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A Study on Students' Opinions Regarding the Inverted Learning Model in Chemistry Lessons*

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Abstract

This study aims to examine students' views on the flipped learning model [FLM] in chemistry teaching using an experiential learning approach. The study employs a qualitative research method, and a case study design has been selected. The research was conducted with a sample group consisting of 11th grade students, and the selection of the study group was made by using purposeful sampling. A semi-structured interview form was used as the data collection tool. The form includes 15 questions regarding the effects of the FLM on the teaching process, its benefits, technological advantages, its impact on students' success in chemistry, a comparison with existing learning methods and opinions on the use of the model in chemistry instruction. The collected data were analyzed by using content analysis method. In the content analysis, each theme was explained in detail by the participants' views which were supported. The findings indicate that students' views on the FLM changed positively and their perceptions of the speed in chemical reactions, when the model was applied, were also positively affected. The results of the study reveal that the application of the FLM in chemistry lessons is an effective method for increasing students' attitudes and achievements in the subject. These findings suggest that the FLM, as a student-centered approach, is effective in enhancing students' interest in and success in the subject. The research offers recommendations for the widespread implementation of the model in chemistry instruction.

Keywords: Chemistry education, flipped learning model, student opinion.

Introduction

Chemistry is a branch of science that studies the structure, properties, composition, transformations of substances, and the energy aspects of these transformations. Providing insight into the natural world, chemistry helps us develop scientifically based solutions (Atkins & Friedman, 2021). Furthermore, chemistry plays a crucial role in industrial applications, including pharmaceutical production, energy generation, and environmental engineering (Chang, 2016). The goal of chemistry is to analyze the behavior of substances at the atomic and molecular levels, to explain the results of these behaviors, and, particularly, the regularities in their reactions (McMurry & Fay, 2022). Chemistry has a critical role in addressing environmental issues and fostering innovations in health and technology (Baird & Markus, 2021; Zhang, 2020). Chemistry education aims to teach students the fundamental principles of this discipline while also helping them develop analytical thinking, problem-solving, and scientific research skills (Gabel, 2020; Taber, 2013). In addition to providing knowledge and skills to help students understand natural phenomena and technological advancements, chemistry education also guides them toward finding solutions to environmental and societal issues (Cooper & Klymkowsky, 2013; Gabel, 2020). In this context, chemistry teaching adopts student-centered and experimental learning approaches, ensuring active student participation and enabling deep learning (Bodner, 2014; Johnson et al., 2021). Moreover, the FLM has been increasingly integrated into chemistry education, where students engage with instructional materials outside of class, freeing classroom time for interactive activities and deeper exploration of concepts (Bergmann & Sams, 2012; Lage et al., 2000). Studies have shown that flipped learning enhances student engagement, improves conceptual understanding, and promotes higher-order thinking skills in chemistry courses (Chen et al., 2014; Mason et al., 2013).

In chemistry education, digital tools such as virtual laboratories, simulations, and online resources are increasingly utilized. These tools allow students to visualize various chemical processes and reactions, while also overcoming the limitations of physical laboratories, thereby providing broader access (Atarés-Huerta & Leiva-Brondo, 2022; Harrison & Treagust, 2000; Martinez & Singh, 2025; Yang & Li, 2020). The effective use of technology in education not only enhances students' learning experiences but also prepares them to solve future scientific and engineering problems (Puentedura, 2014). In recent years, the importance of active learning methods and student-centered approaches in chemistry education has been steadily increasing (Freeman & Quaglia, 2020; Lee & Park, 2024; Miller & Schuster, 2022). These methods increase students' engagement with the subject and help them develop a deeper understanding (Freeman et al., 2014; Michaelsen et al., 2014). In a critical discipline like chemistry education, the use of contemporary and technological approaches, such as the flipped classroom model, is of great significance in enhancing educational efficiency (Akdeniz, 2011; Kim et al., 2021; Koçak & Şimşek, 2023; Özdemir & Yılmaz, 2017; Seery, 2015). This model allows students to develop their conceptual understanding (O'Flaherty & Phillips, 2015; Stes et al., 2012; Wu & Hsieh, 2018).

The FLM reverses traditional teaching methods, ensuring that students come prepared to class. Prior to the lesson, students engage with video and reading materials to familiarize themselves with the topic. The classroom is then used for interactive activities and experiments, deepening the learning process and providing more opportunities for group work and discussions. This approach enhances students' collaboration skills (Bishop & Verleger, 2013; Cabı, 2018).

Among the advantages of the FLM are students coming to class prepared, utilizing class time for interactive activities, and increasing student engagement (Galindo-Dominguez, 2021). This model allows students to learn at their own pace, contributing to the development of deep understanding and critical thinking skills (Bishop & Verleger, 2013; O'Flaherty & Phillips, 2015). However, like all teaching models, the flipped learning model [FLM] also has some disadvantages. These include limited access to lesson materials for some students at home and students' unfamiliarity with learning independently. Such challenges can lead to difficulties for students and require teachers to spend more time on lesson planning (Gannod, 2008; Hamdan, 2013). Therefore, for the FLM to be implemented effectively, it is critical that both teachers and students adapt to this model.

The FLM is based on constructivist approaches and blended learning theory. According to these theories, students are active participants in the learning process. Additionally, the model is grounded in various theoretical foundations, such as Bloom's Taxonomy, social learning theory, and learning styles. By encouraging students to review lesson materials at home and engage in hands-on activities in the classroom, the model facilitates the development of critical thinking and problem-solving skills. When integrated with constructivist approaches and blended learning, the FLM combines online and face-to-face learning opportunities, allowing each student to learn at their own pace and in their preferred style (Bergmann & Sams, 2012; Kim et al., 2021; O'Flaherty & Phillips, 2015).

The FLM emerged in the early 2000s and gained significant popularity, particularly in higher education programs. The foundations of this model are attributed to faculty members Jonathan Bergmann and Aaron Sams from the University of Colorado. In 2007, Bergmann and Sams created video lectures for chemistry courses to allow students to use their class time more efficiently. Through these videos, students could learn the lesson content at home, while in-class time was devoted to more interactive activities (Bergmann & Sams, 2012). Over time, the model has been adopted and developed in a broader educational context (Bergmann & Sams, 2012; O'Flaherty & Phillips, 2015). Bergmann and Sams supported the application of concepts and collaborative learning with this approach (Gannod, 2008; McFadden & O'Connor, 2016).

Various terms have been used to describe the FLM, such as "inverted classrooms" "flipped classrooms" "inverted learning" "home study, school assignments" "flipped teaching" and "blended learning" (Bergmann & Sams, 2012; Hayırsever & Orhan, 2018). Initially, the term "classroom" was more commonly used, but over time, the term "learning" became preferred, and the model began to be referred to as the FLM (Bergmann & Sams, 2012; Hayırsever & Orhan, 2018; Johnson & Hughes, 2025; O'Flaherty & Phillips, 2015).

The key components of the FLM are represented by the acronym FLIP. For the effective implementation of flipped learning, these components must be provided:

1. Flexible Environment: Students must have access to a flexible environment to complete pre-class tasks. They can use this environment at any time and in any place they choose. This offers opportunities for both individual and group work.

2. Learning Culture: The FLM is student-centered. In this model, students actively engage in research and application, leading to deep learning.

3. Intentional Content: Educators design appropriate programs and tasks for students. They plan suitable lesson content and activities aligned with students' learning outcomes and goals.

4. Professional Educators: Instructors observe and guide students throughout the course. They provide guidance and feedback during activities and practical applications.

The FLM has been developed in various ways with different themes. Among the significant works on this model, the contributions of Chen et al. (2014) hold an important place. Chen et al. (2014) took a more comprehensive approach to the FLM, particularly proposing a new structure developed for higher education. This structure is called "FLIPPED," where each letter represents a subdimension of the model. In developing this comprehensive model, Chen et al. (2014) were inspired by the traditional FLM of Khan Academy, Bergmann & Sams's (2012) "Mastery-Based FLM," Gerstein's (2011) "Flipped Classroom Model" and the works of Staker and Horn (2012). These themes define the different dimensions of the FLM more clearly, expanding its contribution to the learning process.

F-Flexible Learning Environments: Providing a flexible environment for students to access learning resources and engage with content at their own pace and in their preferred context.

L-Learner-Centered Approach: Focusing on students as active participants in their learning process, promoting autonomy, and encouraging independent learning.

I-Intentional Content: Educators provide carefully planned and appropriate content, ensuring that students engage with meaningful materials that align with their learning objectives.

P-Professional Educators: Instructors take on the role of facilitators, offering guidance, observation, and feedback throughout the learning process.

P-Progressive Networking Learning Activities: Gradually introducing learning activities that encourage collaboration, networking, and the development of skills through structured tasks.

E-Engaging and Effective Learning Experiences: Ensuring that students have interactive and effective learning experiences that promote engagement and foster deep understanding.

D-Diversified and Seamless Learning Platforms: Using various, interconnected learning platforms to provide students with seamless access to learning materials across different environments (e.g., online, face-to-face).

The FLM has gained significant importance in chemistry education, and research on how this model is effective in teaching chemistry continues to grow (Bergmann & Sams, 2012; Hayırsever & Orhan, 2018; Johnson & Hughes, 2025; Martinez & Zhang, 2025; O'Flaherty & Phillips, 2015). O'Flaherty and Phillips (2015) explain that flipped learning enhances students' problem-solving and critical thinking skills in chemistry courses. Similarly, Bishop and Verleger (2013) note that when enriched with hands-on experiments, the FLM deepens learning in the complex nature of chemistry education. Gannod et al. (2008) demonstrate that flipped learning provides students with more interactive learning opportunities, thus allowing for more efficient use of class time. These studies highlight the importance of implementing the FLM as an effective teaching method in chemistry education (Keskin et al., 2020).

There is a limited amount of research in the literature regarding the use of the FLM in chemistry education (Carter & Stewart, 2023; Mortimer, 1989; Smith & Williams, 2022; Taber, 2013). Specifically, it is emphasized that there is a lack of experimental studies in the field of chemistry (Keskin, 2020; Tekin, 2021). Although chemistry courses and the FLM have gained significant attention in recent years, there is insufficient research on the application of this model in chemistry teaching. This situation indicates that further research is needed to explore the contributions of the FLM to chemistry education.

Studies examining the effects of the FLM generally address many different variables, but often focus on only one or two of these variables. The existing studies primarily concentrate on variables such as academic achievement, student attitudes, motivation, self-efficacy, mental effort, student engagement, problem-solving skills, writing skills, technology usage skills, and preparedness levels, with only a few of these factors being examined in detail (Abeysekera & Dawson, 2015; Kay, 2012). In Türkiye, it has been observed that there are limited studies on the use of the FLM in chemistry courses, and there is a lack of sufficient research that comprehensively investigates its effects in chemistry education (Abraham & Renner, 1986; Carter & Stewart, 2023; Eichler & Peeples, 2016; Flynn, 2015; Gabel, 1998; Hofstein & Kesner, 2012; Johnstone, 2006; Keskin, 2020; Kozma & Russell, 2005; Mason et al., 2013; Mortimer, 1989; Nakhleh, 1992; Seery, 2015; Smith & Williams, 2022; Taber, 2013; Tekin, 2021;).

In this context, it is important for future research to adopt a broader perspective to better understand the effectiveness of the FLM in chemistry education. This will allow for a more comprehensive evaluation of the model's effects in chemistry courses and the identification of its potential benefits in education.

The FLM allows students to learn chemical concepts, reactions, and experiments beforehand through videos, readings, or other resources in chemistry courses. In the classroom, under the guidance of the teacher, students reinforce what they have learned through interactive activities such as group work, experiments, and discussions. This model aims to provide students with a deeper conceptual understanding and increase their interest in chemistry. The aim of this study is to examine students' perspectives on the FLM in chemistry teaching using a classroom-based, hands-on learning approach.

In this study, the question "What are students' views on the FLM in chemistry instruction conducted through the in-class applied learning approach?" is defined as the main research problem. In line with the main problem of the study, the sub-problems are as follows:

1. What are students' views on the FLM?

2. What are students' opinions regarding the benefits provided by the FLM?

3. What are students' perspectives on the technological components of the FLM?

4. What are students' views on the implementation of the FLM in chemistry courses?

5. What are students' perceptions of the impact of the FLM on academic achievement in chemistry?

6. What are students' opinions on the FLM compared to traditional learning methods?

7. What are students' views on the use of the FLM in chemistry instruction?

Method

Research Model

In this study, a qualitative research design was used. Qualitative research methods are employed by researchers to conduct in-depth investigations into social phenomena, individuals' experiences, and the meanings of these experiences. In qualitative research, verbal or written data are typically analyzed rather than numerical data. Qualitative research designs enable the collection of in-depth information aimed at understanding complex social processes and human behaviors (Creswell, 2013; Denzin & Lincoln, 2011; Patton, 2015; Stake, 2010). In this study, a case study, which is a qualitative research design, was chosen. A case study is used to conduct an in-depth examination of a specific phenomenon or event. Typically focusing on an individual, group, community, or situation, this type of study aims to analyze an event that occurs in a particular context in detail (Baxter & Jack, 2022; Merriam & Tisdell, 2019; Yin, 2023).

Study Group

Table 1 presents the demographic characteristics of the students in the sample group.

Table 1.

Gender Data of the Sample

Gender	*n*	%
Female	4	40
Male	6	60

A total of 186 students participated in the implementation phase of this study during the spring semester of the 2023-2024 academic year. However, for the qualitative component of the study, 10 students from the 11th grade were selected through purposeful sampling to provide rich, in-depth information relevant to the research question. Purposeful sampling is a strategic sampling method used in qualitative research that involves selecting participants based on predefined criteria to ensure they possess the knowledge and experience necessary to address the research problem (Büyüköztürk, 2018; Patton, 2015). The selection criteria included active participation in the implementation of the FLM and ensuring demographic representation. Students were initially ordered by their school registration numbers; however, the final selection was made according to established eligibility criteria and the relevance of their experiences. This process reflects a strategic, rather than random, sampling approach aligned with the research objectives. The sample consisted of 40% female and 60% male students, reflecting the existing gender distribution within the school population. This demographic composition has been considered among the study's limitations, and the gender imbalance was carefully taken into account during data analysis and interpretation, given that the study prioritized participants' depth of knowledge and experiential richness.

Data Collection Tools

In this study, a student interview form was used as the data collection tool. Semi-structured interviews were conducted with the selected students as the qualitative data collection method. During the preparation phase of the interview questions, previous studies related to the topic in the literature were utilized (Akçayır & Akçayır, 2018; Çakır, 2019; Demirci, 2017; Özdemir & Demirtaş, 2020; Yılmaz & Güler, 2016). The interview questions were designed to evaluate different aspects of the FLM. The questions covered a wide range of topics, from the overall effects of the model to students' use of technology and success in specific subjects. The questions were formulated to serve the primary purpose of the research. The language of the questions was carefully designed to be clear and appropriate for the educational level of the participants, taking into account that the target group consisted of 11th grade students. Moreover, the questions were designed to address the participants' knowledge levels, particularly regarding their experiences with the FLM and how they used technological tools. To allow participants to freely express their opinions, open-ended questions were used. Open-ended questions enable students to describe their experiences in detail, thus providing deeper insights and richer data.

The interview questions have been organized around key themes that align with the research objectives. These main themes include the general effects of the FLM, students' views on technology, the applicability of the model in specific subjects (e.g., chemistry), and the advantages the model provides compared to traditional learning methods. The interview questions were reviewed and evaluated by the researcher and three experts in the field. Additionally, the questions were tested through a pilot implementation. During the pilot phase, factors such as the clarity, sequence, and impact of the questions on the participants were observed, and necessary adjustments were made.

The interview questions were developed in accordance with ethical guidelines. Participants' anonymity and confidentiality were prioritized, and they were informed about the purpose, process, and potential risks of the study. It was ensured that participants could freely decide whether or not to take part in the study, based on their own will. In the final phase, seven core questions and fifteen sub-questions relevant to the FLM were formulated.

The students (coded as S5, S17, S18, S22, S36, S39, S45, S47, S64, S69) were selected and subsequently interviewed using semi-structured interviews. Prior to the interviews, necessary permissions for the interviews and audio recordings were obtained from the students, school administration, and their families. The interviews were recorded and transcribed into written documents. The interviews were conducted under seven main themes and fifteen sub-themes. To ensure the reliability of the interview data, the interviews were recorded and analyzed. Observations were documented through videos, photographs, and audio recordings. The interviews were conducted based on the identified seven main themes. These main themes are as follows:

a. Students' views on the FLM
b. Students' views on the benefits provided by the FLM
c. Students' technological perspectives on the FLM
d. Students' views on the use of the FLM in chemistry classes
e. Students' views on the success of the FLM in chemistry classes
f. Students' views on the FLM compared to existing learning methods
g. Students' views on the use of the FLM in chemistry instruction.

Validity and Reliability

Validity and reliability were addressed in accordance with the trustworthiness criteria proposed by Lincoln and Guba (1985). These criteria include credibility, transferability, dependability, and confirmability. Each phase of the research process was meticulously designed and implemented in alignment with these principles.

To enhance the internal validity of the study, the interview questions were reviewed by an expert panel. This panel comprised two chemistry teachers, one Turkish language teacher, two field researchers, and two academics specializing in qualitative research and the subject matter. The experts assessed the extent to which the questions aligned with the research objectives, scope, and theoretical framework. The agreement among the experts was high, indicating that the questions were well-aligned with the research goals.

Additionally, a pilot study was conducted with four students to evaluate the comprehensibility of the interview questions and the overall flow of the data collection process. Feedback obtained from the pilot study led to final revisions of the interview form. The data collection process was carried out systematically, and all methodological decisions were documented in detail. All interviews were recorded using audio devices to prevent data loss, and the transcriptions were analyzed without interpretive bias. Coding and theme development were conducted in alignment with the predefined sub-problems of the study, and methodological transparency was maintained throughout the analysis.

To minimize researcher bias, data were analyzed based strictly on participants' original statements. Interpretations were supported by direct quotations, ensuring that the findings were grounded in the data. All analytic procedures and results were documented thoroughly, thereby enhancing the objectivity and auditability of the study. Comprehensive descriptions of the research context, participant characteristics, sampling procedures, and data collection methods were provided to facilitate the transferability of the findings to similar educational contexts. By detailing the implementation environment and participant selection criteria, the study offers sufficient contextual information for researchers seeking to apply or adapt the findings in comparable settings.

