için nitel ve nicel araştırma yöntemleri bir arada kullanılmıştır. katılımcılarını Türkiye'de bulunan bir devlet üniversitesinde, eğitim fakültesinde, biyoloji eğitimi bölümünde Genel Kimya dersine kayıtlı toplam 38 öğrenci oluşturmaktadır. **Bulgular:** Her iki video grubundaki öğrenciler önemli performans artışı göstermiştir (p<0,05), video türleri arasında istatistiksel olarak anlamlı bir fark yoktur (p=.569). Görüşme yapılan tüm öğrencilerin ders videoları hakkında olumlu görüşe sahip olduğu, ders video türleri hakkında ise öğrencilerin görüşlerinin kendi öğrenme durumlarına göre değişkenlik gösterdiği belirlenmiştir. **Tartışma**: Ders videolarının içinde gömülü sorular olması ve her iki gruptaki öğrencilerin bu soruları cevaplayabilmek için videoları çok etkili bir şekilde seyretmiş olmaları öğrencilerin başarı puanlarındaki artışın sebebi olabilir. Bununla birlikte grupların sulu çözeltiler başarı testi puanları arasında istatistiksel olarak anlamlı bir fark bulunmamasının nedeninin her iki video türünde de hem konu anlatımı, hem de soru çözümü etkinliklerinin yer alması olabileceği düşünülmektedir. Görüşmelerden elde edilen veriler, öğrencilerin video türü tercihlerinde kendi öğrenme süreçlerine ilişkin anlayışları, öğrendikleri dersin yapısı gibi unsurların etkili olduğunu göstermektedir. **Sonuç:** Bulgular, eğitmen-slaytlar konu anlatım video türü grubundaki öğrencilerin başarı testi puan ortalamalarının eğitmen- sesli notlar video türü grubundaki öğrencilerin ortalamalarına göre daha yüksek olduğunu göstermektedir. Ancak öğrencilerin son test puanları incelendiğinde bu farkın istatistiksel olarak anlamlı olmadığı görülmüştür (p=.569). Gelecek araştırmalarda, öğrencilerin video izleme aktivitelerini daha iyi anlamak için, örneğin öğrencilerin videoları hangi bölümlerinde duraklatıp geri sardıkları, videoları seyretmek için harcadıkları zaman, sıklıkları gibi davranışların izlenmesi ve bu yönde veri toplama araçlarının geliştirilmesi önerilmektedir.

Anahtar kelimeler: *ders video türleri, kimya eğitimi, ters yüz öğrenme modeli*

1. INTRODUCTION:

As distance education became widespread during the COVID-19 pandemic and hybrid learning models became more preferred after the pandemic period, the flipped learning model has become more used and preferred in the world of education. In the flipped learning model, students acquire basic knowledge outside the classroom, usually through video lectures or reading materials. In this way, teachers can allocate class time to more interactive and hands-on learning activities and ensure students' active participation (Bergmann and Sams 2012).

In the pre-class phase of the flipped learning model, teachers upload resources such as videos, articles, and presentations containing basic information about the course to online platforms, and students learn the basic concepts of the course by examining the materials at their

own pace outside the classroom (Shaw *et al*., 2022).

In-class time is used for students to apply what they have learned, discuss and interact with the teacher. Teachers organize discussions, problem-solving activities, group work or projects in class. Provide guidance by answering students' questions. They clarify more difficult concepts. Students actively participate in the discussions. They try to apply and deepen what they have learned. They collaborate in group work. The model helps develop 21st century skills such as problem solving, critical thinking, communication and collaboration. Students actively use these skills in classroom activities.

In the post-class evaluation and feedback phase, teachers evaluate the results of in-class activities or assignments. They give immediate feedback to students. Students take the feedback into account and improve their learning process. Students deepen what they have learned in class by repeating it at home or with additional resources.

In flipped learning, out-of-class activities are the main tools used to ensure that students understand and prepare for the course content in advance during the individual learning process. These activities include a variety of resources and methods. Tools and methods that can be used in out-of-class activities: Videos, articles, textbooks, e-books, notes or short summaries prepared by the teacher or taken from ready-made educational platforms, interactive websites, online course platforms and digital simulations, online forums or groups where students can post questions and have discussions, online quizzes, multiple-choice tests, fill-in-the-blank or matching activities, audio files recorded by the teacher or educational podcasts on the subject, research assignments, digital presentations or projects to find a solution to a specific question, virtual activities that enable students to learn topics by experiencing them. The most widely used of these activities are videos (Maher *et al*., 2013; Davies *et al*., 2013). If students do not effectively watch the videos sent by the teacher before the lesson or if the videos are not prepared effectively enough, the effectiveness and success of the flipped learning model are limited (Koh & Ahn, 2023).

Thanks to the development of technology, platforms where teachers can easily prepare video materials or select them from the internet have become widespread, which has greatly increased the use of video-based materials (Farah *et al*., 2025). Instructors can either use training videos, which are widely available on the internet, or create their own materials.

