

P-ISSN: 2338-8617

E-ISSN: 2443-2067

Jurnal Ilmiah

PEURADEUN

Vol. 11, No. 3, September 2023



 **Clarivate**
Analytics

Emerging Sources Citation Index

Web of Science™



INDEX  COPERNICUS

INTERNATIONAL



SCAD Independent
Accreditation by IAO since 2014
 Copernicus Publications
The Innovative Open Access Publisher

JIP
The Indonesian Journal of the Social Sciences
www.journal.scadindependent.org
DOI Prefix Number: 10.26811



ACCREDITED "Sinta 2" by Decree No. 164/E/KPT/2021
Valid Until the January 2026 Edition

Flipped Learning Model Based on Learning Styles in Chemistry Education

Sema Karapınar¹; Nagihan Kadioğlu²; Özge Özyalçın Oskay³

¹Milli Eğitim Vakfı Schools, Turkey

^{2,3}Department of Education, Hacettepe University, Turkey

Article in Jurnal Ilmiah Peuradeun

Available at : <https://journal.scadindependent.org/index.php/jipeuradeun/article/view/954>

DOI : <https://doi.org/10.26811/peuradeun.v11i3.954>

How to Cite this Article

APA : Karapınar, S., Kadioğlu, N., & Oskay, Ö.Ö. (2023). Flipped Learning Model Based on Learning Styles in Chemistry Education. *Jurnal Ilmiah Peuradeun*, 11(3), 847-872.
<https://doi.org/10.26811/peuradeun.v11i3.954>

Others Visit : <https://journal.scadindependent.org/index.php/jipeuradeun>

Jurnal Ilmiah Peuradeun (JIP), *the Indonesian Journal of the Social Sciences*, is a leading peer-reviewed and open-access journal, which publishes scholarly works, and specializes in the Social Sciences that emphasize contemporary Asian issues with interdisciplinary and multidisciplinary approaches. JIP is published by SCAD Independent and published 3 times of year (January, May, and September) with p-ISSN: 2338-8617 and e-ISSN: 2443-2067. Jurnal Ilmiah Peuradeun has become a CrossRef Member. Therefore, all articles published will have a unique DOI number. JIP has been accredited by the Ministry of Education, Culture, Research, and Technology, the Republic of Indonesia through the Decree of the Director-General of Higher Education, Research and Technology No. 164/E/KPT/2021, date December 27, 2021. This accreditation is valid until the January 2026 edition.

All articles published in this journal are protected by copyright, licensed under a Creative Commons 4.0 International License (CC-BY-SA) or an equivalent license as the optimal license for the publication, distribution, use, and reuse of scholarly works.

JIP indexed/included in Web of Science, Scopus, MAS, Index Copernicus International, Erih Plus, Sinta, Garuda, Moraref, Scilit, Sherpa/Romeo, Google Scholar, OAJI, PKP, Index, Crossref, BASE, ROAD, GIF, Advanced Science Index, JournalTOCs, ISI, SIS, ESJI, SSRN, ResearchGate, Mendeley and **others**.





FLIPPED LEARNING MODEL BASED ON LEARNING STYLES IN CHEMISTRY EDUCATION

Sema Karapınar¹; Nagihan Kadioğlu²; Özge Özyalçın Oskay³

¹Milli Eğitim Vakfı Schools, Turkey

^{2,3}Department of Education, Hacettepe University, Turkey

²Correspondence Email: nagihankadioglu@hacettepe.edu.tr

Received: February 19, 2023	Accepted: July 26, 2023	Published: September 30, 2023
Article Url: https://journal.scadindependent.org/index.php/jipeuradeun/article/view/954		

Abstract

This study aimed to investigate the effectiveness of the flipped learning model, which was designed according to learning styles in the unit of "Acids, Bases, and Salts," compared to the traditional flipped learning model. For this purpose, the study was conducted in a pretest-posttest control group quasi-experimental design with the participation of 37 students who were 10th graders and it lasted for 7 weeks. The students in the experimental group students were taught in the flipped learning model, which was designed according to learning styles. In contrast, the ones in the control group were taught in the traditional flipped learning model. The results demonstrated that the experimental group achieved more success than the control group students taught in traditional flipped models. Besides, it was found through semi-structured interviews with voluntary students that the students generally had a positive perspective of the flipped learning model.

Keywords: *Flipped Learning Model; Learning Style; Acids, Bases, Salts; K-12 Students.*



A. Introduction

Differences emerged in students' learning behaviors and teachers' teaching methods in parallel to the most recent developments in learning technologies (Kinshuk et al., 2016; Malonisio, 2023). Accordingly, educational-instructional activities can be done in classrooms and any environment where the Internet is available.