In conclusion, all methodological procedures were carefully planned and executed to ensure the trustworthiness of the study. The interview form was validated both in terms of content and structure, and the data collection and analysis processes were conducted in a systematic, transparent, and coherent manner. As such, the study meets the scientific standards required in qualitative research and provides reliable and credible findings.

Application Process

The research was conducted with 186 students from the 11th grade during the 2023-2024 spring semester. The study was carried out over a 12-week period, in alignment with the students' course schedules. The FLM was applied in the teaching of a topic included in the chemistry curriculum.

In line with the requirements of this model, students were assigned daily homework for one week prior to the lessons to prepare for the subject. These out-of-school activities, along with visual materials, in-school experiments, and student activities, are detailed in Table 2 under the section "Application Categories." Following their theoretical preparation, three classroom experiments related to reaction rates in chemical reactions were conducted. Additionally, six student activities focusing on the topic of reaction rates were organized.

During the implementation of the FLM, students were assigned to watch animations and videos related to the chemistry course at home. These visual materials supported the students' learning process. At the end of the educational process, student opinions were collected to evaluate the effectiveness of the FLM.

Table 2.
Application Categories

Category	Activity	Description
Out-of-school activities (homework)	Day 1: Molecular perspective	✓ Study the concept of the molecular perspective in chemical reactions. ✓ Solve 5 questions related to the topic and write the solutions. ✓ Provide 1 real-life example related to the topic
	Day 2: Reaction rates and average rate	✓ Study the topics of reaction rates and average rate. ✓ Solve 5 questions related to the topics and write down the solutions. ✓ Provide 1 real-life example related to the topics.
	Day 3: Homogeneous and heterogeneous phase reactions	✓ Study the topic of homogeneous and heterogeneous phase reactions. ✓ Solve 5 questions related to the topic and write down the solutions. ✓ Provide 1 real-life example related to the topic.
	Day 4: Reaction rate equations	✓ Study the topic of reaction rate equations. ✓ Solve 10 questions related to the topic and write down the solutions. ✓ Provide 1 real-life example related to the topic.
	Day 5: Factors affecting reaction rate	✓ Study the factors affecting reaction rate. ✓ Solve 15 questions related to the topic and write down the solutions. ✓ Provide 3 real-life examples related to the topic.
Visual materials	Animations and videos	The animations and videos used in the chemistry class helped students to visually understand the topic. These materials were shown at home to support the theoretical part of the lesson.
In school activities	Experiments	1. The reaction of sodium metal with water (Explosion). 2. The reaction of magnesium particles with hydrochloric acid. 3. The color change between lead (II) nitrate and potassium iodide solution.
	Student activities	1. Writing the rate relationship in chemical reactions. 2. Constructing rate equations using experimental data. 3. Showing concentration changes through graphs. 4. Demonstrating microscopic interactions within the framework of the effective collision theory. 5. Discussing the differences between rusting and gas explosions. 6. Graphically interpreting the energy concepts in reaction rates.
Evaluation and feedback	Student opinions	At the end of the course, student opinions were collected to evaluate the effectiveness of the FLM. The students' thoughts on the course content, hands-on learning processes, and the impact of the model were assessed.

Analysis of Data

In this study, semi-structured interviews were conducted to gain an in-depth understanding of students' perspectives regarding the FLM and reaction rates. Following obtaining the necessary permissions, the interviews were audio-recorded using a mobile device. The recorded data were transcribed verbatim to prepare for analysis.

Content analysis, a qualitative data analysis method that facilitates systematic and structured examination of textual data, was employed (Krippendorff, 2018; Yıldırım & Şimşek, 2013). This approach enables the identification of meaning units within the transcripts and their categorization, allowing for an in-depth interpretation of the data. The data analysis proceeded through a three-stage coding process: open coding, axial coding, and selective coding (Glaser & Strauss, 1967). Open coding; in the first stage, the transcripts were read line by line, and meaningful segments were labeled with descriptive codes that were derived inductively from the raw data. Each code was carefully documented with reference to the participant's original expression to maintain data fidelity. Axial coding; in the second stage, similar and related codes were grouped together to form sub-themes. Relationships among codes were explored, and conceptual links were established to organize the data into coherent categories. Selective coding; in the final stage, the sub-themes were further analyzed and integrated into overarching core themes that reflected the theoretical framework of the study. These central themes captured the essence of the participants' perspectives and structured the study's key findings.

Throughout the coding process, inter-coder reliability was ensured by involving a second researcher to cross-check coding decisions, enhancing the trustworthiness and objectivity of the analysis (Yıldırım & Şimşek, 2013).

Example of the Coding Process

To exemplify the coding process, consider the question: "*What do you understand by the FLM*?" The following excerpts were collected:

S5 and 47: "*When I hear flipped, I think of breaking something down and rebuilding it. It makes me think of redoing*."

S64: "*I understand this model as coming prepared to class.*"

S36: "*I understand it as an education system supported by experiments and activities.*"

S69: "*I see it as a model that supports students. A model that will benefit us. A model that will reduce our school workload.*"

S45: "*I think the FLM is a working method that will reduce the students' school workload and balance it with their home responsibilities. That would probably be good for us.*"

1. Open Coding:

Structural transformation / reconstruction

Preparedness for class

Activity and experiment-based learning

Student support and benefit

Balancing school and home workload

2. Axial Coding:

Structural and procedural change of the model

Student preparedness and engagement

Active learning strategies

Student workload reduction and support

3. Selective Coding:

Impact of the FLM on the educational process

This example demonstrates how codes are directly derived from raw data, then grouped into categories, and finally synthesized into core themes that represent the broader meanings in the data. The identified themes were supported by direct participant quotations to ensure data transparency and trustworthiness. The research context, participant characteristics, sampling method, and data collection procedures are described in detail to enhance the transferability of the findings to similar educational settings. This systematic, transparent, and theoretically grounded approach to data analysis ensures the reliability, validity, and objectivity of the study's findings, providing robust and meaningful insights into students' perceptions of the FLM.

Ethical Permits of Research:

In this study, all the rules specified to be followed within the scope of "Higher Education Institutions Scientific Research and Publication Ethics Directive" were complied with. None of the actions specified under the heading "Actions Contrary to Scientific Research and Publication Ethics", which is the second part of the directive, have been taken.

Ethics Committee Permission Information:

Name of the committee that made the ethical evaluation = Hacettepe University Ethics Committee

Date of ethical review decision= September 26, 2023

Ethics assessment document issue number= E-66777842-300-00003098228

Findings

Semi-structured interviews were conducted with 10 students to determine their views on the FLM. These students were selected using purposive sampling. In this context, interviews were conducted with students numbered S5, S17, S18, S22, S36, S39, S45, S47, S64 and S69. The interview questions were organized under 7 main headings and consist of a total of 15 subheadings. The findings from the analysis of the interview questions with the students are presented in the tables below.

The students' responses to the question "*Have you encountered this model before*?" during the interviews are presented in Table 3, according to the themes and codes.

Table 3.

The Findings regarding the Students' Previous Encounters with This Model

Theme	Code	Participant no	*f*	%
No (f=9, 90%)	We have not encountered it before I am hearing about it for the first time	S47, S17, S22, S39, S36, S45, S69, S64, S5	9	90
Yes (f=1, 10%)	I had heard of it by name before	S18	1	10

When Table 3 is examined, the students' responses regarding their prior encounters with this model are categorized into two themes: Yes (f=9, 90%) and No (f=1, 10%).

In response to the question, "Have you encountered this model before?" the following statements were made:

S36: *"No, I haven't. I am hearing about it for the first time from you."*

S18: *"I had heard of the FLM before, but only by name. I came across it in a book, in the textbook."*

S17: *"No, we have never encountered this model in any way. Nothing has been done regarding this model, so I have never heard of it."*

When the student responses are grouped according to the frequency of their statements, two main categories are identified: "No, I am hearing about it for the first time" and "Yes, I had only heard of it by name before." Participants S47, S17, S22, S39, S36, S45, S69, S64, and S5 used the expression, *"No, I have never heard of it before, I am hearing about it for the first time,"* while only S18 used the expression, "I had only heard of it by name before." The expression *"I am hearing about it for the first time*" was used by f=9 participants, accounting for 90% of the responses. This indicates that the FLM is generally not well-known or is minimally recognized among the participants. The expression "*I had only heard of it by name before*" was used by only 10% of the participants, suggesting that the FLM may have been heard of, but the participants did not have a detailed understanding or full knowledge of it. These responses indicate that the FLM is not widely known.

The students' responses to the question "*What do you understand by the FLM*?" during the interviews are presented in Table 4, according to the themes and codes.

Table 4.

The Findings regarding What the Students Understood from the FLM

Theme	Code	Participant no	*f*	%
Construction and reinforcement (f=2, 20%)	Doing something again	S5	1	10
	Changing some things again	S47	1	10
Pre-class preparation (f=4, 40%)	Coming prepared for class	S64	1	10
	Studying at home	S17	1	10
	Reducing the workload of school	S69	1	10
	Reducing and balancing the workload	S45	1	10
Effective learning (f=3, 30%)	Conducting experiments and activities	S36	1	10
	Learning through animation	S39	1	10
	Learning visually	S22	1	10
Lack of knowledge (f=1, 10%)	I have no knowledge	S18	1	10

When Table 4 is examined, the students' views on what they understood by the FLM are categorized into four themes: effective learning (f=3, 30%), pre-class preparation (f=4, 40%), construction and reinforcement (f=2, 20%), and lack of knowledge (f=1, 10%).

In response to the question, "What do you understand by the FLM?", the following statements were made:

S5: *"When I think of flipped learning, I think of something being broken down and rebuilt. Rebuilding comes to my mind."*

S64: *"I understand this model as coming prepared for class."*

S36: *"I understand it as an educational system supported by experiments and activities."*

S69: *"I understand it as a model that supports students. I think it will be beneficial for us. It is a model that will reduce our school workload."*

S45: *"Hmm, I understand flipped learning as a model that will reduce the school workload and balance it with the homework load. This will be a good thing for us."*

Table 4 shows that the FLM is perceived differently among participants, with various aspects of the model being emphasized. Some participants focused on features such as doing things again (S5), coming prepared for class (S64), reducing school workload (S69), and using visuals and animation (S39), while others highlighted aspects such as conducting experiments and activities (S36) or encouraging studying at home (S17). This demonstrates that the various components of the FLM stand out in different ways in student experiences, and each student interprets the model according to their own learning style and needs.

The students' responses to the question "*What benefits has the FLM provided you?*" during the interviews are presented in Table 5, according to the themes and codes.

Table 5.

The Students' Findings regarding the Benefits of the FLM

Theme	Code	Participant no	*f*	%
Permanent and effective learning (f=6, 60%)	Learning the topic better	S18	1	10
	Using information-rich animations	S22	1	10
	Preparing for class	S64	1	10
	Facilitating visual learning	S39	1	10
	Ensuring permanent learning	S36	1	10
	Providing permanent learning through experimental methods	S69	1	10
Experimental and collaborative learning (f=2, 20%)	Providing experimental and visual learning	S47	1	10
	Providing experimental learning	S17	1	10
Ease of application (f=1, 10%)	Providing more advantageous learning	S5	1	10
Lack of knowledge (f=1, 10%)	Lack of knowledge	S45	1	10

When Table 5 is examined, the students' views on the benefits of the FLM are categorized into four themes; permanent and effective learning (f=6, 60%), experimental and collaborative learning (f=2, 20%), ease of application (f=1, 10%), and lack of knowledge (f=1, 10%).

In response to the question, "*What benefits has the FLM provided you*?" the following statements were made:

S5: *"I think it is more advantageous compared to other methods."*

S45: *"Since we haven't applied it continuously, I don't really know its benefits. I can't think of anything right now."*

S64: *"It has been beneficial. It helps us come prepared for class. It allows us to respond more easily to the questions asked by the teacher."*

S36: *"It provides visual memory. The lessons we cover, the writings we make, and the formulas we memorize make the topics more permanent. We gain more permanent knowledge."*

In the table, participants (S18, S39, S36, S22, S64, S69) mentioned that they learned the topic better, experimentally and visually. Participants S17 and S47 indicated that it was useful in experimental and visual learning. Participant S5 mentioned that it provides ease of application. Participant S45 did not provide any views on the benefits of the model. Sixty percent of participants stated that the FLM helped them learn the topic more permanently and effectively. This indicates the level of satisfaction with the model among the participants. Additionally, the model's usefulness for students has been emphasized.

The students' responses to the question "*What do you think about the contribution of the FLM to your understanding of chemistry concepts?"* during the interviews are presented in Table 6, according to the themes and codes.

Table 6.

The Findings regarding the Contributions of the FLM to Students' Understanding of Chemistry Concepts

Theme	Code	Participant no	*f*	%
Reinforcement and understanding (f=4, 40%)	Better reinforcement of chemistry topics	S5	1	10
	Better understanding of chemistry topics	S36	1	10
	Easily answering questions	S18	1	10
	Coming prepared for class	S64	1	10
Effective learning (f=5, 50%)	Providing experimental, visual, and enjoyable learning	S69	1	10
	Ensuring permanent knowledge	S45	1	10
	Facilitating visual learning	S39, S22	2	10
	Contribution of visuals and animations	S47	1	10
Method and application (f=1, 10%)	Providing variety and diversity in the class	S17	1	10

When Table 6 is examined, students' thoughts on the contributions of the FLM to chemistry are grouped under three themes: effective learning (f=4, 40%), reinforcement and understanding (f=5, 50%), and method and application (f=1, 10%).

In response to the question, "*What do you think about the contribution of the FLM to your understanding of chemistry concepts?"* the following statements were made:

S5: *"It helps reinforce the topics we don't understand in chemistry. Also, as far as I know, flipped learning prepares us to learn the topic beforehand and come to class prepared. It helps reinforce what we've learned in class. I think this is beneficial."*

S64: *"It helps us come prepared for class. It allows us to answer the teacher's questions more easily. It's a good method for chemistry, a useful model. But it would be better if it benefits everyone equally."*

S69: *"Yes, it has been very helpful to us. Especially in chemistry, it helped us learn the material permanently through experimental and visual methods. And most importantly, it created a fun learning environment."*

S17: *"We have just started using this model. It brings variety to the class, and in the future, if students study at home, they will have established discipline at home as well. Teachers tell us to do something, but it doesn't settle well later. But, does it add variety to the class?"*

In Table 6, participants S5, S36, S18, and S64 (f=4, 40%) stated that the FLM helped reinforce chemistry topics. The model was also said to improve their ability to answer questions easily. Participants S39, S69, S22, S47, and S45 (f=5, 50%) mentioned that the FLM made the learning process more enjoyable. Additionally, they stated that it led to permanent learning. Furthermore, they emphasized that the FLM facilitated visual learning and provided diversity in the learning process. Participant S17 (f=1, 10%) noted that the FLM added variety to the class. This suggests that the model contributed to long-term knowledge acquisition and retention.

The students' responses to the question "*Are there technological benefits of the FLM compared to the current method in chemistry teaching?*" during the interviews are presented in Table 7, according to the themes and codes.

Table 7.

The Students' Findings regarding the Technological Benefits of the Model

Theme	Code	Participant no	*f*	%
Technology-supported learning (f=7, 70%)	Visually useful	S18	1	10
	Software programs and visual animations are beneficial	S39	1	10
	Watching animations and videos	S22	1	10
	Being supported by videos and animations	S69	1	10
	Useful for molecule representations	S64	1	10
	Beneficial with videos	S17	1	10
	Facilitating visual learning	S36	1	10
Effective learning (f=2, 20%)	Helping to reinforce topics better	S5	1	10
	Ensuring permanent learning	S47	1	10
Lack of knowledge (f=1, 10%)	Lack of knowledge	S45	1	10

When Table 7 is examined, student opinions are categorized into three different themes: technology-supported learning (f=7, 70%), effective learning (f=2, 20%), and lack of information (f=1, 10%).

In response to the question, "*Does the FLM have technological benefits compared to the current methods in chemistry education?"* The following opinions were expressed:

S17: *"I haven't encountered this before, but it could have some benefits. Topics are better reinforced through videos. The topic is not forgotten and stays in the student's mind longer."*

S47: *"I haven't used it in chemistry or other subjects, but for example, I encountered flipped learning today and will now use it as I believe it will allow me to understand the material more effectively and retain it for a longer period."*

S64: *"I believe it can be beneficial. When we see something visually, it tends to be more memorable. I think it's particularly useful for molecular representations. We previously created slides from programs, for example."*

According to Table 7, participants mentioned that visual materials (S18) helped reinforce learning in chemistry lessons. Software programs and visual animations (S39) were found to enhance the effectiveness of the lesson and improve students' understanding of topics. Furthermore, watching animations and videos (S22) contributed to the learning process, and being video and animation-supported (S69) attracted the students' attention. Molecule representations (S64) were highlighted as especially useful in chemistry topics, while learning through videos (S17) was noted as effective. Visual learning (S36) and better reinforcement of topics (S5) were among the elements that participants identified as contributing to the improvement of their learning process. Participants also stated that the FLM promoted permanent learning (S47) and addressed knowledge gaps (S45). The participants indicated that 70% of them benefited from technology-supported learning, 20% found it to promote effective learning, and 10% did not know about the technological benefits of the model. These findings suggest that visual and video-supported teaching methods offer students a more permanent and effective learning experience.

The students' responses to the question "*Do you find the use of technological software and programs beneficial in the FLM compared to the current method in chemistry teaching?*" during the interviews are presented in Table 8, according to the themes and codes.

Table 8.

The Students' Findings regarding the Use of Technological Software and Programs

Theme	Code	Participant no	*f*	%
Positive (f=8, 80%)	Useful for video programs	S5	1	10
	Video-supported learning	S17	1	10
	Useful for molecule representations and slides	S64	1	10
	Technological and practical benefits	S36	1	10
	Visual benefits	S39	1	10
	Useful for animations	S22	1	10
	Enables better understanding and more effective learning	S47	1	10
	Promotes permanent learning	S18	1	10
Negative	-	-	-	-
Neutral (f=2, 20%)	Haven't used it	S69	1	10
	Don't know its benefits	S45	1	10

When Table 8 is examined, the students' views on the use of technological software and programs are grouped into three distinct themes: positive (f=8, 80%), neutral (f=2, 20%), and negative (f=0, 0%).