In order for a flipped course to contain the same amount of student work as a traditional course, it is recommended that the duration of the lecture videos should be around 5-10 minutes, taking into account that students will frequently pause and rewind the videos and therefore watch them for longer than the actual playback time (Baig & Yadegaridehkordi, 2023). Since students watch videos for an average of ten minutes without losing interest, longer topics should be divided into smaller topics (Baig & Yadegaridehkordi, 2023).

In the flipped learning model, the purpose of the lecture videos sent to students to prepare them for the class is to ensure that students come to class more prepared and benefit more from in-class activities. Long *et al*. (2016) reported in their study that students found pre-class videos useful and that short and attention-grabbing lecture videos, especially those in which the face of the lecturer is visible, increase learning motivation.

Lecture videos both allow students to repeat the content according to their individual learning pace and provide an opportunity for teachers to better analyze students' prior knowledge levels. In this context, the way the videos are presented to students, their length, technical features, and accessibility play an important role in the success of the flipped learning model. In addition, pre- class activities are also important for preparing students for in-class activities that require their active participation. In flipped learning environments, structuring pre-class learning materials, especially enriching lecture videos with various guidance and interactive elements, stands out as a pedagogical necessity in order for students to benefit sufficiently from pre-class videos and prepare cognitively for in-class activities and to prevent deepening individual differences among students (Deng *et al*., 2024).

1.1. The Benefits of Using Videos in the Pre-Class Preparation Phase in the Flipped Learning Model

Educational videos enrich the learning environment and motivate students in the learning environment as they provide students with the chance to convey information both visually and aurally. (Chen & Wu, 2015). Students can watch video lectures at any time (Schacter & Szpunar, 2015). This ensures that students who miss lessons do not fall behind and allows them to manage their learning process at their own pace. Students can reinforce the topics they have difficulty with by watching them again. This is

especially useful for learning complex concepts. Students can personalize their learning environment by choosing video content according to their needs. This can improve the learning performance of students at different academic levels (Hill & Nelson, 2011; Hong *et al.*, 2018, Jung & Lee, 2015). Videos allow students to review course content at their own time and pace, which facilitates time management. Research reveals that video lectures have a positive impact on students' learning performance. In particular, the content of video lectures can support students to better grasp and apply concepts (Bergmann & Sams, 2009; Lage et.al, 2000; McGivney-Burelle & Xue, 2013).

These benefits explain why video lectures are increasingly preferred in flipped learning and other hybrid models. This increases the importance of the content and style of such lecture videos. Scagnoli *et al*. (2019) stated that the content and style of the videos to be used are effective in increasing learning performance and motivation.

Videos that can be used in the flipped learning model can be prepared in different ways. These are:

- Instructor-whiteboard video: This type of video is a traditional format where the instructor lectures and explains topics using a whiteboard.
- Instructor voice-handbook video: These videos are content that shows lecture notes or book pages with audio narration by the instructor.
- Instructor-slides video: It is a type of video in which the instructor presents a lecture and explains the content through slides. In this format, the instructor's image and voice are included with the slides (Chen & Wu, 2015; Chorianopoulos & Giannakos, 2013; Guo *et al*., 2014; Urhan & Kocadere, 2024).

There are different learning theories and opinions about which type of video may be more advantageous to use when preparing lecture videos.

Social presence theory and the cognitive theory of multimedia learning support the use of these video styles (Pi *et al*., 2017). Social presence theory emphasizes the role of nonverbal and social cues in multimedia learning (Mayer, 2014). The appearance of the teacher's face in lecture videos creates a sense of social presence in students. This helps students build a stronger bond with the teacher and makes the learning environment more intimate. Students can pay more attention while watching the teacher's face. Research shows that students spend more time looking at the teacher's face and this has a positive impact on their learning process. The teacher's facial expression and body language can help create an emotional connection with the content of the lesson. Students can better understand the teacher's excitement and interest. Seeing the teacher's face can increase students' motivation. Students tend to follow the lesson more willingly when they feel that the teacher is addressing them directly. In addition, students with different learning styles can experience both visual and auditory learning by watching the teacher's face. This makes the learning process more effective (Guo *et al*., 2014; Kizilcec, *et al*., 2014; McLaren *et al*., 2011; Pi & Hong, 2015).

In addition, according to the Cognitive Theory of multimedia learning (Pi *et al*., 2017), showing the teacher's face in a video can be considered as unnecessary material that is not essential learning content. According to the Cognitive Theory of multimedia learning, Harp and Mayer (1998) warned that showing the teacher's face during a conversation could potentially distract students and create an overload in video lectures because the processing of the image consumes additional cognitive resources of students. Kizilcec *et al*. (2015) argued that the teacher's face is “an additional visual stimulus that can overload and even actively distract students”.