The flipped learning model is one of the currently used methods due to the developments in educational technologies. Even though the model is defined differently in the literature, it can be described as generally based on the logic of "classes at home and homework at school". Students revise the lesson content at home after they follow the lesson at school instead of going home to work on the assignment and problems given by the teacher; they internalize the course materials through videos, and then they engage in problem-solving, analysis and discussion in the classroom under the guidance of the teacher (Nouri, 2016).

The flipped learning model aims to ensure that students also take on active roles in the learning process through technology rather than to make teachers transfer the knowledge directly in the classroom (Teo et al., 2014). In what environments and when learning will occur depends on the model's students (Gómez-Tejedor et al., 2020). Teachers and videos from various internet sites can prepare classroom videos. Students learn about the lesson content via those videos without entering the classroom. The situation gives teachers flexibility regarding time spent in the classroom (Teo et al., 2014).

The foundations of flipped learning were laid by using television for educational purposes and computer-assisted teaching in the early 20th century. However, the concept of "flipped learning" today emerged within a broader pedagogical development with the mixture of online learning experiences and face-to-face classroom experiences in higher education (Strayer, 2012; Giray et al., 2022).

The flipped learning model became widely known when the chemistry teachers in Woodland Park High School recorded and broadcast their classes online with software they had bought to help students who



missed the classes compensate for their losses (Bergmann & Sams, 2012). Teachers may think that flipping the learning environment can be done by sending their students extra videos related to the lesson content and giving them homework.

However, it differs from the flipped learning model (FLN, 2014). Flipped learning network [FLN] (2014) argues that there are 4 basic properties whose initial letters are represented by the letters of the word "FLIP" so that the method used can be consistent with the flipped learning model. Namely, it is a flexible learning environment, learning culture, intentional content, and professional educator. When and where to learn the lesson content sent prior to the lesson is students' responsibility in flexible learning environments. They can watch the videos as much as they wish, pause them whenever they want, and take notes. It means, they can learn basic lesson content before entering the *classroom* and actively participate in the in-class activities. The flipped learning model enables students to remain up-to-date while learning the lesson materials instead of postponing their study until the day before the exam (Tabrani ZA et al., 2023). Thus, it can help them develop study habits (Leatherman & Cleveland, 2020), which, in turn, can provide teachers with flexibility in designing student-centered active learning environments. Teachers can use activities such as group work, which enable students to configure knowledge.

Even though the flipped learning model is student-centered, teachers have the greatest part of the duty in the model. Thus, they need to plan learning in three stages, pre-class, classroom environment, and post-class, to observe and evaluate students at each stage. An effective flipped learning model can be possible by designing learning environments where students take on active roles both in and outside the classroom, with active participation and enabling them to think critically (O'Flaherty & Phillips, 2015).

The literature, studies, and opinions show that the flipped learning model effectively increases academic achievement. Schultz et al. (2014) examined the effect of the flipped learning model applied in high school



chemistry courses on students' academic achievement. At the end of the study, they concluded that the students in the experimental group to which the flipped learning model was applied were statistically more successful.

The researchers also stated that most of the students participating in the study had positive opinions about the flipped learning model, especially the opportunity to pause, rewind, and review the lessons, the individualized learning environment, and the chance to reach the lesson teacher more easily. Werner et al., (2012) also supported the view that the flipped learning model is effective in increasing the success of students. They also stated that this effect emerges in a long time.

It is extremely important to consider students' individual properties in planning the pre-class, in-class, and post-class activities in the flipped learning model as in all contemporary approaches that put individuals at the center of teaching. Kılıç and Karadeniz (2004) found that students with different personal properties displayed different behaviors and skills in online learning environments. One of the personal properties was the learning style. Dunn and Dunn (1993) define learning styles as "distinct and specific strategies that students use to prepare for new knowledge, learn and remember what they have learned".

Researchers have analyzed individuals' personal properties by focusing on different points, and as a result, different models of learning styles have emerged. One of them is Grasha and Riechmann's Learning Style model. The model focuses on the "student-teacher", "student-student", and "student-content" interactions. Diaz & Cartnal (1999) argue that Grasha Riechmann's learning style model is the most appropriate instrument in determining students' preference for learning in relation to distance learning regulations (cited in Zereyak, 2005).

Grasha and Riechmann's classification contains two poles and three sub-factors (Jonassen & Grabowski, 1993). Namely.