In response to the question, "*Do you find the use of technological software and programs beneficial in the FLM compared to the current method in chemistry teaching?*", the students provided the following responses:

S64: *"I think it is beneficial. When we see something visually, it becomes more permanent. It is particularly useful for molecule representations. We used to create slides from programs before."*

S5: *"I find it beneficial because chemistry is a subject that involves mathematical and numerical methods, so it can be difficult. That's why I think the model will be technologically beneficial, especially for videos and programs... especially for reinforcing the topics."*

S36: *"I think that practical technology always provides easier and more permanent knowledge. That's why I think it is beneficial."*

According to Table 8, participants mentioned the usefulness of video programs (S5), noting that video-supported learning (S17) improved their learning processes. The use of molecule representations and slides (S64) was particularly emphasized for helping students better understand chemistry topics. Technological and practical benefits (S36) were noted for aiding in the more effective delivery of course content. Visual benefits (S39) were highlighted as contributing to learning, and animations (S22) were mentioned as making the lessons more engaging. Participants also mentioned that these methods helped them understand the material better (S47) and promoted permanent learning (S18). However, some participants (S69 and S45) stated that they had not used these technologies and were unaware of their benefits. Overall, 80% of participants expressed a positive view regarding the use of technological software and programs, while 20% remained neutral and did not express an opinion on whether the tools were beneficial or not. These findings suggest that technological and visual learning tools play a significant role in improving students' understanding and promoting lasting learning. However, some students have not yet used these tools or have not yet recognized their benefits.

The responses to the question "*How has the FLM affected your attitude towards the chemistry course?*" provided by the students during the interviews are presented in Table 9, based on the themes and codes.

Table 9.

The Students' *Findings regarding Students' Attitudes towards the Model in the Chemistry Course*

Theme	Code	Participant no	*f*	%
Positive attitude (f=8, 80%)	Increasing interest in the course Permanent learning Reinforcing topics through experiments and activities	S64, S36, S39	3	30
	Preparation at home before class	S18	1	10
	Visual learning and animation-supported learning	S47	1	10
	Increased course interest due to rich content	S17	1	10
	Providing enjoyable learning	S22	1	10
	Reduction in prejudice towards chemistry	S45	1	10
Negative attitude	-	-	-	-
Lack of knowledge (f=2, 20%)	Chemistry being a difficult subject A large number of formulas Too many lessons	S69	1	10
	Attitude impact is unknown	S5	1	10

When Table 9 is examined, the students' responses are categorized into three themes: positive attitude change (f=8, 80%), negative attitude change (f=0, 0%), and lack of information (f=2, 20%).

In response to the question, "*How has the FLM affected your attitude towards the chemistry course?"*, the following statements were made:

S69: *"Chemistry is a difficult subject for me, especially since there are a lot of formulas. The FLM positively affected my attitude, but still not completely." Why not completely? "Because there are many subjects, and I don't have enough time for all of them. I don't know."*

S45: *"I think it has reduced my prejudice towards chemistry. "S17: In general, we started with alchemy at the beginning, and I was interested at that time. Later, I lost interest. However, due to the rich content, Flipped Learning has increased my interest a bit more."*

S36: *"I'm not* really someone who understands and excels at chemistry. But if it's supported with experiments, it could be better. In my opinion, my attitude has been positively affected."

According to Table 9, participants emphasized the important role of permanent learning in increasing interest in the course. Experimental activities and various activities (S64, S36, S39) help reinforce topics. It was emphasized that preparation before class (S18) enables students to participate in the class more prepared. Visual learning and animation-supported learning methods (S47) were stated to make the learning process more effective, while also increasing interest in the course. The rich content (S17) was noted to enhance the course's appeal, and enjoyable learning (S22) strengthened students' interest in the lessons. Participants also expressed positive developments in terms of reducing prejudice towards chemistry (S45). A total of 80% of participants indicated a positive attitude towards the chemistry course, while 20% did not express an opinion.

On the other hand, some participants mentioned that chemistry is a difficult subject, with too many formulas and a large number of lessons (S69). Additionally, (S5) stated that the effect on attitude was unknown. These findings highlight the importance of various strategies used to make the course more engaging and effective, as well as the potential for reducing some of the negative attitudes students have towards chemistry.

In the interviews conducted with the students, the responses to the question "*What do you think about the effect of the FLM on your attitude towards chemistry?"* are presented in Table 10, based on the themes and codes.

Table 10.

The Students' Findings regarding Their Opinions about the Effects of FLM in the Chemistry Lessons

Theme	Code	Participant no	*f*	%
Visual Learning (f=2, 20%)	Providing visual enrichment	S18	1	10
	Visual learning of chemistry concepts	S5	1	10
Learning Motivation (f=5, 50%)	Increased willingness to learn	S47	1	10
	Simplifying chemistry	S45	1	10
	Making chemistry enjoyable through various activities	S22	1	10
	Offering richer content	S69	1	10
	Increasing interest in chemistry lessons	S64	1	10
Collaborative and Experimental Learning (f=3, 30%)	Assisting in the understanding of chemistry concepts	S39	1	10
	Effectiveness through experiments and activities	S36	1	10
	Promoting experimental learning	S17	1	10

Table 10 shows that the responses are categorized into three themes: visual learning (f=2, 20%), learning motivation (f=5, 50%), and collaborative and experimental learning (f=3, 30%).

In response to the question, '*What is your opinion on the effect of the FLM on your attitude towards chemistry?*', the following statements were made:

S36: *"I am not really someone who understands and excels in chemistry, but if it is supported by experiments, it could be better. It becomes more effective when it is experimental."*

S45: *"Hmm... I think it makes chemistry easier. Chemistry always seems hard, but this model could make it easier. This would increase my interest more."*

S39: *"It has positively affected me. I understand more with experiments and activities."*

According to Table 10, participants indicated that providing visual enrichment (S18) made the learning process in chemistry more effective. It was emphasized that visual learning of chemistry concepts (S5) helped students develop a deeper understanding of the subject. Additionally, participants stated that the increase in learning motivation (S47) and the simplification of chemistry (S45) improved their attitudes towards the subject. Engaging in different activities and making chemistry fun (S22) increased students' interest in the course, while making the course more content-rich (S69) was seen as significant in enhancing students' interest in chemistry. Participants also highlighted that helping in the understanding of chemistry concepts (S64) played a significant role in the learning process, and experiments and activities (S39) contributed to the effectiveness of the course. The provision of experimental learning (S36) was noted to help ensure the retention of knowledge in students' learning processes. Moreover, the implementation of visual, experimental, activity-based, and diverse applications (S17) was noted to make the course more efficient. Participants mentioned that visual learning (20%) methods contributed to students' better understanding of chemistry topics. They also expressed that increasing students' learning motivation (50%) significantly influenced the efficiency of the course. Collaborative and experimental learning (30%) methods were described as facilitating interaction between students and reinforcing topics through experimental activities. The findings reveal that various teaching methods (visual, experimental, activity-based) are crucial tools for enhancing students' understanding of chemistry and reinforcing their interest in the course

In the interviews with students, their responses to the question "*How has the FLM your success in chemistry?*" are presented in Table 11, categorized according to themes and codes

Table 11.

Findings Regarding How the Model Affected Student's Success

Theme	Code	Participant no	*f*	%
Positive impact (f=9, 90%)	Providing visual learning	S5, S39	2	20
	Achieving more lasting learning	S64	1	10
	Lasting learning through experiments	S17, S22	2	20
	Increased interest in chemistry	S18	1	10
	Achievement improvement	S36	1	10
	Long-term use leading to increased achievement	S69	1	10
	Providing experimental application	S47	1	10
Negative impact	-	-	1	10
Lack of knowledge (f=1, 10%)	Lack of knowledge	S45	1	10

When examining Table 11, the student opinions on the impact of the model on student success are categorized into three themes: positive impact (f=9, 90%), no impact (f=0, 0%), and lack of knowledge (f=1, 10%).

In response to the question, "*How has the FLM affected your success in chemistry?",* students provided the following responses:

S47: *"For example, I'm no longer afraid of formulas in chemistry, I become more enthusiastic. Because the information doesn't stay theoretical, we can understand it through teacher support and experiments."*

S18: *"Actually, if it were used in other subjects as well, I would like it even more. With the flipped model, I became more interested in chemistry. My level improved."*

S36: *"It increased my success, but... as I said, if the use is extended over a longer period, we will see the effects better."*

According to Table 11, participants have expressed that providing visual learning (S5, S39) supports lasting learning in chemistry. Experimental applications and experiments (S17, S22, S69) were mentioned as contributing to enduring learning. Additionally, an increase in interest in chemistry and achievement (S18) was observed, and extended use (S36) resulted in a significant improvement in achievement levels. Increased motivation to learn (S47) and more lasting learning (S64) demonstrate the effectiveness of the model. However, some participants have noted a lack of knowledge (S45). Students indicated that 90% of them reported positive effects of the model, while only 10% expressed a lack of knowledge regarding the model's function. Overall, it is understood that visual and experimental learning methods play a significant role in enhancing student success in chemistry, reinforcing student engagement, and facilitating lasting learning.

In the interviews conducted with students, their responses to the question "*How do you think the FLM has affected your success in chemistry?*" are presented in Table 12, according to themes and codes.

Table 12.

Findings regarding Students' Thoughts of the İmpact of the Model on Their Success

Theme	Code	Participant no	*f*	%
Knowledge and comprehension (f=5, 50%)	I believe it provides visual learning and increases success.	S5, S22, S39	3	30
	It helps us see the chemistry concepts.	S64	1	10
	I think its long-term use would be more beneficial.	S36	1	10
Skill acquisition (f=1, 10%)	It ensures learning through experiments.	S69	1	10
Interest and motivation (f=3, 30%)	It is better in terms of visual aspects.	S18	1	10
	I think it's a modern model that increases my interest in chemistry.	S47	1	10
	The increase in interest in the course through activities and the rapid learning of the topic.	S17	1	10
Lack of knowledge (f=1, 10%)	Lack of knowledge	S45	1	10

When examining Table 12, student responses are categorized into four themes: knowledge and comprehension (f=5, 50%), skill acquisition (f=1, 10%), interest and motivation (f=3, 30%), and insufficient knowledge (f=1, 10%).

In response to the question, "*How do you think the FLM affected your success in chemistry?",* the following statements were made:

S47*: "I believe it had a positive effect. This was exactly what we, as students, wanted; it just didn't have a name. I also think it increased my interest in chemistry. It's a modern model."*

S22: *"I think it had a positive effect. I believe it provided visual richness. I think it increased my success. It has become more permanent."*

S18: *"Especially in terms of visual aspects, it's very good. I read in a book that 60% of learning occurs through seeing."*

According to Table 12, participants expressed that visual learning methods increased success in chemistry and that visual learning had been effectively implemented (S5, S22, S39). Additionally, it was emphasized that presenting chemistry concepts visually (S64) made it easier for students to understand. Views were also expressed that long-term usage (S36) would contribute more to the learning process. Participants indicated that learning through experiments (S69) helped students develop a more permanent understanding. Rich visual content (S18) was noted to make learning more effective. It was also mentioned that a modern model increases interest in chemistry (S47) and that activities (S17) enhanced interest in the course, while enabling faster learning of the topics. However, some participants reported difficulties due to insufficient knowledge (S45). Participants indicated that the process of knowledge and comprehension (50%) is significant, skill acquisition (10%) contributes to the learning process, and interest and motivation (30%) enhance success. However, some participants also reported insufficient knowledge (10%). The findings suggest that visual and experimental learning methods are effective tools in increasing success in chemistry, enhancing student interest, and ensuring permanent learning.

In the interviews conducted with students, the responses to the question “*What do you think are the differences between chemistry instruction using the FLM and chemistry instruction using the Current Method?*” are presented in Table 13, categorized based on themes and codes.

Table 13.

Findings Regarding the Differences Between Chemistry Instruction Using the FLM and Chemistry Instruction Using the Current Method

Theme	Code	Participant no	*f*	%
Visual and lasting learning (f=6, 60%)	The FLIP model is more visual.	S5, S18, S39	3	30
	The FLIP model is more lasting.	S18, S5, S64	3	30
Application-based learning (f=2, 20%)	The FLIP model is more experimental and more up-to-date.	S45	1	10
	The FLIP model is experimental and makes chemistry more enjoyable.	S17	1	10
Rich content learning (f=4, 40%)	The FLIP model has more animations and experiments.	S47	1	10
	The FLIP model is more understandable and reduces prejudice.	S36	1	10
	The FLIP model has richer content.	S69	1	10
	The FLIP model is more fun and easier with activities.	S22	1	10

When Table 13 is examined, student responses are categorized into three themes: visual and lasting learning (f=6, 60%), application-based learning (f=2, 20%), and content-rich learning (f=4, 40%). In response to the question, “*What differences do you think exist between chemistry teaching using the FLM and the traditional teaching method?”,* students stated the following:

S5: *“The FLIP model is more visual. Hmm, actually, chemistry is based on logic (since it is mathematical), and I think it would be better understood through this model compared to the traditional method. As students, we are not very successful in these subjects. I think this model will be successful.”*

S39: *“There is a big difference. For example, I don’t understand much when I just listen, but I understand better with the FLIP model because it is more visual.”*

S69: *“The FLIP model is much better compared to the traditional learning model, in my opinion. One is a very old method, very classical, and doesn’t seem modern at all. The FLIP model, however, has much richer content.”*

S22: *“The current method is a bit more boring. It feels harder. But with activities, it becomes simpler and more enjoyable. It teaches more easily. I think it is a model that appeals more to young people and children.”*

According to Table 13, participants expressed that the FLM is more visual (S5, S18, S39), and that these visual elements reinforce learning. They also indicated that the FLM provides more lasting learning (S18, S5, S64). Participants emphasized that the FLM is more experimental and up-to-date (S45), and that it is a model that makes chemistry more enjoyable and includes experimental elements (S17). They noted that the FLM includes more animations and experiments (S47) and that it is more understandable (S36) and has a reducing effect on prejudices. Lastly, participants stated that the FLM is more content-rich (S69) and becomes more enjoyable and easier through activities (S22). Participants expressed that visual and lasting learning (60%) plays a crucial role in the learning process, application-based learning (20%) makes learning more effective, and content-rich learning (40%) increases students' interest in the subject and helps them better understand the topics. These findings indicate that when the FLM is enriched with visual, experimental, and interactive elements, it contributes positively to the learning process.

The responses from students to the question, *"What differences do you think exist between the FLM and the traditional method?"* are presented in Table 14, categorized according to themes and codes

Table 14.

Findings regarding the Differences Between the FLM and the Traditional Method

Theme	Sub-theme	Code	Participant No	*f*	%
FLM	Effective learning (f=4, 40%)	The FLM provides more effective learning.	S5	1	10
		The FLM is more visual.	S36, S64	2	20
		The FLM is more lasting.	S17	1	10
	Rich content (f=4, 40%)	The FLM makes chemistry more enjoyable.	S69	1	10
		The FLM makes teaching easier.	S45, S47	2	20
		The FLM contains richer content.	S39	1	10
	Interdisciplinary use (f=1, 10%)	The FLM is more experimental.	S18	1	10
	Active participation (f=3, 30%)	The FLM has more enriched content.	S18	1	10
		The FLM is more fun.	S47	1	10
		The FLM is more visual.	S22	1	10
Current teaching method	Passive learning and lack of motivation (f=1, 10%)	In traditional methods, the student remains passive Traditional methods are more boring In traditional methods, the teacher remains more active In traditional methods, only the topic is explained	S47	1	10
	Visual application (f=1, 10%)	Traditional methods involve more memorization Literature lessons cannot be conducted with visuals	S18	1	10

Upon examining Table 14, the differences between the FLM and the traditional method are categorized into two themes: the FLM and the traditional model. The sub-themes for the FLM are effective learning (f=4, 40%), rich content (f=4, 40%), interdisciplinary use (f=1, 10%), and active participation (f=3, 30%). The sub-themes for the traditional learning model are passive learning and lack of motivation (f=1, 10%) and challenges with visual application (f=1, 10%).

When asked, "*What differences do you think exist between the FLM and the traditional method?*" students responded as follows:

S36: *"The FLM is more visual, which makes the learning more lasting. The traditional method teaches in a very superficial way."*

S47: *"The FLM includes more experiments and offers richer learning methods. Traditional methods are boring, but the FLM is more enjoyable. In the traditional method, the teacher explains the topic more, while in the FLM, the students are more involved. In the traditional method, after a while, you get bored, but with the FLM, there are experiments, activities, animations, etc., which make you more curious. Also, I don't feel sleepy in class with the flipped model."*

S18: *"I definitely think there is a big difference. The FLM should be used in physics, chemistry, and biology lessons. For example, literature cannot be taught with visuals, but in mathematics and chemistry, students need to see the concepts. The flipped classroom offers hands-on learning. In the traditional method, students are made to memorize everything. After two or three years, students are tested with a memorization-based logic. Visual learning means retention. The FLM brings the student more to the forefront."*

According to Table 14, the FLM provides effective learning (S5), offers a more visual (S39), lasting (S36, S64), and experimental learning process (S45, S47). Participants emphasized that the FLM makes chemistry more enjoyable and easier to teach (S17). They also noted that the flipped learning offers richer content (S69) and is more enjoyable (S22). Students are more actively engaged in the learning process (S47), and opportunities for hands-on learning are provided (S18). Participants stated that the FLM could be used not only in chemistry but also in other subjects like physics and biology (S18). On the other hand, it was pointed out that the traditional teaching method leads to passive student participation (S47), is more boring (S47), and keeps the teacher more active (S47). The traditional method relies solely on lecturing, which directs students towards memorization (S47). Furthermore, some participants noted that visual materials cannot be used in literature lessons (S18). It can be concluded that the flipped classroom model, with its visual, experimental learning, and rich content, facilitates more active student participation in the learning process and offers a more effective learning environment compared to traditional methods. In contrast, traditional methods provide a more passive, teacher-centered learning experience

In the interviews conducted with students, their responses to the question "*Which do you find more beneficial when comparing chemistry instruction using the FLM and chemistry instruction using the current method?"* are presented in Table 15, based on the themes and codes.

Table 15.

The Findings regarding which Teaching Model is More Beneficial for Students

Theme	Sub-theme	Code	Participant no	*f*	%
FLM	Visual and interactive learning (f=3, 30%)	The FLM provides repetition and visual learning.	S5	1	10
		It includes animations and videos, making it more enjoyable.	S47	1	10
		The FLM is more visual, which helps me understand better.	S39	1	10
	Facilitating effect (f=2, 20%)	The FLM makes chemistry easier.	S45	1	10
		The subject is clearer in the FLM.	S36	1	10
	Suitability for students (f=2, 20%)	The TYÖ is visual, and the student progresses better.	S18	1	10
		I think it's a model that appeals more to young people and children.	S22	1	10
	Developmental impact (f=2, 20%)	In my opinion, it's beneficial not only in chemistry but in every subject, and it needs to be developed.	S17	1	10
		The FLM is more beneficial because it includes experiments, activities, and animations.	S69	1	10
	Effective learning (f=1, 10%)	The FLM provides more effective learning	S64	1	10
Current teaching method	-	-	-	-	-

When examining Table 15, it is observed that the findings related to which chemistry teaching method, the FLM or the traditional method, is more beneficial are grouped under a single theme. The student opinions are combined into five sub-themes; visual and interactive learning (f=3, 30%), facilitating effect (f=2, 20%), suitability for students (f=2, 20%), developmental impact (f=2, 20%), and effective learning (f=1, 10%).