Fidan and Debbag (2023) compared the effects of different types of instructional videos in online learning environments and found that videos with interactive elements and human presence (instructor's face and body language) were more effective than other types. The instructor's narration style, facial expressions and gestures were identified as important factors affecting the learning process, and it was found that a natural and fluent narration attracted the attention of the audience and facilitated learning. They also found that videos prepared with lightboard and green screen technologies increased learning performance. The pre-service teachers found the videos prepared by their own instructors more effective and stated that they preferred such videos. They stated that the visibility of the instructor's face and its position on the screen positively affected the learning experience of the viewers. They stated that the interactive elements in the videos (e.g., questions and gamification) supported learning and increased their attention. Similarly, Kizilcec *et al*.

(2015) examined the effects of the visibility of the teacher's face in the video on student engagement and learning and found that the visibility of the teacher's face increased the sense of social presence and positively affected students' learning experiences. Seo *et al*. (2021) investigated the relationship between online video and active learning and found that the visibility of the teacher's face increased student engagement and interaction. Students reported that they felt that seeing the teacher's face provided more social interaction in the learning context. Hew and Lo (2020) examined the relationship between the visibility of the teacher's face in video-recorded lectures and students' preferences and learning outcomes. They found that students believed that seeing the teacher's face made their learning process more effective. Guo *et al*. (2014) did not emphasize that the visibility of the instructor's face creates more intimate and personal feelings and also reduces the monotony of presentations. The presence of the instructor can enhance students' learning experiences. Pi and Hong (2015) found that video podcasts with the instructor present along with PowerPoint slides enhanced learning. They concluded that the presence of the instructor would enable students to interact with the content more effectively.

In addition, there are studies that argue that the presence of the instructor's face or image in the lecture video is not very important. For example, Mayer's (2009) visual principle summarizes that the instructor's face in lecture videos does not contribute significantly to learning. A logical reason for this is that academic achievement, usually expressed in points, is often associated with the cognitive content in lecture videos. These videos contain theoretical or prior practical knowledge, especially in flipped or online learning (OL) environments. Accordingly, focusing only on the instructor's face or visibility does not provide concrete evidence. Pi *et al*. (2017) found that the instructor's image size had no significant effect on cognitive load, learning performance, and social presence. Wilson *et al*. (2018) suggest that the presence of the instructor may negatively affect students' attention. They state that the absence of the instructor's image can enable students to interact with the content more effectively and help them focus their attention better.

Based on social presence theory, which explains how a sense of social presence is constructed in the learning process, and cognitive theory, which explains how students' cognitive load is managed, the aim of this study was to determine whether Instructor-Slides videos prepared for pre-class activities of aqueous solutions subject conducted with the flipped learning model would lead to higher student performance in aqueous solutions compared to Instructor Voice-Handbook videos and to investigate students' individual experiences with each type of video.

The research questions of the study are as follows:

RQ1: What is the effect of different types of lecture videos (Instructor Voice-Handbook Video and Instructor-Slides Video) prepared for the topic Introduction to Aqueous Solutions and used as the pre-class learning material of the flipped learning model on students' achievement in aqueous solutions?

RQ2: What are the students' opinions and experiences about Instructor Voice-Handbook and Instructor-Slides video types?

2. MATERIALS AND METHODS:

In this study, which was conducted according to the flipped learning model, it was examined whether the instructor voice-handbook notes lecture video type and instructor-slides lecture video type sent to the students as a pre-class activity made a difference in students' performance in Aqueous Solutions. Qualitative and quantitative research methods were used together to answer the research problems. RQ1 seeks an answer to the quantitative dimension of the research. To address RQ1, it was investigated whether there was a significant difference between the achievement test scores of the students before and after the implementation. In addition, the post-test scores of both groups were compared and the effect of different video types on students' performance was investigated. For this purpose, Independent Samples t Test analysis was performed. RQ2 constitutes the qualitative dimension of the study. In order to answer RQ2, face-to-face interviews with students were transcribed and then analyzed by thematic analysis.

Participants: The participants of the study consisted of a total of 38 students enrolled in the General Chemistry course at the Department of Biology Education, Faculty of Education, a state university in Turkey (n-girl=33; n-boy=5). The average age of the participants was 18.07 years.

Participants were enrolled in two pre-existing class groups. Before the group assignments, the achievement test used in the

study was administered to each participant as a pretest and the analysis revealed that there was no significant difference between the two groups in terms of pretest scores ($p > .05$). Since the initial levels of the groups were equal, they were randomly assigned to Instructor-Slides and Instructor Voice-Handbook groups.

2.1. Lecture Videos

In this study, the subject of "Aqueous Solution" in the General Chemistry course, which is a 1st year undergraduate level course, was discussed. The students enrolled in the course were randomly divided into two groups according to their pre-test scores. In one group, instructor voice-handbook notes type lecture videos were sent to the students for the theoretical part of the course, while instructor-slides type lecture videos were sent to the students in the other group. The content of the lecture videos sent to both groups was the same and prepared by the same instructor. Both types of videos were prepared by the same researcher based on the same lesson plan and content. The content of the videos generally includes theoretical titles, sample questions and explanatory narratives. The examples, definitions and explanations used in the videos are presented in exactly the same order.