1. Collaborative-competitive;
2. Participant-avoidant;



3. Independent-dependent.

The definitions, benefits, and limitations of collaborative, competitive, participant, avoidant, independent, and dependent styles listed in the classification are as follows (Grasha, 2002; Jonassen & Grabowski, 1993).

Competitive: Students with competitive learning styles prefer something other than teacher-centered teaching. They learn the learning materials to be more qualified than others. They make efforts to be rewarded or to gain the teacher's appreciation. The classroom is always the primary place for winning or losing for such students. They are the leaders in in-class projects. They ask questions in the classroom.

Collaborative: Students learn best by sharing their abilities and designs with others. They use learning environments for socializing. They like doing things with their classmates and teachers. They use the documents that they have prepared and introduce themselves. Jointly done homework is their favorite. They talk to students from other classes about their class.

Avoidant: They are the type of students who are indifferent to classes in formal education. They do not communicate with others available in the learning environment. They are ignorant of in-class activities. The activities done in the classroom need to attract their interest. They dislike teachers who are very active and who like teaching. They hate professionally prepared lessons and student-teacher interactions. They do not like doing homework or reading tasks.

Participant: The students labeled as participants in their learning style are eager to learn and enjoy attending school. They like transferring knowledge from other places into the classroom. They are fond of examinations of open-ended questions and objective tests. They like classes in which courses are discussed. They like sharing information with their classmates. They prefer teachers who can use their materials effectively and who tend to do analysis.

Dependent: They learn only the amount of knowledge they consider sufficient, and they do not learn more. They always consider educators as the people who direct them. They demand that lesson notes be made and



that educators clearly announce the deadline for doing homework. They prefer teacher-centered classes.

Independent: They enjoy studying individually. They look at everything from their perspective. They believe in individual learning skills. They want to receive individual and gradual education. They demand that they are allowed to think while searching for solutions to problems. They enjoy the projects designed by themselves. They prefer the learning environments in which students are put in the center (Grasha & Riechmann, 1975 in Demirci, 2018).

Determining students' learning styles makes it possible to choose appropriate learning models, strategies, methods, and techniques and to use them (Peker, 2003; Taşpınar, 2012; Akkoyunlu, 1995). Some of the studies in the literature demonstrated that designing learning environments according to learning styles would inform teachers of students' learning experiences and their choice of learning strategies and models, help them to become aware of their weaknesses and strengths in learning and thus raise their academic achievement by doing relevant activities (Heinich et al., 2002 in Usta et al., 2011; Aşkar & Akkoyunlu, 1993; Güven, 2004; Tekin, 2020).

Gündüz et al. (2016), in a study that analyzed the correlations between university students' learning styles and their academic achievement in flipped classrooms, found significant correlations between students' learning styles and academic achievement.

Since students take an active role throughout the whole process in the flipped learning model, individual differences among students come to the fore. Learning style also draws attention as a factor that makes a difference among students. For example, Kim (2018) found in his study that there is a significant difference between learning styles regarding satisfaction. Specifically, assimilators had the highest overall satisfaction scores, while divergers had the lowest. According to Kim, these results help teachers identify students' learning styles when applying the flipped learning model so they can tailor their teaching methods to suit their students' needs and preferences.



Similarly, Cam et al. (2022) investigated how the learning style interacts with the flipped learning model and how it affects the performance of prospective classroom teachers in a science teaching lesson. In the study, it was concluded that the flipped learning model had a positive effect on the pre-service teachers' performance in a science teaching course compared to traditional teaching. In the experimental and control groups, the course achievements of the pre-service teachers were evaluated with midterm and final exams, and the results differed in favor of the experimental group. In addition, it was determined that the pre-service science teachers' performance in science teaching differed between learning styles, and the course success averages of the pre-service teachers who had adaptive and assimilating learning styles were higher.

Halili et al. (2019), in their study investigating the effect of mobile flipped learning on students' learning styles, concluded that the flipped mobile classroom approach can promote collaborative learning in the teaching and learning process. It has been determined that the university students who are the participants of the study mainly have a cooperative learning style.

Nwokeji and Holmes (2017) investigated the effect of the flipped learning model and traditional teaching method on student achievement in their study with 35 university students. In addition, they examined the effect of students' preferred learning styles on-course performance in the flipped learning model. According to the results of the study, it was observed that the "Homework" and "Exam Grade" scores of the control group students, to whom the traditional teaching method was applied, were higher than those of the experimental group and that the flipped learning model was more effective in the development of students' participation, engagement, and interaction among students skills. In addition, Logical learners were 10% more successful than Visual learners in the flipped learning model.