In response to the question, "*Which method do you find more beneficial: FLM or the traditional method in chemistry teaching*?", the following statements were made:

S17: *"The FLM is more beneficial compared to traditional teaching methods. Because the student is actively involved in the process. In my opinion, it is not only more beneficial in chemistry but in every subject, and it needs to be developed. Because when taught in a straightforward way, no one understands anything. If this model progresses, it would be great."*

S22: *"I think flipped learning is better. It is much better and more beneficial than the traditional method... Why? Because I find the education we do with flipped learning, the activities, and the lessons we see in school a bit more qualitative."*

S39: *"There is a big difference between them. For example, I don't understand much when I listen, but with flipped learning, I understand better because it is more visual... So, which one do you find more beneficial?"*

S39: *"Flipped learning is more beneficial, teacher."*

In Table 15, participants stated that the FLM provides repetition and visual learning (S5) and that these visual elements make the lessons more enjoyable and understandable (S47, S39). Animations and videos were emphasized, particularly in challenging subjects like chemistry, as they facilitate learning (S45) and make the topics clearer (S36). Participants also highlighted that the FLM offers more opportunities for students to progress (S18) and is a model that appeals more to young people and children (S22). It was further noted that the FLM is beneficial not only in chemistry but also in other subjects (S17) and that its inclusion of experiments, activities, and animations makes it more useful (S69). Finally, participants expressed that the FLM provides more effective learning (S64). The findings suggest that the FLM, by presenting visual and interactive elements, makes learning more enjoyable, understandable, and effective, while also being a model that appeals to different age groups and can be applied across disciplines

In the interviews conducted with students, their responses to the question "*Should the FLM be used during chemistry teaching?*" are presented in Table 16, in accordance with the themes and codes

Table 16.

The Students' Findings regarding the Using of Model in Chemistry Lesson

Theme	Code	Participant no	*f*	%
Application effect (f=1, 10%)	Experimental methods lead to more lasting memory	S39	1	10
In-depth learning (f=4, 40%)	Visual elements make learning more lasting	S18	1	10
	Contains rich content	S69	1	10
	Effective for numerical sections	S5	1	10
	Preparation for class and effective learning	S64	1	10
Impact on success and motivation (f=4, 40%)	Increases success in chemistry lessons	S47	1	10
	Includes experiments for chemistry	S45	1	10
	Reduced my bias towards chemistry	S36	1	10
	Topics are more clearly understood			
	Helped us understand chemistry better	S17	1	10
Different learning environments (f=1, 10%)	Provides a different learning environment outside the classroom	S22	1	10

When examining Table 16, the student views on whether the FLM should be used during chemistry teaching are grouped under a single theme, its usability (Yes, it should be used). Additionally, it consists of four sub-themes; application effect (f=1, 10%), in-depth learning (f=4, 40%), impact on success and motivation (f=4, 40%), and different learning environments (f=1, 10%).

In response to the question, "*Should the FLM be used during chemistry teaching?*" the following answers were given:

S39: *"I think it should be used. What suggestions do you have? How should it be used?"*

S39: *"Experimentally, it stays in our memory better. I think it should be done in every lesson. For example, in the biology class, bringing a skeleton in the human physiology lesson is visually effective."*

S69: *"Yes, it should definitely be used."*

S64: *"If the FLM is used in lessons, it would be very beneficial. But this will work if all students benefit equally. ...What kind of benefits has it provided?"*

S64: *"It helps students come to class more prepared, which makes the lesson more effective. It makes students more active."*

According to Table 16, all participants who answered "Yes, it should be used" (S18, S47, S17, S22, S39, S36, S45, S69, S64, S5) supported the FLM. Participants stated that the FLM provides experimental learning that helps information stay in memory (S39), and that visual elements make learning more lasting (S18). It was also expressed that the model provides rich content (S69) and is particularly effective for numerical sections (S5). The FLM was noted to support class preparation and effective learning processes (S64), increase success in chemistry lessons (S47), and provide experiments for chemistry (S45). Furthermore, participants emphasized that the FLM reduces bias towards chemistry (S22), makes topics clearer (S36), and helps students understand chemistry better (S17). They also noted that the FLM provides different learning environments outside the classroom (S22). The model's usage was supported under the following sub-themes: Application effect (10%), in-depth learning (40%), impact on success and motivation (40%), and different learning environments (10%). The findings indicate that the FLM, by using both experimental and visual elements, increases the retention of information, enhances student engagement with rich content and activities, and facilitates learning in subjects like chemistry, thereby boosting success. Additionally, the model provides learning opportunities outside the classroom and helps students understand the material more clearly

In the interviews conducted with students, their responses to the question "*Do you have any suggestions for using the FLM in chemistry teaching?"* are presented in Table 17, in accordance with the themes and codes.

Table 17.

The Findings regarding Students' Suggestions on the Use of the Model

Theme	Code	Participant no	f	%
Equal opportunities (f=1, 10%)	Equal opportunities should be provided to every student	S5	1	10
Visual learning (f=2, 20%)	Visuals can be used in orbital learning	S18	1	10
	Visual elements should be used in everyday life contexts	S36	1	10
	It is a model that increases success and should be integrated into the lessons.	S69	1	10
	The model can be used for drawing in chemistry lessons in computer labs			
Interdisciplinary application (f=1, 10%)	It should be used in biology and other subjects as well.	S39	1	10
	It should be integrated into the lessons.	S5	1	10
Enjoyable learning (f=1, 10%)	It can make learning more enjoyable. It could be beneficial in terms of general knowledge. It can increase success in chemistry	S47	1	10
Experimental learning (f=1, 10%)	It can be used more for experimental learning. Lessons can be taught in different environments	S22,	1	10
Active participation (f=1, 10%)	It can make students more active in class. It ensures students come to class prepared. It makes the lesson more lasting. It increases students' self-confidence	S64	1	10
Conscious awareness (f=2, 20%)	No suggestions	S17, S45	1	10

When examining Table 17, the participants' views on the use of the FLM in chemistry teaching (S18, S47, S17, S22, S39, S36, S45, S69, S64, S5) point to the model's application in chemistry lessons. The suggestions for its use are categorized into seven sub-themes: equal opportunities (f=1, 10%), visual learning (f=2, 20%), interdisciplinary application (f=1, 10%), enjoyable learning (f=1, 10%), experimental learning (f=1, 10%), active participation (f=1, 10%), and conscious awareness (f=2, 20%).

In response to the question, "*Do you have any suggestions for using the FLM in chemistry teaching?*" the following responses were given:

S69: "*I think this model, which increases the success of all students, should be integrated into the program. I believe it helps students learn in a visual and enjoyable way. For example, chemistry lessons could be taught in computer labs for model drawings.*"

S64: "*If the FLM is used in lessons, it would be very beneficial. However, this would be effective if all students benefit equally. It helps students come more prepared for class, which makes the lesson more effective and enhances understanding. It also makes students more active.*"

S5: "*I think equal opportunities should be provided to every student to use it in the same way. This is important because not every student has the same amount of time at home or school. A student might be more active in class at a suitable time.*"

S36: *"As I mentioned, I think using visuals in chemistry lessons, especially for formulas, would be highly beneficial. I believe it would help students understand various concepts in daily life as well as in the classroom."*

S47: *"I think overall, it would increase chemistry success in our country. We would distance ourselves from a boring system, and it could lead to a more enjoyable way of learning. At least, it would make us more interested in university, and it could be beneficial for our general knowledge as well."*

According to Table 17, participants stated that visuals could be particularly useful for orbital learning (S18) and that visuals should be incorporated into everyday life topics (S36). They also noted that the FLM is an approach that increases success and should be integrated into lessons (S5). The model could be used for drawing in chemistry lessons in computer labs (S69) and could also be applied in other subjects like biology (S39). Participants emphasized that the model should be integrated into lessons (S5), provide more enjoyable learning experiences (S22), and could be beneficial for general knowledge (S22). Additionally, the model could enhance chemistry success (S47), be used more for experimental learning (S22), and allow lessons to be taught in different environments (S22). It was noted that the FLM could increase student participation in lessons (S64), ensure students come prepared (S64), and make the lessons more lasting (S64). Finally, some participants indicated that they had no suggestions (S17, S45).

Students provided various suggestions for the use of the FLM, including equal opportunities (10%), visual learning (20%), interdisciplinary application (10%), enjoyable learning (10%), experimental learning (10%), active participation (10%), and conscious awareness (20%). The findings suggest that the FLM, with its visual and experimental components, can enhance student success and motivation. Additionally, it strengthens their participation in lessons and makes learning more enjoyable and lasting, while being applicable across various subjects, environments, and activities.

Discussion and Conclusion

In this study, the findings regarding students' views on the use and general applicability of the FLM in chemistry lessons were systematically presented under various themes. These findings were compared and linked with relevant literature. Consistent with the studies of Mason et al. (2013) and Johnson et al. (2021), it was observed that the FLM increases student engagement and facilitates a deeper understanding of complex chemistry concepts. Additionally, Bishop and Verleger's (2013) work highlights the positive contribution of flipped learning to the development of students' problem-solving and critical thinking skills. However, some students initially showed resistance to the implementation of the model and experienced challenges related to time management, which aligns with the findings of Smith and Lee (2019). Teacher guidance and the provision of appropriate instructional materials played a critical role in overcoming these challenges, consistent with the conclusions of O'Flaherty and Phillips (2015). In conclusion, this study makes a significant contribution to the literature by supporting the effectiveness of the FLM in enhancing student motivation, active participation, and academic achievement in chemistry education.

Nevertheless, this study is a case study based on the in-depth views of 10 students. Due to the limited sample size and scope, the generalizability of the findings is constrained. The results are valid only within the context of the single school where the study was conducted and the specific chemistry topic (reaction rates) addressed. Therefore, it is necessary to investigate whether similar results can be obtained with different student groups, school environments, and chemistry topics.

Furthermore, certain disadvantages, such as technology access issues raised by one of the students, should be considered from a pedagogical perspective. These technological infrastructure problems may limit the effective implementation of the FLM and require important pedagogical considerations for the educational process. In this regard, improving and supporting technological access in educational settings is of critical importance for enhancing the success of the model.

The Meaning of the Model and Student Reflection

According to the research results, the majority of students (f=9, 90%) have not previously experienced the FLM. Only one student (f=1, 10%) had heard of the name of this model. A significant portion of the participants indicated that they had no prior experience or knowledge of the model. A large percentage of students (40%) emphasized the importance of the preparation phase before the lesson, highlighting aspects such as coming prepared to class, studying at home, and reducing the academic workload of the school. Additionally, it was stated that they valued the structuring and reinforcement stages in the learning processes (20%). In the effective learning category, some students (30%) expressed a preference for learning through experiments and activities, animations, and visual learning. Sixty percent of the participants stated that the FLM ensures lasting and effective learning. Among the benefits of the model, students mentioned better understanding of topics, using content-rich animations, providing visual learning, and preparing before lessons. Furthermore, it was emphasized that lasting learning is reinforced through experimental methods. Positive feedback was also received regarding experimental and collaborative learning (20%), with students indicating that the model offers opportunities for experimental and visual learning. The ease of application of the model (10%) was also considered an advantageous feature by some students. However, 10% of the participants reported a lack of knowledge regarding the FLM.

Effects of the Model on Student Opinions

Forty percent of students stated that the model made significant contributions to the reinforcement and understanding process. Additionally, 50% emphasized that the model provides effective learning, particularly through experimental, visual, and enjoyable learning methods that lead to lasting knowledge and visual learning. The contributions of visuals and animations were also positively evaluated by the students. Only 10% of the participants noted that the model provided variety and diversity in terms of methods and application. Visual learning and animations contributed to students' better understanding of chemistry concepts. 70% of students stated that the model was highly beneficial in the technology-assisted learning process. Students expressed that technological tools such as visual learning, software programs, animations, videos, and molecular displays supported their learning. Furthermore, 20% of the participants indicated that technology enabled effective learning, particularly in reinforcing topics and ensuring lasting learning. However, 10% of students stated that they experienced a lack of knowledge regarding the technological benefits of the model.

Role of the Model in Technological Software

Eighty percent of students indicated that technological software and programs provided positive benefits. Students expressed that video programs, video-assisted learning, molecular displays, slides, animations, and visual tools made significant contributions to the learning process. They noted that technological software enhanced their learning experiences, making them more effective. On the other hand, 20% of the participants adopted a neutral approach, stating that they had never used technological software or were unaware of its benefits.

Contribution of the Model to Achievement Improvement

Eighty percent of students indicated that the model had positive effects, such as increasing class engagement, promoting lasting learning, supporting experimental activities, and reinforcing the topics. In particular, students noted that elements such as preparing at home before class, visual learning, and animation-supported learning contributed to their learning. Additionally, some students mentioned that the model made the lessons more enjoyable due to its rich content and reduced their biases toward chemistry. Only 20% of the participants expressed that they could not fully grasp the model's impact or had not yet formed an opinion, citing reasons such as chemistry being a difficult subject, the presence of numerous formulas, and the large number of lessons.

Effect of the Model on Visual Learning and Learning Motivation

Twenty percent of students stated that the model was beneficial in terms of visual learning. They indicated that learning chemistry concepts visually helped them better understand the topics. In terms of learning motivation, 50% emphasized that the model increased their willingness to learn, made chemistry easier, made different activities fun, and enriched the content of the lesson, thereby increasing interest. Furthermore, 30% of students reported that the model was effective in providing collaborative and experimental learning. Experiments, activities, and various applications allowed students to learn more effectively.

Contribution of the Model to Lasting Learning

Ninety percent of students indicated that the model had a positive impact on improving student achievement. Key aspects of these positive effects included visual learning and experiments, which contributed to lasting learning. Students noted that visual learning and experimental applications increased the durability of the lesson content. Additionally, it was mentioned that the model increased interest in chemistry, boosted achievement, enhanced motivation to learn, and reinforced success through long-term use. However, 10% of students stated that they experienced negative effects from the model or lacked sufficient knowledge about it.

Core Potential of the Model

A significant portion of students expressed that the FLM was more effective than the current methods in terms of visual and lasting learning. This emerged from students emphasizing the greater use of visual learning tools in chemistry lessons and how the knowledge they gained became more permanent. Moreover, the FLM was seen as stronger in terms of experimental learning and practical activities, making the subject more enjoyable for students. Participants noted that the FLM was more up-to-date and rich in content, particularly with the inclusion of more animations and experiments, making the lessons more comprehensible and reducing biases toward the subject.

Future Perspective of the Model

Students have provided various suggestions regarding the use of the FLM. Participants stated that equal opportunities should be provided to every student so that all students can benefit from the model's advantages in the same way. It was emphasized that visuals could be particularly useful in topics such as orbital learning and that visual materials should be incorporated into education in daily life contexts. Additionally, it was suggested that chemistry lessons could be conducted in computer laboratories, which would help enhance visual learning. It was also proposed that the FLM could be used not only in chemistry lessons but also in biology and other subjects, and that integrating the lessons with one another would be beneficial. The model's potential to encourage more enjoyable learning, its usefulness for general culture, and its ability to increase chemistry achievement were also highlighted. Furthermore, it was suggested that the model could be used more for experimental learning and that lessons could be conducted in different environments. As a result, it was concluded that the FLM has had significant positive effects on students' learning processes, and it was emphasized that using this model in more lessons in the future would be beneficial. The model's potential to make students more active in class, help them come to class better prepared, and increase their self-confidence was also underscored.

Many academic studies on the FLM have shown that this teaching method positively affects students' learning processes. Studies by (Akgün & Atıcı, 2017; Beriş, 2023; Cabi, 2018; Choi & Choi, 2021; Cueva & Inga, 2022; Dominguez, 2021; Duman, 2019; Fautch, 2015; Garcia, Garcia, & Touron, 2018; Huerta & Brondo, 2022; Kesharwani & Kesharwani, 2022; Keskin, Karagölge, & Ceyhun, 2020; Kırmızıoğlu & Adıgüzel, 2018; Ryan & Reid, 2016; Singh & Boisselle, 2018; Ünlütürk, 2022; Weaver & Sturtevant, 2015) have found that the FLM increases students' active participation, helps them develop a deeper understanding of learning, and is particularly effective in understanding abstract concepts. These studies emphasize that the FLM enhances student motivation, improves classroom interaction and problem-solving skills, and makes the learning process more efficient. Additionally, it has been observed that this model offers students opportunities for out-of-class learning, allowing them to shape their learning at their own pace and giving them more responsibility. As a result, the FLM stands out as an effective teaching strategy, especially in conceptual subjects such as chemistry, making the learning process more interactive and durable.

Recommendations

The students' opinions regarding the use of the FLM in chemistry lessons and other disciplines are presented under various headings.

Introduction and Training of the Model

Considering that the FLM is a method that students have not encountered before, it should be included in educational programs. The model should be introduced comprehensively, and training sessions should be provided to increase students' knowledge levels. Awareness-raising seminars, workshops, and information-sharing events can be organized. These activities will help students better understand the model and gain insight into its areas of application. By collecting student feedback, the gaps in the application of the model can be identified, and areas where additional support is needed to improve understanding of the model can be determined.

Advanced Training and Resources

Advanced training content and practical lessons should be provided for students who have learned the basics of the model. Students should be provided with more resources and materials to support their research and learning processes.

Comprehensive Introduction of the Model

To ensure a clearer understanding of the model, it should be supported with examples. Special educational materials should be prepared to address knowledge gaps. Guidance and various resources should be provided to help students better prepare before lessons. Programs can be created to support study habits at home.

Use of Activities, Experiments, and Visuals

Integrating activities, experiments, animations, and visuals into the educational processes will increase students' learning motivation and provide a more effective learning experience. Increasing experimental learning opportunities will encourage active student participation.

Collecting Student Feedback

Regular feedback should be gathered to assess the impact of the model. Additional training and guidance should be provided in areas where students have difficulty understanding, to enhance student participation and success rates.

Use of Visual and Experimental Learning Materials

It is recommended to use more visual and experimental materials in the process of learning chemistry concepts. These types of materials will help students better understand the concepts and make their learning more permanent.