In the Instructor Voice-Handbook version, no non-verbal cue was added except for the instructor's handwriting on a piece of paper. In the Instructor slides, however, the researcher was careful to stick only to the content of the topic and not to provide cues such as gestures and facial expressions. The videos were prepared using the same equipment and simple visuals to reduce the cognitive load of the students in accordance with the principles stated in Mayer's (2009) Multimedia Learning Theory.

The length of the lecture videos was between 10-12 minutes and all videos included both lectures and question solutions. Each video contains an average of 2 questions. These questions were generally in open-ended format requiring short answers to minimize the chance factor. Although the videos sent to the groups were of different types, the same questions were used in the videos. The questions were automatically opened at appropriate moments of the videos. In the videos, students were prevented from skipping (skip) the video while watching, but students were given control rights such as play/pause.

The questions embedded in the videos were designed not only to assess students' prior knowledge but also to structure the learning process.

As the first step of the study, four lecture videos were prepared by taking into consideration the theoretical knowledge on which the selected subject is based, the duration of the course, etc. Canva graphic design platform and video conferencing tool were utilized in the preparation of Instructor-slides type lecture videos. During the video preparation process, firstly, a course presentation was prepared on the graphic design platform. Then, with the presentations prepared, a meeting was created in a video conferencing tool and a lecture was given by using the screen sharing feature and the lecture was recorded. Figure 1 shows the screenshot of the lecture video prepared.

As can be seen in Figure 1, such lecture videos include the instructor's image, voice and presentation. In these videos, the instructor can take written notes on the presentation, solve problems and make additional explanations. The instructor can mark the points he/she wants to emphasize on the presentation and can also use his/her own gestures and facial expressions.

The Instructor Voice-Handbook video type shows the lecture notes and the pen used to emphasize the content and take notes. In this video, there is no image of the instructor, only his/her voice. As in the other video types, the instructor can take additional notes and make verbal explanations.

As seen in Figure 2, in this type of lecture video, the instructor's voice and highlighted notes are visible. In this type of video, the instructor can solve problems and make additional explanations. In the parts of the topic that need to be clarified and emphasized, the instructor uses a pen and the intonations of his/her own voice.

2.2. Implementation Process

Before the application started, all students were informed about the flipped learning model. Then, the achievement test prepared by the researchers was applied as a pre-test. After the pre-test, the students were divided into two groups and the implementation process started.

The implementation process lasted 4 weeks in total. Each week, the implementation process progressed in 3 stages: pre-class, in-class and post-class. Before the class, only lecture videos were sent to the students and no additional study material was sent.

Edpuzzle platform was used to share the lecture videos with the students and to analyze the

viewing of the videos. A virtual classroom was opened on the Edpuzzle platform and all students enrolled in the course were enrolled in this classroom. During the unit, a lecture video was sent to the students 3 days before each lesson. Since the desired impact of lecture videos in the flipped classroom depends on whether the videos are watched before the lecture, the timing is critical when sending the videos to students (Förster *et al*., 2022). All students were responsible for watching the videos and solving the questions in the videos before the lesson. Watching the videos and solving the questions were prerequisites for students to attend the lesson. The Edpuzzle report was downloaded by the researchers before each lesson and feedback was given to the students about their video watching status, video watching time, and their answers to the questions. Since students who watch lecture videos with embedded questions may not fully understand the solutions to these questions, it is necessary to guide them to understand the learning materials before the class, as this may reduce the effectiveness of classroom activities on students (Deng *et al*., 2024). For this reason, when the students came to the class, first they were given feedback about their performance in watching the videos and the questions in the videos were reviewed. Then, a 3 question quiz was given and the solved questions were examined. After a short review of the topic, during the class time, the students participated in various active learning activities such as brainstorming, small group discussions, question solving, experimentation, etc. that focused on their active participation in their own learning process. Students benefited from the AR application prepared by the researchers in the experiment they participated in as an in-class activity. While no homework was given to the students after the in-class activities such as small group discussions, students were asked to write an experiment report after 2 experimental activities during the implementation process.

At the end of the implementation, the same achievement test was administered to all students as a post-test. In addition, face-to-face interviews were conducted with a total of 8 students selected voluntarily from both groups. The implementation process is shown in Figure 3.