Chae (2021) examined students' satisfaction according to their learning styles in the online flipped learning model. Forty-two second-year medical students participated in the study. As a result of the statistical analysis, it was found that students with active-reflective learning styles



had a statistically significant difference in the dimensions of problem-solving and understanding, active participation, and self-directed learning attitudes. It was revealed that students with a sense-intuitive learning style have a significant difference in the active participation dimension of learning compared to the other learning styles.

This study aims to determine the effectiveness of teaching chemistry in the flipped learning model, which was designed according to learning styles to 10th graders in the unit of Acids, Bases, and Salts. To this end, the unit available in the 10th-grade chemistry curriculum was taught in the flipped learning model, designed according to the learning styles of the experimental group. In contrast, it was taught in the standard flipped learning model to the students in the control group. At the end of the study, the effects of the model on the students' academic achievement were determined and their views were also obtained after the implementation.

Even though there are studies investigating which learning style is more efficient in flipped learning environments, no studies in which flipped learning environments were designed according to students' learning styles in chemistry were found in the literature. Therefore, this study contributes to chemistry education in this respect.

B. Method

This study was conducted in pretest-posttest control group quasi-experimental design using quantitative and qualitative research methods. The participants assigned to experimental and control groups were exposed to measurements with dependent variables prior to and after the experimental research in this model. The random method was not used in this design; instead, two ready groups were assigned randomly as the experimental and control groups (Karasar, 1999).

The study group comprised 37 students who were the 10th graders in a private high school in Ankara. Experimental and control groups were formed in the classrooms where the same teacher taught the chemistry



course. Eighteen students were included in the experimental group, while 19 were included in the control group.

The students in the experimental group were given the Grasha-Riechmann Student Learning Styles Scale and divided into groups according to their learning styles. Figure 1 shows the students' distribution according to their learning styles.

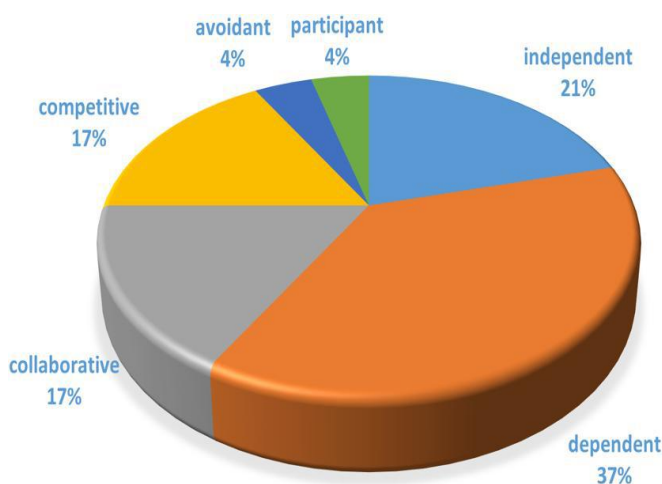


Figure 1. The experimental group of students were distributed according to their learning styles

1. Instruments

a. Grasha-Riechmann Student Learning Styles Scale

The 5-pointed Likert-type scale of 60 items which was developed by Grasha-Reichmann (Grasha, 2002) was used in determining the students' learning styles. The scale contains six different learning styles, graded as low, medium, and high. The learning styles are participant, independent, dependent, avoidant, collaborative, and competitive. The grade with the highest average, according to the answers, represents the participants' dominant learning style. The scale was adapted into Turkish by Zereyak (2005), and the validity and reliability tests were done by giving the scale to 239 students who attended four departments of the educational faculty of Ankara University. The data collected from the study group indicated that the Cronbach's Alpha internal consistency coefficient for the overall scale



was .83. In contrast, the coefficients for the sub-scales ranged between .3 and .78. The internal consistency for the overall scale in this study was found to be .77.

b. Acids, Bases, and Salts Achievement Test

With the achievement test including 10 open-ended questions developed by the researchers, it was determined whether there would be any changes in the student's academic achievement. The content validity of the test was found by consulting the views of two academicians who were experts in chemistry education. Each question in the achievement test differed in their value of points. Questions one, seven, and nine were given 8 points, questions two and ten were given 9 points, questions four were given 10 points, and questions three, five, six, and eight were given 12 points in evaluation, and the maximum score receivable from the test was 100 points. Table 1 shows samples for the test questions.