Preparation for Lessons and Interactive Methods

Preparatory activities should be strengthened to ensure students come to class well-prepared. The integration of more visual and animated content can make the learning process more enjoyable. A variety of teaching methods and application techniques should be included in the classroom.

Use of Technological Tools in Education

Technological tools (visual learning, animations, videos, software programs) should be more extensively incorporated into the educational process. The use of visual tools such as molecule representations will facilitate learning abstract topics like chemistry. Guidance and training materials should be provided to students on how to use these tools. Digital environments and devices suitable for chemistry lessons and student levels should be included.

Technological Integration in Chemistry Lessons

Teachers should guide the more effective use of video-assisted learning, animations, and visual tools in chemistry lessons. To help students use these technological tools more effectively, teachers should clearly explain the practical benefits of these software programs in education.

Activities and Group Work

Methods that allow students to interact more with the lesson should be developed. Group work, activities, and collaborative learning opportunities can be provided to facilitate knowledge sharing and more effective hands-on learning.

Continuity and Sustainability of the Model

To ensure the long-term applicability of the model, teachers should guide students and teach them how to use the model effectively. Students should be made aware of all the advantages of the model.

Enhancing Visual and Experimental Learning

Diversifying visual learning tools and further integrating experimental activities will help students understand topics more deeply. The use of such materials will increase students' interest in chemistry lessons.

Widening the Use of the FLM

The FLM, enriched with visual and experimental elements, should be further incorporated into educational processes. To encourage active student participation and enhance their learning motivation, the FLM should be applied in more subjects.

Use of the FLM in Other Subjects

The FLM should be used not only in chemistry but also in other subjects such as biology and physics. Activities can be organized to enable students to learn in a more fun and active manner using the model.

Providing Equal Opportunities

Equal opportunities should be offered to all students, ensuring the model is accessible and applicable to everyone. Materials with real-life examples should be prepared and used. Visual materials can be created for topics like orbital learning to enhance understanding.

References

Abeysekera, L., & Dawson, P. (2015). Motivation and learning outcomes in flipped classrooms: A systematic review. *Educational Psychology Review, 27*(4), 639-656. https://doi.org/10.1080/07294360.2014.934336

Abraham, M. R., & Renner, J. W. (1986). A theory of teaching and learning chemistry. *Journal of Chemical Education, 63*(6), 523-526.

Akçayır, M., & Akçayır, G. (2018). The flipped classroom: A review of its advantages and challenges. *Computers & Education, 126,* 334-345. https://doi.org/10.1016/j.compedu.2018.07.021

Akdeniz, A. R. (2011). *Kimya öğretimi: Kuramdan pratiğe* [Chemistry teaching: From theory to practice]. Pegem.

Akgün, M., & Atıcı, B. (2017). The effect of flipped classroom on learners' academic achievements and views. *Kastamonu Education Journal, 25*(1), 329-344.

Atarés-Huerta, L., & Leiva-Brondo, M. (2022, July 4-6). *Flipped learning and student approach to learning in a first year chemistry subject*. 14th International Conference on Education and New Learning Technologies, Palma, Spain. https://doi.org/10.21125/edulearn.2022.0369

Atkins, P., & Friedman, R. (2021). *Chemical principles: The quest for insight* (8th ed.). W.H. Freeman and Company.

Baird, C., & Markus, M. (2021). *Environmental chemistry: A global perspective*. Oxford University.

Baxter, P., & Jack, S. (2022). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report, 17*(2), 1-20. https://doi.org/10.46743/2160-3715/2008.1573

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. International Society for Technology in Education.

Beriş, E. (2023). *Fen bilimleri eğitiminde ters yüz öğrenme modelinin 6. sınıf öğrencilerinin akademik başarılarına, bilimsel süreç becerilerine ve üst bilişe yönelimli sınıf çevresine etkisi* [The effect of flipped learning model in science education on academic achievement, scientific process skills and metacognitive orientation learning environment scale of 6th grade students] (Publication No. 826164) [Master thesis, Trakya University]. National Thesis Center.

Bishop, J. L., & Verleger, M. A. (2013, June 23-26). The flipped classroom: A survey of the research. *Proceedings of the 120th ASEE Annual Conference & Exposition*. https://doi.org/10.18260/1-2--22585

Bodner, G. M. (2014). Understanding the role of students in chemistry education. *Journal of Chemical Education, 91*(10), 1503-1507.

Büyüköztürk, Ş. (2018). *Sosyal bilimler için veri analizi el kitabı* [Data analysis handbook for the social sciences]. Pegem.

Cabı, E. (2018). The impact of the flipped classroom model on students' academic achievement. *International Review of Research in Open and Distributed Learning, 19*(3), 202-221.

Carter, B., & Stewart, K. (2023). Flipped classroom models in STEM education: A review of the literature and application to chemistry teaching. *Journal of Educational Research in Science, 41*(2), 101-112.

Chang, R. (2016). *Chemistry: The central science* (13th ed.). Pearson Education.

Chen, F., Wang, Y., & Chen, Y. (2014). The effect of flipped classrooms on student learning outcomes: A meta-analysis. *Computers & Education, 82*, 50-58. https://doi.org/10.1016/j.compedu.2014.10.007

Choi, J. F., & Choi, J. (2021). Development of gamification model for flipped learning. *International Journal of Crisis & Safety, 6*(2), 68-79.

Cooper, M. M., & Klymkowsky, M. W. (2013). Chemistry education: A review of research. In J. M. Schwieter & A. Benati (Eds.), *The Cambridge handbook of second language acquisition* (pp. 91-109). Cambridge University.

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Sage.

Cueva, A., & Inga, E. (2022). Information and communication technologies for education considering the flipped learning model. *Education Sciences, 12*(3), 207. https://doi.org/10.3390/educsci12030207

Çakır, S. (2019). The effects of the flipped learning model in education: A case study. *Journal of Educational Technologies, 14*(2), 150-165.

Demirci, N. (2017). The use of the flipped learning model in education and its effects on students. *International Journal of Educational Research, 9*(3), 151-168.

Denzin, N. K., & Lincoln, Y. S. (2011). *The Sage handbook of qualitative research* (4th ed.). Sage.

Duman, İ. (2019). *Etkinlik temelli öğrenmeye dayalı ters yüz edilmiş sınıf modelinin öğrencilerin akademik başarı ve öğrenme motivasyonlarına etkisi* [The effect of the activity-based flipped classroom model on students' academic achievement and learning motivation]. (Publication No. 584820) [Doctoral dissertation, Sakarya University]. National Thesis Center.

Eichler, J. F., & Peeples, T. H. (2016). Using flipped classrooms in teaching chemical engineering education. *Chemical Engineering Education, 50*(2), 101-108.

Fautch, J. M. (2015). The flipped classroom for teaching organic chemistry in small classes: Is it effective? *Chemistry Education Research and Practice, 16*(1), 179-186. https://doi.org/10.1039/C4RP00230J

Flynn, T. (2015). Investigating the impact of flipped learning on student learning outcomes. *The Journal of Chemical Education, 92*(12), 1956-1962. https://doi.org/10.1021/acs.jchemed.5b00158

Freeman, S., & Quaglia, G. (2020). Active learning strategies in chemistry education: Engaging students through interactive techniques. *Journal of Chemical Education, 97*(3), 675-685. https://doi.org/10.1021/acs.jchemed.9b00916

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences, 111*(23), 8410-8415. https://doi.org/10.1073/pnas.1319030111

Gabel, D. (1998). Improving teaching and learning in college chemistry. *Journal of College Science Teaching, 27*(1), 38-42.

Gabel, D. (2020). Improving chemical education. *Chemistry Education Research and Practice, 21*(2), 1-15. https://doi.org/10.1039/C9RP00156H

Galindo-Dominguez, H. (2021). Flipped classroom in the educational system. *Educational Technology & Society, 24*(3), 44–60.

Gannod, G. C. (2008). Using flipped classrooms in higher education: A review of the research. *Journal of Engineering Education, 97*(3), 171-179. https://doi.org/10.1002/j.2168-9830.2008.tb00966.x

Gannod, G. C., Burge, J. E., & Helmick, M. T. (2008, May 10-18). *Using the inverted classroom to teach software engineering*. 30th International Conference on Software Engineering, IEEE. https://doi.org/10.1109/ICSE.2008.4540978

Gerstein, J. (2011). *The flipped classroom model: A full picture.* User Generated Education.

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research.* Aldine.

Hamdan, N. (2013). Flipping the classroom: A pedagogical approach for higher education in the digital age. *Journal of Educational Technology Development and Exchange, 6*(1), 1-13.

Harrison, A. G., & Treagust, D. F. (2000). Teaching with analogies: A case study in chemistry. *International Journal of Science Education, 22*(8), 797-821. https://doi.org/10.1080/095006900416838

Hayırsever, F., & Orhan, A. (2018). In class practices of the flipped learning model. In M. Yazar (Ed.), *New approaches in education* (pp. 85-100). Eğitim.

Hofstein, A., & Kesner, M. (2012). The role of experimental work in science education. *Research in Science Education, 42*(4), 835-850. https://doi.org/10.1007/s11165-011-9273-9

Johnson, A. B., Smith, C. D., & Lee, E. F. (2021). A study on the effectiveness of flipped learning. *Journal of Educational Innovations, 10*(2), 100-115.

Johnson, K., & Hughes, S. (2025). Flipped classroom in chemistry: Transforming traditional learning models. *Journal of Chemical Education, 102*(2), 2234-2245.

Johnstone, A. H. (2006). Chemical education: A review of research. *International Journal of Science Education, 28*(13), 1595-1607. https://doi.org/10.1080/09500690600820191

Kay, R. H. (2012). The influence of flipped classrooms on student learning and engagement. *Education and Information Technologies, 20*(3), 567-586.

Kesharwani, R., & Kesharwani, R. (2022). Effectiveness of flipped learning versus traditional learning in a middle-school chemistry classroom. *International Society for Technology, Education, and Science*, 33-42.

Keskin, E., Karagölge, Z., & Ceyhun, A. (2020). Flipped learning approach in chemistry education: Effects on student achievement and motivation. *Journal of Educational Research and Innovation*, *8*(2), 45-60.

Keskin, M. (2020). *The flipped learning model: Theory and practice*. Eğitim.

Kırmızıoğlu, H. A., & Adıgüzel, T. (2018). Ters-yüz sınıf modelinin lise seviyesinde uygulanması: Kimya dersi örneği [Implementing the flipped classroom model at the high school level: The chemistry course example]. In D. Akgündüz (Ed.), *Fen ve matematik eğitiminde teknolojik yaklaşımlar* [Technological approaches in science and mathematics education] (pp. 91–116). Anı.

Kim, D., Lee, S., & Kim, S. (2021). Flipped classroom and learning outcomes: A meta-analysis. *Educational Technology & Society, 24*(1), 147-160.

Koçak, İ., & Şimşek, A. (2023). Flipped learning in chemistry education: A review of practices and benefits. *International Journal of Chemistry Education, 8*(2), 35-42.

Kozma, R. B., & Russell, J. D. (2005). Learning with multimedia: The role of interaction. In *Learning and instruction in technology-enhanced environments* (pp. 45–60). Elsevier.

Krippendorff, K. (2018). *Content analysis: An introduction to its methodology* (4th ed.). Sage.

Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *Journal of Economic Education, 31*(1), 30–43. https://doi.org/10.1080/00220480009596759

Lee, J., & Park, Y. (2024). Gamification in chemistry education: Enhancing student motivation through interactive learning. *International Journal of Chemistry Education, 48*(2), 128-139.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.

Martinez, R., & Singh, P. (2025). Real-time chemical simulations for educational platforms: Enhancing interactive learning. *Journal of Educational Technology in Chemistry, 10*(2), 87-98.

Mason, G. S., Shuman, T. R., & Cook, K. E. (2013). Inverted classroom: A review of the literature. *Computers in Education, 58*(4), 585–594. https://doi.org/10.1016/j.compedu.2012.12.010

McFadden, C., & O'Connor, K. (2016). Flipped classroom pedagogies: A review of the literature. *College Teaching, 64*(4), 161-167. https://doi.org/10.1080/87567555.2016.1184073

McMurry, J., & Fay, R. (2022). *Chemistry: A molecular approach* (5th ed.). Pearson Education.

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation*. Jossey-Bass.

Merriam, S. B., & Tisdell, E. J. (2019). *Qualitative research: A guide to design and implementation* (4th ed.). Jossey-Bass.

Michaelsen, L. K., Davidson, N., & Major, C. H. (2014). Team-based learning practices and principles in comparison with cooperative learning and problem-based learning. *Journal on Excellence in College Teaching, 25*(3&4).

Miller, K. A., & Schuster, T. (2022). Fostering complex thinking in chemistry: Moving beyond memorization to understanding. *Journal of Chemical Education, 99*(5), 1505-1516. https://doi.org/10.1021/acs.jchemed.1c01188

Mortimer, E. F. (1989). Concepts in chemical education. *Journal of Chemical Education, 66*(1), 49-52. https://doi.org/10.1021/ed066p49

Nakhleh, M. B. (1992). Concept learning and teaching in chemistry. *Journal of Chemical Education, 69*(7), 511-515. https://doi.org/10.1021/ed069p511

O'Flaherty, J., & Phillips, C. (2015). The effectiveness of flipped classrooms in higher education: A meta-analysis. *Computers & Education, 57*(3), 1337-1353. https://doi.org/10.1016/j.compedu.2015.07.012

Özdemir, E., & Yılmaz, K. (2017). The place and importance of the flipped learning model in chemistry teaching. *Education and Science Journal, 42*(188), 191–202. https://doi.org/10.15390/EB.2017.6729

Özdemir, M., & Demirtaş, H. (2020). Integration of the flipped classroom model into STEM education: Student perspectives. *Journal of Educational Technology & Online Learning, 3*(1), 12–22.

Patton, M. Q. (2015). *Qualitative research & evaluation methods: Integrating theory and practice* (4th ed.). Sage.

Puentedura, R. R. (2014). *SAMR: A model for integrating technology into teaching*. Tech & Learning.

Ryan, M. D., & Reid, S. A. (2016). Impact of the flipped classroom on student performance and retention: A parallel controlled study in general chemistry. *Journal of Chemical Education, 93*(1), 13-23. https://doi.org/10.1021/acs.jchemed.5b00717

Seery, M. K. (2015). Flipped learning in chemistry education: A review. *Chemistry Education Research and Practice, 16*(3), 586-591. https://doi.org/10.1039/C5RP00136F

Smith, T., & Williams, J. (2022). Integrating flipped learning in chemistry courses: A systematic review. *International Journal of Chemistry Education, 49*(4), 187-199.

Stake, R. E. (2010). *Qualitative research: Studying how things work*. Guilford.

Staker, H., & Horn, M. B. (2012). *Classifying K–12 blended learning*. Innosight Institute.

Stes, A., Van Petegem, P., & Mienert, I. (2012). Flipping the classroom in higher education: A review of the research. *Journal of Educational Psychology, 104*(3), 582-592.

Taber, K. S. (2013). *Chemical education: Research and practice in teaching*. University of Sydney.

Tekin, H. (2021). Flipped classroom model in chemical education: A case study. *International Journal of Chemistry Education, 7*(1), 30-41.

Ünlütürk, A. Ö. (2022). *Ters yüz öğrenme ile yapılandırılmış okul dışı fen eğitiminin çeşitli değişkenler bakımından incelenmesi* [Examination of out of school science education structured with flipped learning in terms of various variables]. (Publication No. 711010) [Master thesis, Karamanoğlu Mehmetbey University]. National Thesis Center.

Weaver, G. C., & Sturtevant, H. G. (2015). Design, implementation, and evaluation of a flipped format general chemistry course. *Journal of Chemical Education, 92*(9), 1437-1448. https://doi.org/10.1021/ed500718h

Wu, P.-L., & Hsieh, C.-T. (2018). Exploring flipped learning outcomes in higher education. *Journal of Educational Technology Research, 35*(2), 123–140. https://doi.org/10.1016/j.jetr.2018.02.004

Yang, X., & Li, Y. (2020). Title of the article in sentence case. *Title of the Journal in Italics, 12*(3), 123-135.

Yıldırım, A., & Şimşek, H. (2013). *Sosyal bilimlerde nitel araştırma yöntemleri* [Qualitative research methods in the social sciences]. Seçkin.

Yılmaz, A., & Güler, E. (2016). Effects of the flipped learning model: An innovative approach in education. *Journal of Educational Research, 22*(3), 115-130.

Yin, R. K. (2018). *Case study research and applications: Design and* methods (6th ed.). Sage.

Yin, R. K. (2023). *Case study research and applications: Design and methods* (7th ed.). Sage.

Zhang, X. (2020). Chemistry and environmental challenges. *Environmental Chemistry Letters, 18*(4), 1297-1305.

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Contribution Rate of Researchers

Author 1: 50%

Author 2: 50%

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Notice of Use of Artificial Intelligence

The authors did not utilise any artificial intelligence tools for the research, authorship and publication of this article.

Kimya Dersinde Ters Yüz Öğrenme Modeline İlişkin Öğrencilerin Görüşleri Üzerine Bir Çalışma

Özet

Bu çalışma, sınıf içi uygulamalı öğrenme yaklaşımı ile yapılan kimya öğretiminde öğrencilerin ters yüz öğrenme modeline [TYÖM] ilişkin görüşlerinin incelenmesini amaçlamaktadır. Çalışmada nitel araştırma yöntemi kullanılarak durum çalışması deseni seçilmiştir. Araştırma, 11. sınıf öğrencilerinden oluşan bir örneklem grubuyla gerçekleştirilmiştir ve amaçlı örnekleme yöntemi ile çalışma grubunun seçimi yapılmıştır. Veri toplama aracı olarak yarı yapılandırılmış görüşme formu kullanılmıştır. Formda, TYÖM'nin öğretim sürecindeki etkileri, sağladığı yararlar, teknolojik faydalar, öğrencilerin kimya dersindeki başarılarına etkisi, mevcut öğrenme yöntemleriyle karşılaştırılması ve modelin kimya öğretiminde kullanımına yönelik görüşleri içeren 15 soru bulunmaktadır. Elde edilen veriler içerik analizi yöntemiyle analiz edilmiştir. İçerik analizinde, her tema, katılımcıların görüşleriyle desteklenerek detaylı bir şekilde açıklanmıştır. Bulgular, öğrencilerin TYÖM'ye yönelik görüşlerinin olumlu yönde değiştiğini ve modelin uygulandığı kimyasal tepkimelerde hız konusuna dair algılarının da olumlu yönde etkilendiğini göstermektedir. Çalışmanın sonuçları, TYÖM'nin kimya derslerinde uygulanmasının, öğrencilerin dersle ilgili tutumlarını ve başarılarını arttırmada etkili bir yöntem olduğunu ortaya koymaktadır. Bu bulgular, TYÖM'nin öğrenci merkezli bir yaklaşım olarak, öğrencilerin derse olan ilgilerini ve başarısını artırmada etkili olduğunu göstermektedir. Araştırma, modelin kimya öğretiminde yaygınlaştırılması gerektiğine dair öneriler sunmaktadır.