2.3. Data Collection Tools

An achievement test consisting of open-ended questions developed by the researchers was used to determine students' performance in Aqueous Solutions. Chemistry is an experimental science. In order to learn chemistry, it is necessary to deal with the macroscopic, submicroscopic and symbolic levels of chemical phenomena as a whole. Johnstone (1993) states that students have difficulty in learning chemistry because they have difficulty in understanding the relationships between macroscopic, submicroscopic and symbolic levels. The subject of Aqueous Solutions is also an important subject in chemistry as it represents events occurring at macroscopic, microscopic and symbolic levels. For this reason, both in the lecture videos and in-class activities, it was aimed for students to make connections between these three levels of chemistry. Therefore, it was decided that the test should consist of open-ended questions in order to enable students to justify and interpret the information they learned. In order to ensure the content validity of the test, the prepared questions were checked by 2 chemistry education experts. The questions were revised in line with the feedback of the field experts and the test was finalized. The questions in the achievement test consisted of similar difficulty levels to the quiz questions that were both integrated into the lecture videos and applied to the students during in-class activities. There are 4 questions in total in the achievement test. The maximum score that can be obtained from the test is 60. An answer key and an evaluation rubric were developed by the researchers for scoring the questions in the achievement test. In order to avoid subjectivity in the evaluation of the achievement test, the researchers evaluated 6 randomly selected papers separately according to the rubric. After the evaluation process, Cohen's Kappa (κ) coefficient was calculated to check the inter-coder consistency and the agreement rates were analyzed. In this study, the average Kappa agreement coefficient was found to be 0.81. This value indicates a high level of agreement (Landis & Koch, 1977).

At the end of the study, semi-structured interviews were conducted to obtain students' opinions on video types. The individual interviews with each student lasted an average of 25 minutes. Audio recordings were taken during these interviews and the recordings were then transcribed and transcribed.

3. RESULTS AND DISCUSSION:

3.1. Results

In order to answer the first research question of the study, “What is the effect of the Instructor Voice-Handbook Video and Instructor-Slides Video types of lecture videos prepared for

the pre-course activities of the Aqueous Solutions subject carried out with the flipped learning model on students' performance in Aqueous Solutions?", normality assumption was tested first. Since the number of participants was less than 50, Shapiro-Wilk test was applied (Büyüköztürk, 2008) and according to the test results (p_slide pre-test = .56 > .05; p_voice pre-test = .07 > .05; p_slides post-test = .60 > .05; p_voices post-test = .22 > .05), it was seen that the pre and post-test scores showed normal distribution. After the normality assumption was verified, independent sample t-test analysis was performed to determine whether there was a significant difference between the achievement test scores of the students in both groups. The results of the analysis are given in Table 1.

Table 1 shows the results of the pre-test administered to the students before the implementation started. According to the pre-test results, there was no statistically significant difference between the two groups. This result indicates that the students were at the same level at the beginning of the study. After the implementation, the groups answered the same data collection tool as the post-test.

An independent sample t-test was conducted to examine the difference between the post-test scores of the Instructor Voice-Handbook and Instructor-Slides groups. As a result of the analysis, no statistically significant difference was found between the groups, $t(36) = -0.57$, $p = .569$. The mean difference between the groups was calculated as -1.58 at 95% confidence interval. Cohen's d was calculated to evaluate the effect size between groups. The mean posttest score of the Instructor Voice-Handbook group was 40.52 (SD = 9.94) and the mean posttest score of the Instructor-Slides group was 42.10 (SD = 6.69). The calculated Cohen's d value was 0.186, which indicates a small effect size (Cohen, 1988). These results show that there is no significant difference between the two groups in terms of achievement and that the effect of the intervention is at a low level.

According to the ANCOVA results, pretest scores had a significant effect on posttest scores ($F(1, 35) = 22.34$, $p < .001$, $\eta^2\_partial = .390$). However, there was no significant difference between the groups in terms of posttest scores ($F(1, 35) = 0.003$, $p = .958$, $\eta^2\_partial = .000$). It is seen that the model is generally significant and the pretest scores explain 39.5% of the posttest scores ($R^2 = .395$, Adjusted $R^2 = .361$).

In order to answer the second research question of the study, "What are the students' opinions on different types of lecture videos?", semi-structured interviews were conducted with a total of 8 students selected voluntarily from both groups. In these interviews, the following questions were asked to obtain in-depth information about students' opinions on video types and learning processes and to better understand their experiences.

1. Which elements (e.g. teacher's face, interactive elements, video duration) affect your learning the most during video lessons used in flipped learning model?

2. Do you prefer the teacher's face in the lecture videos? Which types of topics do you think it is effective to have the face of the teacher in the videos?

To analyze the data, the interview audio recordings were transcribed. Then, the data were analyzed separately by two researchers using the thematic analysis method, which is one of the methods frequently used in the interpretation of qualitative findings. In thematic analysis, data analysis is carried out in six steps: familiarization with the data, coding, identifying themes, reviewing themes, defining and naming themes and writing-up (Clarke & Braun 2013).

After the analysis, the reliability between the coders was calculated using Miles & Huberman's (Reliability=Agreement/ (Agreement + Disagreement)) reliability formula and the reliability value was found to be 90.2%.

The themes obtained from the data are presented in Table 2.

As can be seen in Table 2, students' opinions were grouped under the themes of "Instructional Design and Interaction" and "Instructor Image".

In the interviews with the students, it was seen that students in both groups had positive opinions about the course videos. Students stated that they benefited from the video lectures regardless of the type of lecture video sent to them, so that they could come to class prepared.