Table 1. Samples for the questions in the acids, bases, and salts achievement test

Decide whether the statements about the HCl compound are True (T) or False (F).	a. It is commonly called hydrochloric acid. b. It is used as a rust remover. c. It is available in the stomach in diluted form. d. It reacts with carbonated compounds of metals and releases H ₂ gas.
Write down the products of the reaction given on the right-hand side. Say the number of atoms available in the salt formula generated as a result of the reaction.	$\text{Ca(OH)}_2 + \text{H}_3\text{PO}_4 \rightarrow$
Write down the products of the reaction given on the right-hand side. Explain which reaction results in a gas different from others.	a. $\text{Mg} + \text{HCl} \rightarrow$ b. $\text{Hg} + \text{H}_2\text{SO}_4 \rightarrow$ c. $\text{Al} + \text{KOH} \rightarrow$ d. $\text{Na} + \text{HNO}_3 \rightarrow$ e. $\text{Mg} + \text{H}_2\text{SO}_4 \rightarrow$

c. The Semi-structured Interview Form

Semi-structured interviews were held with four voluntary students, two of whom were in the experimental group (a girl and a boy) and two of



whom were in the control group (two girls) to obtain their views on the standard flipped learning model and the flipped learning model which was designed according to student's learning styles.

Semi-structured interviews were held with four voluntary students (dependent-independent-competitive-collaborative) with different learning styles, two of whom were in the experimental group (a girl and a boy) and two of whom were in the control group (two girls) to obtain their views on standard flipped learning model and the flipped learning model which was designed according to student's learning styles. In the interview, 4 questions about the flipped learning model were asked of the students.

2. Procedures

- a. The 7-week study was conducted in a private high school in Ankara.
- b. In week one, the students in the experimental and control groups were given an achievement test prepared by the researchers about acids, bases, and salts. In addition, the students in the experimental group were given the Grasha-Riechmann Student Learning Styles Scale to determine their learning styles.
- c. The White Panel Teaching Platform (Beyaz et al.) on which the study would be conducted was introduced after giving the scale to the students, who were asked to subscribe to the platform.
- d. On weeks 2-6, the educational videos of theoretical knowledge about the week's subject prepared by the teacher were uploaded onto the white panel platform before the lessons. Thus, students had access to the videos. Discussion was started on the platform to check whether or not the students had watched the videos.
- e. The lessons were taught in the flipped learning model, designed according to students' learning styles in the experimental group. In contrast, they were taught in the traditional flipped learning model in the control group.
- f. The students found to have independent and competitive learning styles in the experimental group were included in a group (Group 1).



- In contrast, those with collaborative, dependent, and avoidant learning styles were included in the other group (Group 2).
- g. The experimental group students who were divided into groups participated in activities suitable to their learning styles. The students in group 1 preferred studying in environments where learners are in the center and where they could work independently and individually, study environments in which they could work individually. They could receive individual support from the teacher who was prepared for them.
 - h. The students in group 2 were the students who used the learning environment for socializing, who were inclined to group work, and who needed their teacher's guidance. Thus, learning environments where they could work in groups and sometimes receive teacher guidance were provided. They did the group activities collaboratively and then handed their product to the teacher.
 - i. Educational sites such as chemcollective.org, ck12.org, and phet.colorado.edu which were free- were used for the activities during the classes. The students actively participated in the lessons through the simulations and virtual lab applications on those sites.
 - j. The Acids, Bases, and Salts Achievement test developed by the researchers was given to the students at the end of the study as the post-test and the voluntary students' views were obtained in interviews on the Zoom session.

Platforms used in out-of-the-class activities and examples for in-class activities are given in Figure 2 and Figure 3.