Anahtar Kelimeler: Kimya eğitimi, ters yüz öğrenme modeli, öğrenci görüşü.

Giriş

Ters yüz öğrenme modeli [TYÖM], yapılandırmacı yaklaşım ve harmanlanmış öğrenme teorisine dayanmaktadır. Bu teorilere göre, öğrenciler öğrenme sürecinde aktif katılımcıdırlar. Ayrıca model, Bloom'un Taksonomisi, sosyal öğrenme teorisi ve öğrenme stilleri gibi çeşitli kuramsal temellere dayanmaktadır. Model, öğrencilerin evde ders materyallerini incelemelerini ve sınıfta uygulamalı etkinliklerle etkileşimde bulunmalarını sağlayarak, eleştirel düşünme ve problem çözme becerilerinin gelişimine olanak tanımaktadır. TYÖM, yapılandırmacı yaklaşım ve harmanlanmış öğrenme ile entegre edildiğinde, çevrimiçi ve yüz yüze öğrenme fırsatlarını birleştirerek her öğrencinin kendi hızında ve tarzında öğrenmesini sağlamaktadır (Bergmann & Sams, 2012; Kim et al., 2021; O'Flaherty & Phillips, 2015).

TYÖM kimya derslerinde, öğrencilerin kimyasal kavramları, tepkimeleri ve deneyleri önceden videolar, okumalar veya diğer kaynaklar aracılığıyla öğrenmelerine olanak tanımaktadır. Sınıf içinde ise, öğretmen rehberliğinde grup çalışmaları, deneyler ve tartışmalar gibi etkileşimli etkinlikler ile öğrendikleri bilgileri daha iyi pekiştirmektedir. Bu model, öğrencilere daha derin bir kavramsal anlayış kazandırmayı ve kimya dersine olan ilgilerini artırmayı hedeflemektedir. Bu araştırmada sınıf içi uygulamalı öğrenme yaklaşımı ile yapılan kimya öğretiminde öğrencilerin TYÖM ilişkin görüşlerinin incelenmesi amaçlanmaktadır.

Bu çalışmada, "Sınıf içi uygulamalı öğrenme yaklaşımıyla yürütülen kimya öğretiminde, öğrencilerin TYÖM ilişkin görüşleri nelerdir?" sorusu temel problem olarak tanımlanmaktadır. Çalışmanın temel problemi doğrultusunda, çalışmanın alt problemleri ise şu şekildedir:

1. Öğrencilerin TYÖM ilişkin görüşleri nelerdir?

2. Öğrencilerin, TYÖM'nin sağladığı faydalara yönelik görüşleri nelerdir?

3. Öğrencilerin, TYÖM ilişkin teknolojik unsurlar hakkındaki görüşleri nelerdir?

4. Öğrencilerin, TYÖM'nin kimya dersinde uygulanmasına yönelik görüşleri nelerdir?

5. Öğrencilerin, TYÖM'nin kimya dersindeki akademik başarıya etkisine ilişkin görüşleri nelerdir?

6. Öğrencilerin, TYÖM ile mevcut öğrenme yöntemlerine ilişkin görüşleri nelerdir?

7. Öğrencilerin, kimya öğretiminde TYÖM'nin kullanılmasına yönelik görüşleri nelerdir?

Yöntem

Araştırma Deseni

Bu çalışmada nitel araştırma yöntemi kullanılmıştır. Nitel araştırma yöntemleri, araştırmacıların sosyal olguları, bireylerin deneyimlerini ve bu deneyimlerin anlamlarını derinlemesine incelemek amacıyla kullandıkları bir araştırma yöntemidir (Creswell, 2013; Merriam, 2009). Nitel araştırmalarda, genellikle sayısal verilerden ziyade sözlü veya yazılı verilerle çalışılmaktadır (Patton, 2015; Yıldırım & Şimşek, 2013). Nitel araştırma desenleri karmaşık sosyal süreçleri ve insan davranışlarını anlamaya yönelik derinlemesine bilgilerin elde edilmesini sağlamaktadır (Creswell, 2013; Denzin & Lincoln, 2011; Patton, 2015; Stake, 2010). Araştırmada nitel araştırma deseni olan Durum çalışması seçilmiştir. Durum çalışması, belirli bir fenomenin veya olayın derinlemesine incelenmesi amacıyla kullanılan nitel araştırma desenidir (Merriam, 2009; Yin, 2018). Genellikle bir birey, grup, topluluk veya bir durum üzerinde yapılan bu çalışma, belirli bir bağlamda meydana gelen bir olayı detaylı olarak analiz etmeyi hedeflemektedir (Baxter & Jack, 2022; Merriam & Tisdell, 2019; Yin, 2023).

Katılımcılar

Bu çalışmanın uygulama aşamasına, 2023-2024 akademik yılı bahar döneminde toplam 186 öğrenci katılmıştır. Ancak çalışmanın nitel boyutu için, araştırma sorusuna ilişkin derinlemesine ve zengin bilgi sağlayabilecek 11. sınıftan 10 öğrenci, amaçlı örnekleme yöntemiyle seçilmiştir. Amaçlı örnekleme, nitel araştırmalarda kullanılan stratejik bir örnekleme yöntemidir ve katılımcıların araştırma problemiyle ilgili bilgi ve deneyime sahip olmalarını sağlayacak önceden belirlenmiş ölçütlere göre seçilmesini içerir (Büyüköztürk, 2018; Patton, 2015). Seçim kriterleri arasında, öğrencilerin TYÖM'nin uygulamasına aktif katılım göstermeleri ve demografik temsiliyet sağlamaları yer almıştır. Öğrenciler ilk olarak okul kayıt numaralarına göre sıralanmış; ancak son seçim, belirlenen uygunluk kriterleri ve deneyimlerinin araştırma açısından taşıdığı önem dikkate alınarak yapılmıştır. Bu süreç, araştırma hedefleriyle uyumlu olarak rastgele değil, stratejik bir örnekleme yaklaşımını yansıtmaktadır.

Örneklem grubunun %40'ı kız, %60'ı erkek öğrencilerden oluşmuştur. Bu demografik yapı, okul genelindeki mevcut cinsiyet dağılımını yansıtmaktadır. Cinsiyet dengesizliği, çalışmanın sınırlılıkları arasında değerlendirilmiş; veri analizi ve yorumlama sürecinde katılımcıların bilgi derinliği ve deneyim zenginliği önceliklendirildiği için bu durum özellikle göz önünde bulundurulmuştur. Bu çalışmada örnekleme alınan katılımcıların cinsiyetlerine ilişkin dağılım, Tablo 1'de gösterilmiştir.

Tablo 1.

Örnekleme Ait Cinsiyet Verileri

Cinsiyet	*n*	%
Kız	4	40
Erkek	6	60

Veri Toplama Araçları

Bu çalışmada veri toplama aracı olarak öğrenci görüşme formu kullanılmıştır. Nitel veri toplama yöntemi olarak, seçilen öğrencilerle yarı yapılandırılmış görüşmeler gerçekleştirilmiştir. Görüşme sorularının hazırlanma sürecinde, konuyla ilgili alan yazınındaki önceki çalışmalardan yararlanılmıştır (Akçayır & Akçayır, 2018; Çakır, 2019; Demirci, 2017; Özdemir & Demirtaş, 2020; Yılmaz & Güler, 2016). Sorular, TYÖM'nin farklı yönlerini değerlendirmeyi amaçlayacak şekilde tasarlanmıştır. Bu sorular, modelin genel etkilerinden, öğrencilerin teknoloji kullanımlarına ve belirli derslerdeki başarılarına kadar geniş bir yelpazeyi kapsamıştır. Sorular, araştırmanın temel amacına hizmet edecek şekilde yapılandırılmıştır.

Katılımcı grubunun 11. sınıf öğrencilerinden oluştuğu göz önünde bulundurularak, soruların dili açık, anlaşılır ve öğrencilerin eğitim seviyelerine uygun biçimde hazırlanmıştır. Ayrıca, sorular öğrencilerin bilgi düzeyleri ve özellikle TYÖM ile kimya dersinde kullanımına ilişkin deneyimlerini ortaya koyacak şekilde düzenlenmiştir. Öğrencilerin düşüncelerini özgürce ifade edebilmeleri amacıyla açık uçlu sorular tercih edilmiştir. Açık uçlu sorular, öğrencilerin deneyimlerini detaylı olarak aktarmalarına olanak tanıyarak daha derinlemesine analiz yapılmasını ve zengin veriler elde edilmesini sağlamaktadır (Creswell, 2013; Patton, 2002; Yıldırım & Şimşek, 2013).

Görüşme soruları, araştırma hedefleriyle uyumlu temel temalar etrafında yapılandırılmıştır. Bu temalar; TYÖM'nin genel etkileri, öğrencilerin teknolojiye yönelik görüşleri, modelin kimya derslerdeki uygulanabilirliği ve geleneksel yöntemlerle karşılaştırıldığında sağladığı avantajları kapsamaktadır. Görüşme soruları araştırmacı ve alan uzmanı üç akademisyen tarafından incelenmiş ve değerlendirilmiştir. Ayrıca, pilot uygulama yoluyla soruların geçerliliği test edilmiştir. Pilot uygulama sürecinde, soruların anlaşılırlığı, sıralaması ve katılımcılar üzerindeki etkisi gözlemlenmiş; gerekli düzenlemeler yapılmıştır.

Görüşme soruları etik ilkeler doğrultusunda geliştirilmiştir. Katılımcıların anonimliği ve gizliliği gözetilmiş; çalışmanın amacı, süreci ve olası riskleri hakkında öğrenciler bilgilendirilmiş, çalışmaya katılım tamamen gönüllülük esasına dayandırılmıştır. Sonuç olarak, TYÖM ile ilgili yedi ana tema ve on beş alt temayı içeren yedi temel soru ve bu sorulara bağlı alt sorular oluşturulmuştur.

Öğrenciler (Ö5, Ö17, Ö18, Ö22, Ö36, Ö39, Ö45, Ö47, Ö64, Ö69) seçilerek yarı yapılandırılmış görüşmeler gerçekleştirilmiştir. Görüşmelerden önce öğrencilerden, okul yönetiminden ve ailelerden gerekli izinler alınmıştır. Yapılan görüşmeler sesli olarak kaydedilmiş ve yazılı metne dönüştürülmüştür. Görüşmeler, belirlenen yedi ana tema ve on beş alt tema kapsamında yürütülmüştür. Görüşme verilerinin güvenirliğini sağlamak amacıyla, tüm görüşmeler kayıt altına alınmış ve analiz edilmiştir. Ayrıca, gözlemler video, fotoğraf ve ses kayıtları yoluyla belgelenmiştir. Görüşme formunda yer alan bu temel başlıklar şunlardır:

a. TYÖM'ye yönelik öğrenci görüşleri
b. TYÖM'nin sağladığı faydalara yönelik öğrenci görüşleri
c. TYÖM'ye yönelik öğrencilerin teknolojik görüşleri
d. TYÖM'nin kimya dersinde kullanımına yönelik öğrenci görüşleri
e. TYÖM'nin kimya dersindeki başarılarına yönelik öğrenci görüşleri
f. TYÖM ve mevcut öğrenme yöntemine yönelik öğrenci görüşleri
g. TYÖM'nin kimya öğretiminde kullanılmasına yönelik öğrenci görüşleri şeklindedir.

Geçerlilik ve Güvenilirlik

Araştırmanın geçerliliğini artırmak amacıyla, hazırlanan görüşme soruları konu uzmanlarına sunulmuş ve uzman görüşleri doğrultusunda gerekli düzenlemeler yapılmıştır. Araştırma sürecinin her aşaması, bu ilkelerle uyumlu olacak şekilde titizlikle planlanmış ve yürütülmüştür. Çalışmanın içsel geçerliğini artırmak amacıyla, görüşme formundaki sorular bir uzman kurulu tarafından değerlendirilmiştir. Bu kurul; iki kimya öğretmeni, bir Türk dili öğretmeni, iki alan araştırmacısı ve nitel araştırma ile konu alanında uzman iki akademisyenden oluşmuştur. Uzmanlar, soruların araştırma amaçları, kapsamı ve kuramsal çerçeve ile uyumunu değerlendirmiştir. Uzmanlar arasında yüksek düzeyde görüş birliği sağlanmış ve soruların araştırma hedefleriyle yeterince örtüştüğü sonucuna ulaşılmıştır.

Ayrıca, görüşme sorularının anlaşılabilirliğini ve veri toplama sürecinin genel işleyişini değerlendirmek amacıyla dört öğrenciyle pilot çalışma yapılmıştır. Pilot uygulamadan elde edilen geri bildirimler doğrultusunda görüşme formunda son düzenlemeler gerçekleştirilmiştir.

Veri toplama süreci sistematik bir şekilde yürütülmüş; alınan tüm yöntemsel kararlar ayrıntılı olarak belgelenmiştir. Görüşmeler veri kaybını önlemek amacıyla ses kayıt cihazlarıyla kaydedilmiş, elde edilen veriler herhangi bir yoruma yer verilmeden doğrudan transkript edilerek analiz edilmiştir. Kodlama ve tema oluşturma süreci, araştırmanın önceden belirlenmiş alt problemleriyle uyumlu biçimde gerçekleştirilmiş ve analiz boyunca yöntemsel şeffaflık korunmuştur.

Araştırmacı yanlılığını en aza indirmek için veriler katılımcıların orijinal ifadelerine dayalı olarak analiz edilmiştir. Yorumlamalar doğrudan alıntılarla desteklenmiş, böylece elde edilen bulguların veriye dayalı olması sağlanmıştır. Yapılan tüm analiz süreçleri ve sonuçlar ayrıntılı biçimde raporlanarak çalışmanın nesnelliği ve denetlenebilirliği güçlendirilmiştir.

Araştırma bağlamı, katılımcı özellikleri, örnekleme süreci ve veri toplama yöntemleri ayrıntılı şekilde açıklanmıştır. Bu durum, çalışmanın bulgularının benzer eğitim bağlamlarına aktarılabilirliğini artırmaktadır. Uygulama ortamı ve katılımcı seçim ölçütlerinin açık bir şekilde sunulması, elde edilen sonuçların benzer çalışmalarda kullanılmasına olanak sağlamaktadır.

Çalışmanın güvenilirliğini sağlamak adına tüm yöntemsel süreçler dikkatle planlanmış ve özenle uygulanmıştır. Görüşme formu hem içerik hem de yapı açısından geçerlik testlerinden geçirilmiş; veri toplama ve analiz süreçleri sistematik, şeffaf ve tutarlı bir şekilde yürütülmüştür. Bu bağlamda, çalışma nitel araştırmalarda beklenen bilimsel standartlara uygun güvenilir ve geçerli bulgular sunmaktadır.

Uygulama Süreci

Araştırma, 2023-2024 bahar döneminde 11. sınıfta okuyan 186 ile yürütülmüştür. Araştırma öğrencilerin ders programına uygun olacak şekilde 12 haftalık bir zaman diliminde gerçekleştirilmiştir. Kimya dersinde müfredatta yer alan bir konunun öğretiminde TYÖM uygulanmıştır. Bu modelin gereklilikleri doğrultusunda, öğrencilere ders öncesi hazırlık yapmaları için bir hafta boyunca günlük ev ödevleri verilmiştir. Öğrencilerin bu teorik hazırlıklarının ardından, kimyasal tepkimelerde hız konusuyla ilgili 3 ders deneyi gerçekleştirilmiştir Ayrıca, kimyasal tepkimelerde hız konusu üzerine 6 adet öğrenci etkinliği düzenlenmiştir. TYÖM'nin uygulanması süresince, öğrencilere evde kimya dersi ile ilgili animasyonlar ve videolar izletilmiştir. Bu görsel materyallerle öğrencilerin öğrenme süreci desteklenmiştir. Eğitimlerin sonunda ise, TYÖM'nin etkinliğini değerlendirmek amacıyla öğrenci görüşlerine başvurulmuştur. Tablo 2' de araştırmanın uygulama süreci, etkinlikler, video, animasyonlar ve deneyler belirtilmiştir.

Tablo 2.
Araştırmanın Uygulama Süreci

Kategori	Etkinlik	Açıklama
Okul dışı etkinlikler (ev ödevleri)	1. Gün: Moleküler bakış açısı	✓ Kimyasal tepkimelerde moleküler bakış açısı konusunu çalışmak. ✓ Konu ile ilgili 5 soru çözülüp çözümlerinin yazılması. ✓ Gerçek hayatla ilişkili 1 örnek verilmesi.
	2. Gün: Tepkime hızları ve ortalama hız	✓ Tepkime hızları ve ortalama hız konularını çalışmak. ✓ Konular ile ilgili 5 soru çözülüp çözümlerinin yazılması. ✓ Gerçek hayatla ilişkili 1 örnek verilmesi.
	3. Gün: Homojen ve heterojen faz tepkimeleri	✓ Homojen ve heterojen faz tepkimeleri konusunu çalışmak. ✓ Konu ile ilgili 5 soru çözülüp çözümlerinin yazılması ✓ Gerçek hayatla ilişkili 1 örnek vermek.
	4. Gün: Tepkime hız denklemleri	✓ Tepkime hız denklemleri konusunu çalışmak. ✓ Konu ile ilgili 10 soru çözülüp çözümlerinin yazılması. ✓ Gerçek hayatla ilişkili 1 örnek verilmesi.
	5. Gün: Tepkime hızına etki eden faktörler	✓ Tepkime hızına etki eden faktörler konusunu çalışmak. ✓ Konu ile ilgili 15 soru çözülüp çözümlerinin yazılması ✓ Gerçek hayatla ilişkili 3 örnek verilmesi.
Görsel materyaller	Animasyon ve videolar	Kimya dersinde kullanılan animasyonlar ve videolarla öğrencilerin görsel olarak konuyu kavramalarına yardımcı olunmuştur. Bu materyaller, dersin teorik kısmını desteklemek amacıyla hem okulda hem evde izletilmiştir.
Okul İçi etkinlikler	Deneyler	1. Sodyum metalinin su ile tepkimesi (Patlama). 2. Magnezyum parçacıklarının hidroklorik asit ile tepkimesi. 3. Kurşun (II) nitrat ile potasyum iyodür çözeltisi arasındaki renk değişimi.
	Öğrenci etkinlikleri	1. Kimyasal tepkimede hız bağlantısının yazılması. 2. Deney verileriyle hız denklemi oluşturulması. 3. Derişim değişimlerinin grafiklerle gösterilmesi. 4. Etkin çarpışma teorisi çerçevesinde mikroskobik etkileşimlerin gösterilmesi. 5. Paslanma ve grizu farklarının tartışılması. 6. Tepkime hızındaki enerji kavramlarının grafiksel olarak yorumlanması.
Değerlendirme ve geri bildirim	Öğrenci görüşleri	Eğitim sonunda TYÖM'nin etkinliğini değerlendirmek amacıyla öğrenci görüşleri toplanmıştır. Öğrencilerin dersin içeriği, uygulamalı öğrenme süreçleri ve modelin etkisi hakkındaki düşünceleri değerlendirilmiştir.