In order to ensure anonymity, quotations from the students' statements were coded as S1, S2...S8. Students mentioned video length, interaction elements in videos, reality, demonstrations, teacher's facial expressions as factors affecting their learning in video lessons. For example;

S1: "I find videos more effective when the instructor's image is on the screen, when we can easily see his/her facial expressions, when they

are supported by dynamic demonstrations, and when they are prepared by using real and virtual objects".

S2: "When questions are added to the lesson videos, I can concentrate more, so I can understand the subject better".

S3: "When the lesson videos are too long, they are boring and I have difficulty watching them"

When asked about their preferences for the teacher's face in the lesson videos, it was found that there were students with both views. While a group of students stated that they learned more easily and effectively with the teacher's image while learning from video lessons, some students found the teacher's image distracting. Excerpts from the students' views on this question are as follows:

S8: "In the lecture video, I can understand which topics are emphasized more from the facial expressions and facial expressions of the instructor. For this reason, I prefer lecture videos where I can see the teacher's face".

S5: "When I feel that the teacher addresses me directly, I tend to follow the lesson more willingly".

S7: "I focus better when the teacher's image is on the screen. Otherwise, I have to take breaks all the time".

S2: "If I am listening to the lecture for the first time and the video is a lecture-style lecture video, seeing the teacher increases my comprehension level, but in videos where only questions are solved, I feel better without the teacher".

S4: "I understand better when there is no image of the teacher on the screen because I get distracted when there is an image of the teacher".

S6: "I could not catch the details in the video lesson with the teacher's image. I had to study from the book after the lesson".

3.2. Discussion

In this study, the effect of different types of lecture videos designed as a pre-class activity of the flipped learning model on students' performance in the subject of Aqueous Solutions is examined. In the first research question of the study, it was determined whether students' performance on Aqueous Solutions differed according to the lecture video type. The findings showed that the mean achievement test scores of the students in the Instructor-Slides Video Type group were higher than those of the students in the Instructor Voice-Handbook Video Type group. However, when the post-test scores of the students were analyzed, this difference was not statistically significant.

The reason why there was no statistically significant difference between the groups' Aqueous Solutions achievement test scores may be that both video types included both lecture and question-solving activities. Studies show that the video type in which the instructor's image is not present and only audio narration is used is more effective in lessons that focus more on declarative knowledge, while the video type in which the instructor's image is present is more effective especially in computational problem-solving applications that require procedural knowledge. According to the Cognitive Theory of Multimedia Learning, individuals have limited cognitive processing capacity and information from audiovisual channels needs to be appropriately structured. In Deng *et al*. (2024), the use of questions embedded in videos and the review of these questions in the classroom coincide with Mayer's principles of segmenting, coherence and interactivity. This is because the video type with the instructor's image allows the student to see more examples and conveys information quickly, clearly and with short explanations (Hong *et al*., 2018; Urhan & Kocadere, 2024).

In this study, both theoretical content and problem solving practices were practiced in the video type in which the lecturer's image was present and in the video type in which there was no image but only slides. Since the groups had the chance to experience both practices in each video type, there may not have been a statistical difference between the achievement test scores.

Another reason may be that there were embedded questions in the lecture videos and the students in both groups watched the videos very effectively in order to answer these questions. Johnson and Mayer (2009) found that students learned more effectively when they solved questions related to the subject after completing the video or when they were evaluated than when they watched the video repeatedly. Similarly, Peper and Mayer (1986) found that students learned better when they took notes or answered conceptual questions while watching lecture videos.

In the interviews with the students, they generally expressed their satisfaction with the use of lecture videos in the introduction to Aqueous Solutions taught with the flipped learning model. In

general, in studies where lecture videos are used in the flipped learning model and in many other learning approaches, students are willing to use videos and find them more effective than other classical course materials (Berk, 2009; Rothman, 2022; Sezer & Abay, 2019; Whatley & Ahmad 2007; Zhang *et al*, 2006). When the students who participated in the study were asked about their preferences and opinions about the types of videos prepared, some of the students stated that the presence of the teacher's image in the video creates an advantage for them by increasing their concentration and enabling them to make inferences from the teachers' facial expressions. Borup *et al*. (2012) found similar findings in their interviews with students in their study using different video-based teaching strategies. The majority of the students reported that they felt as if they were talking to their instructors and that watching the instructors' video communication helped them to perceive the instructor as a real person. This showed that the presence of the instructor's image had a significant impact on the construction of the instructors' social presence. According to Social Presence Theory, when learners hear the instructor's voice and see the instructor's face in the learning environment, it has a positive effect on their learning motivation and participation in the lesson. In Hew and Lo's (2020) study, the fact that the videos presented as “Khan-style + teacher's talking head” were preferred by the students in terms of both pedagogical effectiveness and ease of production and that the students felt connected to the lesson is in line with these findings.