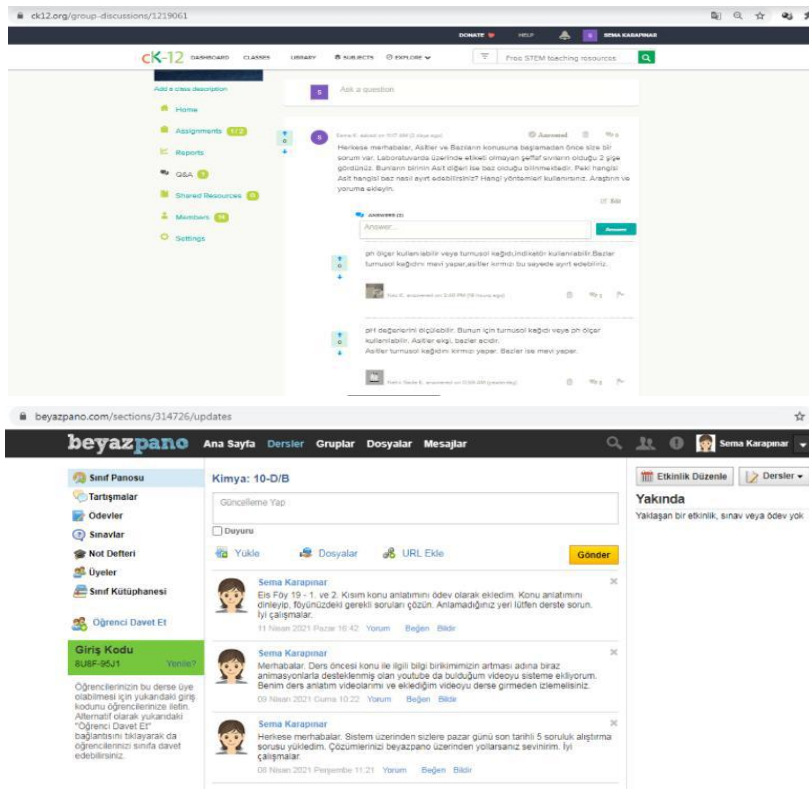


Figure 2. Platforms used in out-of-the-class activities

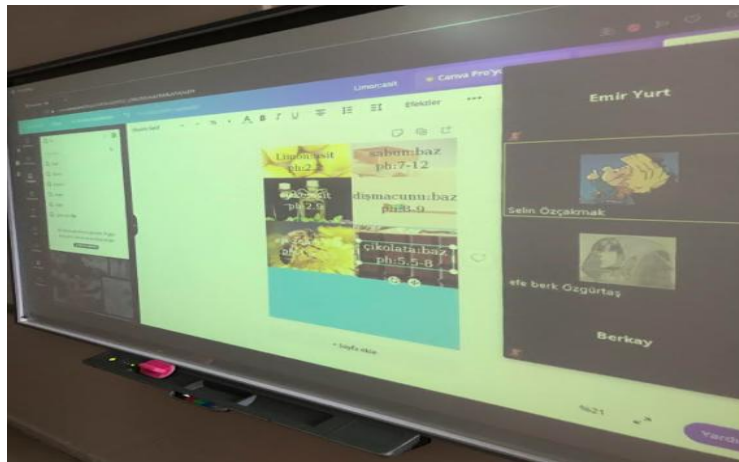


Figure 3. An example of in-class activities



C. Result and Discussion

This study aimed to determine the effectiveness of the flipped learning model, which was designed according to students' learning styles in teaching the unit on Acids, Bases, and Salts. Thus, the students in the experimental and control groups were given an achievement test on the unit of Acids, Bases, and Salts. Then, semi-structured interviews were held with voluntary students.

1. Result

a. Result for the Acids, Bases, and Salts Achievement Test

The acids, bases, and salts achievement test consisting of open-ended questions was given as the pre-test and post-test to find whether there were any changes in the experimental group and control group students' academic achievement. IBM SPSS v23 was used in the analysis of quantitative data.

Table 2. The mann-whitney u test results for the experimental group and the control group students' pre-test scores in the acids, bases, and salts achievement test

Group	n	Sum of Ranks	Mean Rank	U	z	p
Experimental Group	18	387	21,50	126	-1,374	0,170
Control Group	19	316	16,63			

The analyses done to compare the experimental group and the control group students' pre-test results indicated no significant differences between the two groups' pre-test achievement scores ($U=126$, $z= -1,374$, $p>0.05$). Accordingly, the experimental group (rank total= 387) and the control group (rank total= 316) are equal in terms of achievement in the subject of acids, bases, and salts.

Table 3. The mann-whitney u test results for the experimental group and the control group students' post-test scores in the acids, bases, and salts achievement test

Group	n	Sum of Ranks	Mean Rank	U	z	p
Experimental Group	18	413	22,94	100	-2,164	0,030
Control Group	19	290	15,26			



When comparing the post-test average scores for the acids, bases, and salts achievement test through the Mann-Whitney U test, it was found that the two groups differed in their post-test score averages ($=100$, $z = -2.164$ $p = 0.030$, $r = 0.35$). According to the result, the experimental group students (rank total = 413) had higher scores in the acids, bases, and salts achievement test than the control group students (rank total = 290). As a result, it was found that the flipped learning model, designed according to students' learning styles, had medium effects on students' achievement ($r = 0.359$).

b. The Findings Obtained from the Semi-structured Interviews

The semi-structured interviews with 4 voluntary students were decoded and put into the computer. The themes and sub-themes were distinguished by the students' answers to 4 questions, and the data were tabularised. Another researcher with expertise in qualitative analysis also distinguished themes and sub-themes for each question, and then the two researchers compared their analyses and completed the process.

As a result of the analyses, 11 main themes and 23 sub-themes were distinguished.