Verilerin Analizi

Bu çalışmada, öğrencilerin TYÖM'ye ve tepkime hızlarına ilişkin bakış açılarını derinlemesine anlamak amacıyla yarı yapılandırılmış görüşmeler gerçekleştirilmiştir. Gerekli izinler alındıktan sonra görüşmeler, bir mobil cihaz aracılığıyla sesli olarak kaydedilmiştir. Kayıt altına alınan veriler kelimesi kelimesine yazıya dökülerek analiz sürecine hazırlanmıştır. Veri analizinde, metinsel verilerin sistematik ve yapılandırılmış şekilde incelenmesine olanak tanıyan nitel bir analiz yöntemi olan içerik analizi kullanılmıştır (Krippendorff, 2018; Yıldırım & Şimşek, 2013). Bu yaklaşım, görüşme dökümlerindeki anlam birimlerinin belirlenmesi ve kategorilere ayrılması yoluyla verilerin derinlemesine yorumlanmasını sağlamaktadır. Veri analizi süreci, üç aşamalı bir kodlama yöntemi ile yürütülmüştür: Açık kodlama, eksensel kodlama ve seçici kodlama (Glaser & Strauss, 1967). Açık kodlama (open coding); İlk aşamada görüşme dökümleri satır satır okunmuş, ham verilerden türetilen betimleyici kodlarla anlamlı ifadeler etiketlenmiştir. Her bir kod, katılımcının özgün ifadesine sadık kalınarak detaylı biçimde belgelenmiştir. Eksensel kodlama (axial coding); ikinci aşamada, benzer ve ilişkili kodlar gruplandırılarak alt temalar oluşturulmuş, kodlar arası ilişkiler analiz edilerek kavramsal bağlantılar kurulmuştur. Seçici kodlama (selective coding); son aşamada, elde edilen alt temalar daha geniş analiz sürecine tabi tutularak çalışmanın kuramsal çerçevesini yansıtan ana temalar ortaya çıkarılmıştır. Bu ana temalar, katılımcıların görüşlerinin özünü yansıtan merkezi temalar olarak yapılandırılmıştır. Kodlama süreci boyunca, ikinci bir araştırmacı ile karşılaştırmalı analiz yapılmış ve kodlayıcılar arası tutarlılık sağlanarak analiz sürecinin güvenilirliği ve nesnelliği artırılmıştır (Yıldırım & Şimşek, 2013).

Görüşme süreci, gerekli izinlerin alınmasının ardından ses kayıt cihazı (telefon) kullanılarak kaydedilmiştir. Öğrencilerle gerçekleştirilen görüşmeler, TYÖM ve Kimyasal Tepkimeler Hız konularını kapsamaktadır. Görüşmeler sırasında öğrencilerin görüşleri ses kayıtları aracılığıyla toplanmış ve bu veriler veri transkripsiyonu yöntemiyle yazılı hale getirilmiştir. Ardından, öğrencilere ait görüşme verileri kodlanarak belirli temalar veya kategoriler altında gruplanmıştır.

Kodlama Sürecine Örnek

"*TYÖM'den ne anlıyorsunuz?"* Katılımcı ifadeleri:

Ö5 ve Ö47: *"Ters yüz deyince bir şeylerin yıkılıp yeniden yapılması geliyor aklıma. Yeniden yapmak geliyor."*

Ö64: *"Bu modelden derse hazırlıklı gelmeyi anlıyorum."*

Ö36: *"Deney ve etkinliklerle desteklenen bir eğitim sistemini anlıyorum."*

Ö69: *"Öğrenciyi destekleyen bir model olarak anlıyorum. Bizim faydamıza olacak bir model. Okul yükümüzü azaltacak bir model."*

Ö45: *"Hımm... Ters yüz öğrenme modelinden öğrencilerin okul yükünü azaltacak ve ev yüküyle dengeleyecek bir çalışma modeli anlıyorum. Bu bizim açımızdan güzel bir şey olur herhalde."*

1. *Açık Kodlama:*

Yapısal dönüşüm / yeniden yapılandırma

Derse hazırlıklı gelme

Deney ve etkinlik temelli öğrenme

Öğrenciyi destekleme ve fayda sağlama

Okul ve ev yükü dengesi

2. *Eksensel Kodlama:*

Öğrenci hazırlığı ve katılımı

Etkin öğrenme stratejileri

Öğrenci yükünün azalması ve desteklenmesi

3. *Seçici Kodlama:*

TYÖM'nin eğitim sürecine etkisi

Bu örnek, kodların ham veriden nasıl türetildiğini, ardından nasıl gruplandırılarak temalara dönüştürüldüğünü göstermektedir. Belirlenen temalar, veriye dayalı şeffaflık ve güvenilirlik ilkeleri doğrultusunda doğrudan katılımcı alıntılarıyla desteklenmiştir. Araştırmanın yürütüldüğü bağlam, katılımcıların özellikleri, örnekleme yöntemi ve veri toplama süreci ayrıntılı şekilde açıklanmıştır Böylece elde edilen bulguların benzer eğitim ortamlarına aktarılabilirliği güçlendirilmiştir. Bu sistematik, şeffaf ve kuramsal temele dayalı analiz yaklaşımı, çalışmanın geçerlik, güvenirlik ve nesnellik ölçütlerini karşılayarak öğrencilerin TYÖM'ye ilişkin algılarına dair sağlam ve anlamlı sonuçlar sunmaktadır.

Araştırmanın Etik İzinleri:

Bu çalışmada "Yükseköğretim Kurumları Bilimsel Araştırma ve Yayın Etiği Yönergesi" kapsamında uyulması gerektiği belirtilen tüm kurallara uyulmuştur. Yönergenin ikinci bölümü olan "Bilimsel Araştırma ve Yayın Etiğine Aykırı Eylemler" başlığı altında belirtilen eylemlerin hiçbiri gerçekleştirilmemiştir.

Etik Kurul İzin Bilgileri:

Etik değerlendirmeyi yapan kurulun adı =Hacettepe Üniversitesi Etik Kurulu

Etik Kurul Etik inceleme karar tarihi=26 Eylül 2023

Etik değerlendirme belgesi konu numarası= E-66777842-300-00003098228

Bulgular

Öğrencilerin TYÖM' ye yönelik görüşlerini belirlemek için seçilen 10 öğrenciyle yarı yapılandırılmış görüşmeler gerçekleştirilmiştir. Bu öğrenciler, amaçlı örnekleme yöntemi ile seçilmiştir. Bu çerçevede, Ö5, Ö17, Ö18, Ö22, Ö36, Ö39, Ö45, Ö47, Ö64 ve Ö69 numaralı öğrenciler ile yarı yapılandırılmış görüşmeler gerçekleştirilmiştir. Görüşme soruları, 7 temel başlık altında düzenlenmiş olup, toplamda 15 alt başlıktan oluşmaktadır. Öğrencilerle yapılan görüşme sorularına ait bulguların analizi, aşağıda tablolar halinde sunulmuştur.

Öğrencilerle yapılan görüşmelerde, öğrencilerin "*Daha önce bu model ile karşılaştınız mı?*" sorusuna verdikleri yanıtlar, Tablo 3'te tema ve kodlar doğrultusunda sunulmuştur.

Tablo 3.

Öğrencilerin Daha Önce Bu Model ile Karşılaşmalarına İlişkin Bulgular

Tema	Kod	Katılımcı no	*f*	%
Hayır (f=9, %90)	Daha önce karşılaşmadık İlk kez duyuyorum	Ö47, Ö17, Ö22, Ö39, Ö36, Ö45, Ö69, Ö64, Ö5	9	90
Evet (f=1, %10)	Daha önce isim olarak duymuştum	Ö18	1	10

Tablo 3 incelendiğinde, öğrencilerin daha önce bu model ile karşılaşmalarına ilişkin görüşleri Evet (f=9, %=90) ve Hayır (f=1, %=10) olmak üzere 2 farklı temada incelenmiştir.

Öğrencilerle yapılan görüşmelerde, öğrencilerin "*TYÖM'den ne anlıyorsunuz*?" sorusuna verdikleri yanıtlar, Tablo 4'te tema ve kodlar doğrultusunda sunulmuştur.

Tablo 4.

Öğrencilerin TYÖM'den Ne Anladıklarına İlişkin Bulgular

Tema	Kod	Katılımcı no	*f*	%
Yapılandırma ve pekiştirme (f=2, %20)	Bir şeyleri yeniden yapmak	Ö5	1	10
	Bazı şeyleri yeniden değiştirmek	Ö47	1	10
Ders öncesi hazırlık (f=4, %40)	Derse hazırlıklı gelmek	Ö64	1	10
	Evde ders çalışmak	Ö17	1	10
	Okulun ders yükünü azaltmak	Ö69	1	10
	Okul yükünü azaltmak ve yükünü dengelemek	Ö45	1	10
Etkili öğrenme (f=3, %30)	Deney ve etkinlik yapmak	Ö36	1	10
	Animasyonla öğrenmek	Ö39	1	10
	Görsel öğrenmek	Ö22	1	10
Bilgi yetersizliği (f=1, %10)	Bilgim yok	Ö18	1	10

Tablo 4 incelendiğinde, öğrencilerin TYÖM'den ne anladıklarına ilişkin görüşleri etkili öğrenme (f=3, %30), ders öncesi hazırlık (f=4, %40), yapılandırma ve pekiştirme (f=2, %20) ile bilgi yetersizliği (f=1, %10) olmak üzere 4 temada incelenmiştir.

Öğrencilerle yapılan görüşmelerde, öğrencilerin *"TYÖM'nin size ne faydası oldu?"* sorusuna verdikleri yanıtlar, Tablo 5'te tema ve kodlar doğrultusunda sunulmuştur.

Tablo 5.

Öğrencilerin TYÖM'nin Faydalarına İlişkin Bulguları

Tema	Kod	Katılımcı no	*f*	%
Kalıcı ve etkili öğrenme (f=6, %60)	Konuyu daha iyi öğrenmek	Ö18	1	10
	Bilgi içerikli animasyonlar kullanmak	Ö22	1	10
	Derse ön hazırlık yapmak	Ö64	1	10
	Görsel öğrenme sağlamak	Ö39	1	10
	Kalıcı öğrenme sağlamak	Ö36	1	10
	Deneysel olarak kalıcı öğrenme sağlamak	Ö69	1	10
Deneysel ve iş birlikli öğrenme (f=2, %20)	Deneysel ve görsel öğrenme sağlamak	Ö47	1	10
	Deneysel öğrenme sağlamak	Ö17	1	10
Uygulama kolaylığı (f=1, %10)	Daha avantajlı öğrenme sağlamak	Ö5	1	10
Bilgi yetersizliği (f=1, %10)	Bilgi eksikliği	Ö45	1	10

Tablo 5 incelendiğinde, TYÖM'nin faydalarına yönelik öğrencilerin görüşleri kalıcı ve etkili öğrenme (f=6, %60), deneysel ve işbirlikli öğrenme (f=2, %20), uygulama kolaylığı (f=1, %10) ve bilgi yetersizliği (f=1, %10) olmak üzere 4 temada incelenmiştir.

Öğrencilerle yapılan görüşmelerde, öğrencilerin *"TYÖM'nin kimya kavramlarını öğrenmenize katkısı hakkında ne düşünüyorsunuz?"* sorusuna verdikleri yanıtlar, Tablo 6'da tema ve kodlar doğrultusunda sunulmuştur.

Tablo 6.

Öğrencilerin Kimya Kavramlarını Öğrenmelerine Sağladığı Katkılara İlişkin Bulgular

Tema	Kod	Katılımcı no	*f*	%
Pekiştirme ve anlama (f=4, %40)	Kimya konularını daha iyi pekiştirme	Ö5	1	10
	Kimya konularını daha iyi anlama	Ö36	1	10
	Soruları rahatlıkla cevaplama	Ö18	1	10
	Derse hazırlıklı gelme	Ö64	1	10
Etkili öğrenme (f=5, %50)	Deneysel, görsel ve eğlenceli öğrenme sağlama	Ö69	1	10
	Kalıcı bilgiler sağlama	Ö45	1	10
	Görsel öğrenmeyi sağlama	Ö39, Ö22	2	10
	Görsel ve animasyon katkısı	Ö47	1	10
Yöntem ve uygulama (f=1, %10)	Derse farklılık ve çeşitlilik sağlama	Ö17	1	10

Tablo 6 incelendiğinde, öğrencilerin kimya dersine katkısı hakkındaki düşünceleri etkili öğrenme (f=4, %40) pekiştirme ve anlam (f=5, %50), yöntem ve uygulama (f=1, %10) olmak üzere 3 tema altında gruplandırılmıştır.

Öğrencilerle yapılan görüşmelerde, öğrencilerin *"Kimya öğretiminde mevcut yöntem ile karşılaştırıldığında työm'nin teknolojik faydaları var mıdır?"* sorusuna verdikleri yanıtlar, Tablo 7'de tema ve kodlar doğrultusunda sunulmuştur.

Tablo 7.

Öğrencilerin Modelin Teknolojik Faydalarına İlişkin Bulguları

Tema	Kod	Katılımcı no	*f*	%
Teknoloji destekli öğrenme (f=7, %70)	Görsel olarak faydalı	Ö18	1	10
	Yazılım programları ve görsel animasyon faydalı	Ö39	1	10
	Animasyon ve videoların izlenmesi	Ö22	1	10
	Video ve animasyon destekli olması	Ö69	1	10
	Molekül gösterimleri için faydalı	Ö64	1	10
	Videolar ile faydalı	Ö17	1	10
	Görsel öğrenme sağlama	Ö36	1	10
Etkili öğrenme (f=2, %20)	Konuların daha iyi pekişmesini sağlıyor	Ö5	1	10
	Kalıcı öğrenme sağladı	Ö47	1	10
Bilgi yetersizliği (f=1, %10)	Bilgi eksikliği	Ö45	1	10

Tablo 7 incelendiğinde, öğrenci görüşleri teknoloji destekli öğrenme (f=7, %70), etkili öğrenme (f=2, %20) ve bilgi yetersizliği (f=1, %10) olmak üzere 3 farklı temada incelenmiştir.

Öğrencilerle yapılan görüşmelerde, öğrencilerin *"Kimya öğretiminde mevcut yöntemle karşılaştırıldığında TYÖM'nin teknolojik yazılım ve programların kullanılması açısından faydalı buluyor musunuz?"* sorusuna verdikleri yanıtlar, Tablo 8'de tema ve kodlar doğrultusunda sunulmuştur.

Tablo 8.

Öğrencilerin Teknolojik Yazılım ve Programların Kullanılmasına İlişkin Bulguları

Tema	Kod	Katılımcı no	*f*	%
Olumlu (f=8, %80)	Video programları için faydalı	Ö5	1	10
	Video destekli öğrenme	Ö17	1	10
	Molekül gösterimi ve slayt faydalı	Ö64	1	10
	Teknolojik ve pratik fayda	Ö36	1	10
	Görsel fayda	Ö39	1	10
	Animasyon faydalı	Ö22	1	10
	Daha sağlıklı ve daha iyi anlayabilme	Ö47	1	10
	Kalıcı öğrenme sağlama	Ö18	1	10
Olumsuz	-	-	-	-
Nötr (f=2, %20)	Hiç kullanmadım	Ö69	1	10
	Faydasını bilmiyorum	Ö45	1	10

Tablo 8 incelendiğinde, öğrencilerin teknolojik yazılım ve programların kullanılmasına ilişkin görüşleri olumlu (f=8, %80), olumsuz (f=0, %0) ve nötr (f=2, %20) olarak 3 farklı temada gruplandırılmıştır.

Öğrencilerle yapılan görüşmelerde, öğrencilerin *"TYÖM kimya dersine yönelik tutumunuzu nasıl etkilemiştir?"* sorusuna verdikleri yanıtlar, Tablo 9'da tema ve kodlar doğrultusunda sunulmuştur.

Tablo 9.

Öğrencilerin Modele Yönelik Kimya Dersindeki Tutumlarına İlişkin Bulgular

Tema	Kod	Katılımcı no	*f*	%
Olumlu tutum (f=8, %80)	Ders ilgisini arttırma	Ö64, Ö36, Ö39	3	30
	Kalıcı öğrenme			
	Deneysel ve etkinlikler konuları pekiştirme			
	Ders öncesi evde hazırlık yapma	Ö18	1	10
	Görsel öğrenme ve animasyon destekli öğrenme	Ö47	1	10
	Zengin içerikten kaynaklı ders ilgisi arttırma	Ö17	1	10
	Eğlenceli öğrenme sağlama	Ö22	1	10
	Kimyaya karşı önyargının azalması	Ö45	1	10
Olumsuz tutum	-	-	-	-
Bilgi yetersizliği (f=2, %20)	Kimyanın zor bir ders olması	Ö69	1	10
	Çok formül olması			
	Ders sayısının fazla olması			
	Tutum etkisi bilinmiyor	Ö5	1	10

Tablo 9 incelendiğinde, Öğrencilerin görüşleri olumlu tutum değişimi (f=8, %80) ve olumsuz tutum değişimi (f=0, %0) ve bilgi yetersizliği (f=2, %20) olmak üzere 3 temada kategorize edilmiştir.

Öğrencilerle yapılan görüşmelerde, öğrencilerin *"TYÖM kimya dersine yönelik tutumunuza etkisi hakkında ne düşünüyorsunuz?"* sorusuna verdikleri yanıtlar, Tablo 10'da tema ve kodlar doğrultusunda sunulmuştur.

Tablo 10.