In addition, there is also a group of students who think that seeing the teacher's image in the lesson videos will create cognitive load, cause confusion, and that more concentration can be achieved without the teacher's image while solving numerical problems. When the related literature is examined, there are studies in which students have different opinions in this way (Hong et.al, 2018; Kizilcec *et al*., 2015; Mayer & Fiorella, 2014; Mayer & Moreno, 2003; Wilson *et al*., 2018; Zhang *et al*. 2006). According to the findings obtained from this part of the study, it is seen that factors such as students' understanding of their own learning processes and the structure of the course they learn are effective in their video type preferences. In learning approaches using lecture videos such as flipped learning model, applications that fit the learning style and preference of individuals in the whole class can be provided by using different video types while teaching a subject.

The findings of the study, which was limited to the data obtained from a small study group, were in line with the literature.

In line with the findings of this study, the following suggestions are presented for future research:

- In studies conducted with the flipped learning model, studies can be conducted to investigate the effects of interactive elements (e.g., questionnaires and questions) in video content on learning.
- In future research, in order to better understand students' video watching activities, it may be suggested to monitor behaviors such as the parts of the videos where students pause and rewind, the time they spend to watch the videos, their frequency, and to develop data collection tools in this direction. Thus, more effective videos can be prepared.
- Studies can be conducted to evaluate the long-term learning effects of the video types used in the flipped learning model.
- The types of videos used in the flipped learning model can be prepared by taking into account individual differences such as students' learning styles, the types of intelligence they have, and their previous online video tutoring experiences, and the effect of these activities on learning in different video types can be examined.

4. CONCLUSIONS:

The preparation stages of the digital materials used in this study, the way the materials were used and the entire implementation process were explained in detail. Within the scope of the study, the Edpuzzle platform was used both for editing the lecture videos (adding questions, video speed, etc.) and sending them to the students, and for tracking student behaviors such as the frequency of watching the videos, the time spent by the students to watch the videos, and their answers to the questions in the videos.

The results of this study show that lecture videos have a positive effect on students' achievement. However, it was determined that different types of lecture videos had no effect on students' achievement. This reveals that the type of lecture video alone may not be decisive on student learning outcomes and should be evaluated within the holistic structure of the flipped learning-based learning environment. In the interviews conducted to determine the opinions of

the students about the course videos, it was determined that all students had positive opinions about the course videos, and the opinions of the students about the types of course videos varied according to their learning situations. This finding shows that students interpreted the course video materials according to their own perceptions. Some students stated that seeing the teacher's face made them feel like they were in the classroom and interpreted this situation as positive. On the contrary, some students interpreted this situation negatively and stated that seeing the teacher in the video created confusion. This is in line with the view of Kizilcec, *et al*. (2015) that the teacher's face is “an additional visual stimulus that can overload students and even actively distract them”.

5. DECLARATIONS

5.1. Study Limitations

The study was limited to a total of 38 students enrolled in the General Chemistry course in the Department of Biology Education at the Faculty of Education of a state university in Ankara, Turkey. Existing class groups were assigned to Instructor Voice Handbook and Instructor-Slides groups; no random assignment was made at the individual level.

This study was limited to the Introduction to Aqueous Solutions topic and the 4-week implementation period.

Variables such as students' previous video-based learning experiences, self-study habits and intrinsic motivation were not controlled in this study.

Students' achievement was evaluated only with an achievement test developed by the researchers.

Comments on students' video watching are limited only to the video platform used in the study.

5.2. Acknowledgements

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5.3. Funding source

This research received no specific grant from any funding agency in the public, commercial sectors. In accordance with the ethical guidelines of the Periodico Tchê Química, which do not allow donations from authors with manuscripts under evaluation (even when research funds are available), or in cases of authors' financial constraints, publication costs were fully absorbed by the journal under our Platinum Open Access policy, through the support of the Araucária Scientific Association (https://acaria.org/). This policy aims to ensure complete independence between the editorial process and any financial aspects, reinforcing our commitment to scientific integrity and equity in knowledge dissemination.

5.4. Competing Interests

The authors declare that they have no conflicts of interest regarding the publication of this article.

6. HUMAN AND ANIMAL-RELATED STUDIES

6.1. Ethical Approval

This research was conducted in accordance with the Declaration of Helsinki. Prior to participation, participants were informed about the study procedures and the data to be collected. Informed consent was obtained from all participants in accordance with EU data protection regulations.

The research process was conducted in

accordance with the Declaration of Helsinki and the European Union General Data Protection Regulation (GDPR), which sets out ethical principles for studies conducted with human participants. All participants were informed both verbally and in writing and participated in the study by signing the voluntary participation form. The participants gave separate consent for all the practices in the study (enrollment in the Edpuzzle platform and video monitoring process-follow-up, participation in the achievement test, and face-to-face interview). The data obtained from the participants were anonymized, analyzed and securely stored in a digital environment accessible only to the researchers.

Since the research was conducted outside of the semester, there was no relationship between the students and the researchers, such as grading.

6.2. Informed Consent

All participants were informed both in written and verbally before the study started. Consent was obtained from all participants with a voluntary participation form containing detailed information about the study.