Table 4. The findings obtained from the semi-structured interviews

1. What is your general evaluation of the flipped learning model in which you have been taught the unit of Acids and Bases?	1.a. positive views:	1.a.1 possibility to watch the lesson content at any time and as much as desired	Practical Frequent repetition Reinforcement Coming to the <i>classroom</i> as prepared for the subject Permanence Effective interaction (Teachers' opportunity to ask more questions) Sharing (group tasks) Being able to analyze better the points which are not understood well Being able to get
		1.a.2 Increasing the in-class interaction and efficiency	



		1.a.3 A new experience	feedback instantly Innovation (a different learning approach) Being able to use the Web 2.0 instruments
	1. b. Negative views:	1.b.1 negative side about supervising whether or not the videos are watched	The inadequacy of supervising whether the videos are watched
		1.b.2. The view that it is not suitable for every subject	Increase in need for teachers in subjects that are heavily based on operations Students feeling tired in the subjects taught at the end of the semester
2.	Are the videos sent to you before the classes useful? Would you prefer the videos other than the ones prepared by your teacher?	2.a. Positive views:	2.a.1 Video content Helpful to focus on Original clues for the university entrance exam Questions that prepare students for the subject
		2. b. Negative views:	2.b.1 Video content A few questions about the subject Answers in the answers key that are not guiding
3.	What do you think of group work in the <i>classroom</i> ?	3.a. Positive views:	3.a.1. Increase in interaction in the <i>classroom</i> Improvement in interaction between students A democratic atmosphere Possibility to reach the teacher instantly
		3. b. Negative views:	3.b.1. Some of the group members do not observe the distribution of tasks. Students' refusal to participate actively in group work The view that only some of the students shoulder the responsibility for group homework Slower than individual

4. Do you think the homework you did at the end of the class was beneficial?	4.a. Positive views	4.a.1. It enables us to consider the subject as a whole.	work Improving perspectives about the course Helping to acquire different skills Discovering new applications Increase in motivation
	4.b. Negative views	4.b.1. It does not cause improvement.	Difficulties in associating the subject with daily life Difficulties in finding the resources for use in the homework Tedious Waste of time

The student's views on flipped learning were discussed in two themes labeled as positive and negative in this paper. The views that they gained new experience because they had faced the approach for the first time and had the opportunity to use the Web 2.0 instruments more effectively provided the basis for positive views. They thought that watching the lesson videos sent to them whenever and as often as they wanted was quite influential in revising the subjects and reinforcing their knowledge. They also commonly believed that reaching the lesson content whenever needed was beneficial and practical to them while preparing for the university entrance exam.

On the other hand, the negative views put forward by the participants were generally associated with the fact that the research was conducted at the end of the semester. They stated that they had lower motivation because of the end of the semester, that they felt tired due to homework given in other classes, and that all this prevented them from having sufficient interest in the flipped learning model. Besides, they were also found to have concerns about teaching subjects that were heavily based on operations in this model.

For instance, the statement, "In my opinion, it is difficult to use the model in subjects like mol, for example. I can have difficulty at first in



learning at home the subjects in which I make chemical calculations”, made by Ö1 is supportive of the result obtained.

There were negative as well as positive views about the videos that the students were sent. The answers to the question were also similar to the ones given to question one. Accordingly, the positive views argued that the videos helped prepare for the university entrance exam and provided the opportunity to make frequent revisions. On the other hand, the negative views claimed that the videos did not contain sufficient answers to the questions. Thus, the views supported the thought that students would have difficulty learning the chemical calculations on their own.

The participants stated that the activities done in the classroom had increased in-class interaction and that they strengthened the friendship ties. However, some of the students said that they had difficulty because some group members did not fulfill their responsibilities in doing group homework and that, therefore, they had negative consequences. The comment, “I sometimes get tired of group work. At those times, I think I can do it faster on my own, and it would save time. However, my communication with classmates also increased. It is also good. However, some of my friends do not observe the task distribution, and they always ask what their task is. At those times, I get tired of group work”. made by Ö2 indicated that group work had negative sides as well as positive sides.

The final question the students were required to answer asked their views on the homework they did after the classes. They generally found the homework useful. Thus, they said that they had the opportunity to look at the subject from a holistic perspective and to revise it while doing their homework and that, therefore, they learned it better. They also stated that using different applications while doing homework developed their skills and increased their motivation in the classes. The most difficult thing in doing the homework was associating their research with daily life. They said that they had difficulty associating their study

with daily life because they needed to know what resources to use and how to reach the resources.