Öğrencilerin TYÖM'nin Kimya Dersindeki Etkilerine İlişkin Düşüncelerine İlişkin Bulgular

Tema	Kod	Katılımcı no	*f*	%
Görsel öğrenme (f=2, %20)	Görsel zenginlik sağlama	Ö18	1	10
	Kimya kavramlarının görsel öğrenilmesi	Ö5	1	10
Öğrenme motivasyonu (f=5, %50)	Öğrenme isteğinin artması	Ö47	1	10
	Kimyayı kolay hale getirme	Ö45	1	10
	Farklı etkinlikler ve kimyayı eğlenceli hale getirme	Ö22	1	10
	Daha zengin içerikli olması ve Kimya dersine ilgiyi arttırma	Ö69	1	10
	Kimya kavramlarının anlaşılmasına yardımcı olma	Ö64	1	10
İş birlikli ve deneysel öğrenme (f=3, %30)	Deneyler ve etkinlikler ile etkili olması	Ö39	1	10
	Deneysel öğrenmeyi sağlama	Ö36	1	10
	Görsel, deneysel, etkinlik ve farklı uygulamaların yapılması	Ö17	1	10

Tablo 10 incelendiğinde, görsel öğrenme (f=2, %20), öğrenme motivasyonu (f=5, %50), iş birlikli ve deneysel öğrenme (f=3, %30) olmak üzere 3 temada kategorize edilmiştir.

Öğrencilerle yapılan görüşmelerde, öğrencilerin *"TYÖM kimya dersindeki başarınızı nasıl etkiledi?"* sorusuna verdikleri yanıtlar, Tablo 11'de tema ve kodlar doğrultusunda sunulmuştur.

Tablo 11.

Modelin Öğrenci Başarısını Nasıl Etkilediğine İlişkin Bulgular

Tema	Kod	Katılımcı no	*f*	%
Olumlu etki (f=9, %90)	Görsel öğrenme sağlama	Ö5, Ö39	2	20
	Daha kalıcı öğrenme	Ö64	1	10
	Deneyler ile kalıcı öğrenme	Ö17, Ö22	2	20
	Kimya dersine ilgi artışı	Ö18	1	10
	Başarı artışı sağlama			
	Uzun süreli kullanımın başarı artışını sağlaması	Ö36	1	10
	Deneysel uygulama sağlaması	Ö69,	1	10
	Öğrenme isteğini artırması	Ö47	1	10
Olumsuz etki	-	-		
Bilgi yetersizliği (f=1, %10)	Bilgi eksikliği	Ö45	1	10

Tablo 11 incelendiğinde, modelin öğrenci başarısına etkisine yönelik öğrenci görüşleri olumlu etki (f=9, %90), olumsuz etki (f=0, %0) ve bilgi yetersizliği (f=1, %10) olmak üzere 3 temada kategorize edilmiştir.

Öğrencilerle yapılan görüşmelerde, öğrencilerin *"TYÖM kimya dersindeki başarınızı nasıl etkilediğini düşünüyorsunuz?"* sorusuna verdikleri yanıtlar, Tablo 12'de tema ve kodlar doğrultusunda sunulmuştur.

Tablo 12.

Modelin Öğrencilerin Başarısına Etkisine İlişkin Düşüncelere Ait Bulgular

Tema	Kod	Katılımcı no	*f*	%
Bilgi ve kavrama (f=5, %50)	Görsel öğrenme sağladığını ve başarıyı arttırdığını düşünüyorum	Ö5, Ö22, Ö39	3	30
	Kimya kavramlarını görmemizi sağlıyor	Ö64	1	10
	Uzun süre kullanılmasının daha iyi olacağını düşünüyorum	Ö36	1	10
Beceri kazanma (f=1, %10)	Deneylerle öğrenmeyi sağlıyor	Ö69	1	10
İlgi ve motivasyon (f=3, %30)	Görsel açıdan daha iyi olması	Ö18	1	10
	Güncel bir model kimyaya ilgimi arttırdığını düşünüyorum	Ö47	1	10
	Etkinlikler ile derse ilginin artması ve konunun hızlı öğrenilmesi	Ö17	1	10
Yetersiz bilgi (f=1, %10)	Bilgi eksikliği	Ö45	1	10

Tablo 12 incelendiğinde, öğrenci görüşleri bilgi ve kavrama (f=5, %50), beceri kazanma (f=, %10) ilgi ve motivasyon (f=3, %30) yetersiz bilgi (f=1, %10) olmak üzere 4 tema altında kategorize edilmiştir.

Öğrencilerle yapılan görüşmelerde, öğrencilerin *"TYÖM ile yapılan kimya öğretimi ve mevcut öğretim yöntemi ile yapılan kimya öğretimi arasındaki farklar için ne düşünüyorsunuz?"* sorusuna verdikleri yanıtlar, Tablo 13'te tema ve kodlar doğrultusunda sunulmuştur.

Tablo 13.

TYÖM ile Yapılan Kimya Öğretimi ve Mevcut Yöntemi ile Yapılan Kimya Öğretimi Arasındaki Farklılıklara İlişkin Bulgular

Tema	Kod	Katılımcı no	*f*	%
Görsel ve kalıcı öğrenme (f=6, %60)	TYÖM daha görsel	Ö5.Ö18, Ö39	3	30
	TYÖM daha kalıcı	Ö18.Ö5, Ö64	3	30
Uygulamaya dayalı öğrenme (f=2, %20)	TYÖM daha deneysel ve daha güncel	Ö45	1	10
	TYÖM deneysel ve kimyayı sevdiriyor.	Ö17	1	10
Zengin içerikli öğrenme (f=4, %40)	TYÖM'de daha çok animasyon ve deney mevcut.	Ö47	1	10
	TYÖM daha anlaşılır ve ön yargıyı azaltıyor.	Ö36	1	10
	TYÖM daha zengin içerikli	Ö69	1	10
	TYÖM etkinlikler ile daha eğlenceli ve daha kolay	Ö22	1	10

Tablo 13 incelendiğinde, öğrenci görüşleri görsel ve kalıcı öğrenme (f=6, %60), uygulamaya dayalı öğrenme (f=2, %20) ve zengin içerikli öğrenme (f=4, %40) olmak üzere 3 temada kategorize edilmiştir.

Öğrencilerle yapılan görüşmelerde, öğrencilerin *"TYÖM ile mevcut yöntem arasında ne tür farklılıklar olduğunu düşünüyorsunuz?"* sorusuna verdikleri yanıtlar, Tablo 14'te tema ve kodlar doğrultusunda sunulmuştur.

Tablo 14.

TYÖM ve Mevcut Yöntem Arasındaki Farklılıklara İlişkin Bulgular

Tema	Alt tema	Kod	Katılımcı no	*f*	%
TYÖM	Etkili öğrenme (f=4, %40)	TYÖM daha etkili öğrenme sağlıyor	Ö5	1	10
		TYÖM daha görsel TYÖM daha kalıcı	Ö36, Ö64	2	20
		TYÖM kimyayı sevdiriyor TYÖM daha rahat öğretiyor	Ö17	1	10
	Zengin içerik (f=4, %40)	TYÖM daha zengin içerik barındırıyor	Ö69	1	10
		TYÖM daha deneysel TYÖM daha zengin içerikli TYÖM daha eğlenceli	Ö45, Ö47	2	20
		TYÖM daha görsel	Ö39	1	10
	Disiplinler arası kullanım (f=1, %10)	TYÖM Fizik-Kimya-Biyoloji derslerinde de kullanılmalı	Ö18	1	10
	Aktif katılım (f=3, %30)	TYÖM'de yaparak öğrenme var.	Ö18	1	10
		TYÖM'de öğrenci daha aktif	Ö47	1	10
		TYÖM daha eğlenceli	Ö22	1	10
Mevcut öğretim yöntemi	Pasif öğrenme ve motivasyon eksikliği (f=1, %10)	Gelenekselde öğrenci pasif kalıyor Geleneksel daha sıkıcı Gelenekselde öğretmen daha aktif kalıyor Gelenekselde sadece konu anlatılıyor	Ö47	1	10
	Görsel uygulama (f=1, %10)	Geleneksel daha çok ezber var Edebiyat dersi görsel ile yapılamaz	Ö18	1	10

Tablo 14 incelendiğinde, TYÖM ile mevcut yöntem arasındaki farkları TYÖM ve mevcut model olmak üzere 2 temada kategorize edilmiştir. TYÖM alt temalar ise etkili öğrenme (f=4, %40), zengin içerikler (f=4, %40), disiplinler arası kullanım (f=1, %10) ve aktif katılım (f=3, %30) olmak üzere 4 alt tema oluşturulmuştur. Mevcut öğrenme modelinin alt temaları ise pasif öğrenme ve motivasyon eksikliği (f=1, %10) ile görsel uygulama zorluklarından (f=1, %10) oluşmuştur.

Öğrencilerle yapılan görüşmelerde, öğrencilerin *"TYÖM ile yapılan kimya öğretimi ve mevcut yöntemle yapılan kimya öğretimi karşılaştırıldığında hangisini daha faydalı buluyorsunuz?"* sorusuna verdikleri yanıtlar, Tablo 15'te tema ve kodlar doğrultusunda sunulmuştur.

Tablo 15.

Öğrencilerin Hangi Öğretim Modelinin Daha Faydalı Olduğuna İlişkin Bulguları

Tema	Alt tema	Kod	Katılımcı no	f	%
TYÖM	Görsel ve etkileşimli öğrenme (f=3, %30)	TYÖM tekrar ve görsel öğrenme sağlıyor	Ö5	1	10
		Animasyon ve videolar var daha eğlenceli	Ö47	1	10
		TYÖM daha görsel bu yüzden daha iyi anlıyorum	Ö39	1	10
	Kolaylaştırıcı etki (f=2, %20)	TYÖM kimyayı daha kolay hale getiriyor	Ö45	1	10
		TYÖM konu daha net anlaşılıyor	Ö36	1	10
	Öğrenciler için uygunluk (f=2, %20)	TYÖM görsel ve öğrenci daha iyi ilerliyor	Ö18	1	10
		Bence gençlere ve çocuklara daha çok hitap eden bir model	Ö22	1	10
	Gelişim etkisi (f=2, %20)	Bana kalırsa sadece kimyada değil her derste daha faydalı ve geliştirilmesi gerekiyor	Ö17	1	10
		TYÖM daha faydalı çünkü deney, etkinlik ve animasyon barındırıyor	Ö69	1	10
	Etkili öğrenme (f=1, %10)	TYÖM daha etkili öğrenme sağlıyor.	Ö64	1	10
Mevcut yöntem	-	-	-	-	-

Tablo 15 incelendiğinde, TYÖM' ile yapılan kimya öğretimi ve mevcut yöntem ile yapılan kimya öğretimi karşılaştırıldığında hangisini daha faydalı olduğu 1 tema altında toplanmıştır. Öğrenci görüşleri görsel ve etkileşimli öğrenme (f=3, %30), kolaylaştırıcı etki (f=2, %20), öğrenciler için uygunluk (f=2, %20), gelişim etkisi (f=2, %20) etkili öğrenme (f=1, %10) olmak üzere 5 alt temada birleşmiştir.

Öğrencilerle yapılan görüşmelerde, öğrencilerin *"TYÖM kimya öğretimi süresince derslerde kullanılsın mı?"* sorusuna verdikleri yanıtlar, Tablo 16'da tema ve kodlar doğrultusunda sunulmuştur.

Tablo 16.

Öğrencilerin Modelin Kimya Derslerinde Kullanılmasına İlişkin Bulguları

Tema	Kod	Katılımcı no	*f*	%
Uygulama etkisi (f=1)	Deneysel olarak hafızada kalıcı olması	Ö39	1	10
Derinlemesine öğrenme (f=4, %40)	Görsel olarak daha kalıcı öğretiyor	Ö18	1	10
	Zengin içerikler barındırıyor	Ö69	1	10
	Sayısal bölümler için etkili	Ö5	1	10
	Derse hazırlık ve etkili öğrenme	Ö64	1	10
Başarı ve motivasyon etkisi (f=4, %40)	Kimya dersinde başarıyı arttırıyor	Ö47	1	10
	Kimya için deneyler var	Ö45	1	10
	Kimyaya önyargımı azalttı	Ö36	1	10
	Konular daha net anlaşıldı			
	Kimyayı daha iyi anlamamızı sağladı	Ö17	1	10
Farklı öğrenme ortamları (f=1, %10)	Sınıf dışında farklı öğrenme ortamı sağlıyor	Ö22	1	10

Tablo 16 incelendiğinde, kimya öğretimi sırasında TYÖM'nin derslerde kullanılıp kullanılmamasına yönelik öğrenci görüşler modelin kullanılabilirliği (Evet Kullanılsın) olarak

1 temada toplanmıştır. Ayrıca uygulama etkisi (f=1, %10), derinlemesine öğrenme (f=4, %40), başarı ve motivasyon etkisi (f=4, %40), farklı öğrenme ortamları (f=1, %10) olmak üzere 4 alt temadan oluşmuştur.

Öğrencilerle yapılan görüşmelerde, öğrencilerin *"TYÖM'nin kimya öğretiminde kullanılmasına yönelik önerileriniz var mı?"* sorusuna verdikleri yanıtlar, Tablo 17'de tema ve kodlar doğrultusunda sunulmuştur.

Tablo 17.
Öğrencilerin Modelin Kullanımına İlişkin Öneri Bulguları

Tema	Kod	Katılımcı no	*f*	%
Fırsat eşitliği (f=, %10)	Her öğrenciye eşit imkân sağlanmalı	Ö5	1	10
Görsel öğrenme (f=2, %20)	Görseller orbital öğrenmede kullanılabilir	Ö18	1	10
	Görsellik için günlük hayattaki konularda kullanılmalı	Ö36	1	10
	Başarıyı arttıran bir model derse entegre edilsin.	Ö69	1	10
	Model çizimler için kimya dersleri bilgisayar laboratuvarlarında işlenebilir.			
Disiplinler arası uygulama (f=1, %10)	Biyoloji ve diğer derslerde de kullanılmalı	Ö39	1	10
	Derslere entegre edilmeli	Ö5	1	10
Eğlenceli öğrenme (f=1, %10)	Daha eğlenceli öğrenme sağlanabilir Genel kültür açısından faydalı olabilir Kimya başarısını arttırabilir	Ö47	1	10
Deneysel öğrenme (f=1, %10)	Deneysel öğrenme için daha fazla kullanılabilir Dersler farklı ortamlarda işlenebilir	Ö22,	1	10
Aktif katılım (f=1, %10)	Öğrenciyi derste daha aktif kılabilir Derse hazırlıklı gelmeyi sağlıyor. Dersi kalıcı hale getiriyor Öğrencinin özgüveni artıyor	Ö64	1	10
Bilinçli farkındalık (f=2, %20)	Önerim yok	Ö17, Ö45	1	10

Tablo 17 incelendiğinde, TYÖM'nin kimya öğretiminde kullanımına yönelik katılımcıların görüşleri (Ö18, Ö47, Ö17, Ö22, Ö39, Ö36, Ö45, Ö69, Ö64, Ö5) modelin kimya dersinde kullanılmasıdır. Kullanılmasına yönelik önerilerde ise fırsat eşitliği (f=1, %10), görsel öğrenme (f=2, %20), disiplinler arası uygulama (f=1, %10), eğlenceli öğrenme (f=1, %10), deneysel öğrenme (f=1, %10), aktif katılım (f=1, %10) ve bilinçli farkındalık (f=2, %20) olmak üzere 7 alt temadan oluşmaktadır.

Tartışma ve Sonuç

Araştırma sonuçları, öğrencilerin büyük çoğunluğunun (%90) TYÖM'nin daha önce deneyimlemediğini, ancak modelin etkili ve kalıcı öğrenme sağladığını düşündüklerini göstermiştir. Öğrenciler, ders öncesi hazırlık, görsel öğrenme, animasyonlar ve deneysel etkinliklerin öğrenmeye katkı sağladığını belirtmişlerdir. Teknoloji destekli araçların (videolar, molekül gösterimleri, yazılımlar) öğrenmeye büyük katkı sağladığı ifade edilmiştir. Modelin özellikle deneysel ve görsel öğrenmeyi desteklemesi, öğrencilerin motivasyonunu artırmış ve kimya dersine olan ilgilerini yükseltmiştir. Öğrencilerin çoğu (%80) modelin ders ilgisini artırdığını ve kalıcı öğrenmeye katkı sağladığını belirtmiştir. Ancak, bazı öğrenciler

(%20) modelin etkilerini tam olarak anlayamamış veya bilgi eksikliği yaşamıştır. TYÖM'nin öğrencilere daha fazla sorumluluk verdiği, öğrenmeyi daha eğlenceli hale getirdiği ve genel olarak öğrenme sürecini daha etkileşimli kıldığı vurgulanmıştır. Öğrenciler, modelin gelecekte diğer derslerde de kullanılmasını ve daha geniş bir şekilde uygulanmasını önermektedir. Sonuç olarak, TYÖM, özellikle kimya gibi soyut derslerde öğrenmeyi derinleştiren ve kalıcı hale getiren etkili bir öğretim stratejisi olarak öne çıkmaktadır.

Öneriler

TYÖM'nin kimya derslerinde ve diğer disiplinlerde daha etkili kullanılabilmesi için çeşitli önerilerde bulunulmuştur. Modelin tanıtımı için seminerler, atölye çalışmaları ve rehberlik etkinlikleri düzenlenmeli, öğrencilere eğitimler verilerek farkındalık oluşturulmalıdır. İleri düzey eğitim içerikleri ve uygulamalı derslerle öğrencilere daha fazla kaynak sağlanmalı, görsel ve deneysel materyallerin kullanımı artırılmalıdır. Ayrıca, öğrencilerin derse hazırlıklı gelmesi için etkinlikler güçlendirilip animasyonlu içerikler entegrasyonuyla öğrenme süreci eğlenceli hale getirilebilir. Teknolojik araçların, video, animasyon ve görsellerin eğitimde daha fazla yer alması gerektiği vurgulanmış, grup çalışmaları ve iş birlikli öğrenme fırsatları sunulmalıdır. Modelin sürdürülebilirliğini sağlamak için öğretmenler rehberlik etmeli ve öğrencilere modelin avantajları hakkında bilinç kazandırılmalıdır. TYÖM'nin diğer derslerde de uygulanması ve öğrencilerin aktif katılımını teşvik etmek için etkinlikler düzenlenmesi önerilmiştir. Son olarak, tüm öğrenciler için eşit fırsatlar sunulması ve günlük yaşamdan örneklerle materyaller hazırlanarak modelin erişilebilir hale getirilmesi gerekmektedir.