Written information about the study was given to the participants with a consent form. In this form, it was clearly stated that the participants' identity information would be kept confidential, the data would be used only for research purposes, participation was voluntary, they had the right to withdraw from the study at any time without any justification, and participation in the study would have no effect on course grades or academic status. In the form, the entire implementation process (registration to the Edpuzzle platform and video monitoring process-follow-up, participation in the achievement test and face-to-face interview) is given in separate boxes and students are free to choose the box(es) they want.

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Figure 1. *An example of instructor-slides video type*

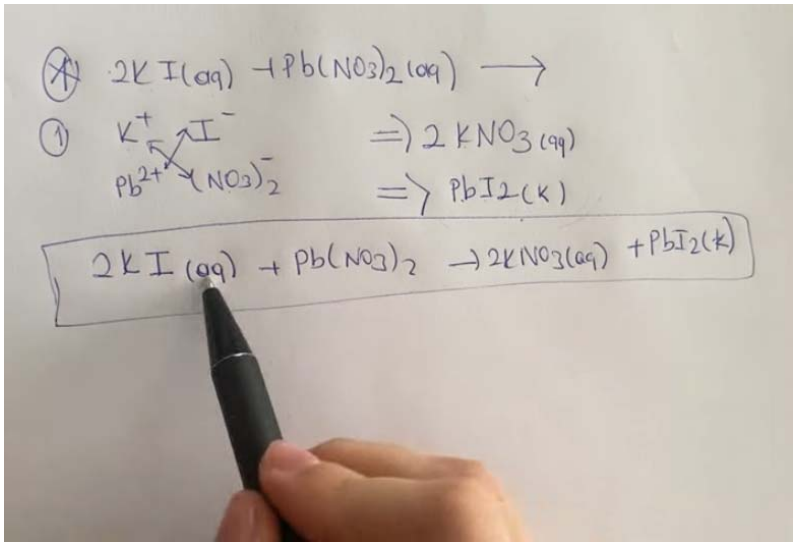

Figure 2. *An example of instructor voice-handbook video type*

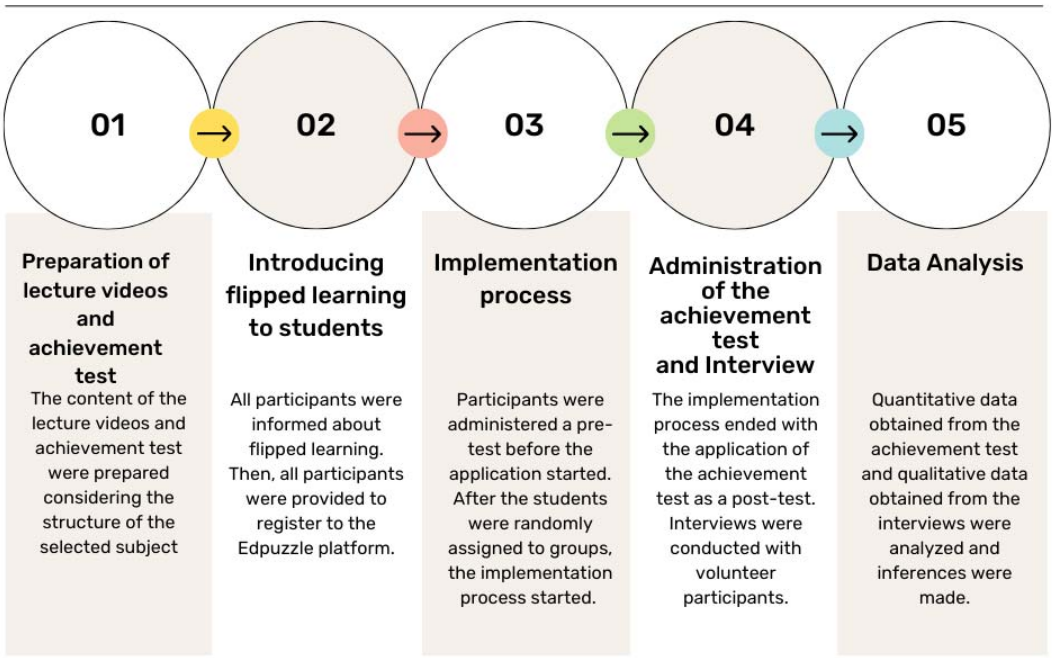

Figure 3. *Process of the current study*

Table 1. *Independent T-test results of pre-test and post-test means of instructor-slides and instructor voice-handbook groups*

Variable	Group	N	Mean	SD	T	p
Pre-test	Instructor-Slides Group	19	23.15	5.05	-.98	.330
	Instructor Voice-Handbook Group	19	21.05	7.79		
Post-test	Instructor-Slides Group	19	42.10	6.69	-.57	.569
	Instructor Voice-Handbook Group	19	40.52	9.94		

Table 2. *Findings related to thematic analysis*

Theme	Subtheme / Description	f
Instructional Design and Interaction	Understandability	4
	Video duration	8
	Interaction Elements (questions, visuals in videos, etc.)	11
Instructor Image	Positive (teacher's face, gestures and facial expressions	12
	Negative (distraction etc.)	3