2. Discussion

This study investigated the effects of the flipped learning model, which was designed according to the learning styles on the tenth graders' academic achievement in the subject of acids, bases, and salts, and it obtained their views on the learning model.

Examining the participants' post-test scores demonstrated an increase in both groups' achievement averages. Thus, the flipped learning model effectively raised students' academic achievement. There are also studies in the literature that have demonstrated that the learning model has positive effects on students' achievement (Cam et al., 2022; Davies et al., 2013; Hwang & Lai, 2017; Lo & Hew, 2020; MacKinnon, 2015; Nwokeji & Holmes, 2017; Prashar, 2015; Wilson, 2013). It was concluded on the comparison of the post-test results that the students in the experimental group who were taught in a flipped learning model, which was designed according to learning styles, achieved higher success in the unit of acids, bases, and salts than the students in the control group who were taught in the traditional flipped learning model. The result could be attributed to the influential individual differences available in the flipped learning model. "Learning styles" are also individual differences that need consideration. It became apparent in this model, in which students took the responsibility for learning, that designing learning environments according to students' learning styles contributed positively to their achievement.

It was found with semi-structured interviews with voluntary students and with the achievement test that they had positive perspectives of the flipped learning model in general. Similarly, Göğebakan Yıldız et al. (2016), in a study that analyzed the flipped classroom model in terms of prospective teachers' access and their views about the model, found that the prospective teachers stated largely positive views on the implementation of the model and that they considered the model effective.



All the students included in this study said that watching the lesson videos whenever they wanted and as often as they wished was influential in reinforcement and that they could constantly revise the subject in this way. In another study conducted by Şengel in 2016, which investigated the effectiveness of the flipped classroom model in comparison with traditional teaching and conducted with the participation of computer teaching students, it was found that the students had similar thoughts. One of the participants, for instance, stated, "Although I spent more time studying than before, I enjoyed it. Watching videos, pausing, and taking notes increased my interaction with the course. As much as I try, I feel that I could do difficult concepts in this manner".

The positive views about the model stated by the students were generally based on their freedom to access the videos at any time. Besides, they also believed that the homework they were asked to do at the end of the classes was also influential in their holistic approach to the subject taught to them. The findings obtained by Lo and Hew (2020) in a study conducted with the ninth graders also supported the view. They revealed that the participants' positive views of the flipped learning model's out-of-the-class activities stemmed from the fact that they could access online learning resources when they wanted.

The students' positive views on the flipped learning model were parallel to the post-test scores they had received from the achievement test. There was an increase in all the participants' post-test scores. Similarly, Adams and Dove (2018), in their study, which investigated the effects of flipped learning on university students' achievement in the calculus course, also found a significant increase in their achievement. The researchers also observed that the students in the experimental group, in which the increased achievement was observed, had positive views of the model.

D. Conclusion

In conclusion, in this study, which aimed to investigate the effectiveness of the flipped learning model designed according to learning



styles in the Acids, Bases, and Salts unit compared to the traditional flipped learning model, it was revealed that the flipped learning model designed according to learning styles was effective in increasing student achievement. In the experimental group, the students who had the opportunity to participate in activities related to the place of acids, bases, and salts in daily life, either through group work or individually, participated more actively and were able to use learning materials more effectively. This situation also strengthened the interaction between the student and the teacher. Because students could develop a study strategy according to their own learning situation and identify the places they did not understand about the subject.

The positive opinions of the students towards the model also supported this situation. With this study, it has been revealed that taking into account individual differences in chemistry lessons and arranging the learning environment according to these differences in the applications of the flipped learning model centered on the learner in the field of chemistry education holds the potential to allow the educational activities to be carried out more effectively.

Bibliography

- Adams, C., & Dove, A. (2018). Calculus Students Flipped Out: The Impact of Flipped Learning on Calculus Student's Achievement and Perceptions of Learning. *PRIMUS*, 28(6), 600-615. <https://doi.org/10.1080/10511970.2017.1332701>.
- Akkoyunlu, B. (1995). Bilgi Teknolojilerinin Okullarda Kullanımı Ve Öğretmenlerin Rolü. [The use of Information Technologies in Schools and the Role of Teachers]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 11, 105-109.
- Aşkar, P. & Akkoyunlu, B. (1993). Kolb Öğrenme Stili Envanteri. [Kolb Learning Style Inventory]. *Eğitim ve Bilim*, 87,37-47. *Eğitim Fakültesi Dergisi*, 11, 105-109.
- Bergmann, J. & Sams, A. (2012). *Flip Your Classroom: Reach Every Student in Every Class Every Day*. Colorado: International Society for Technology in Education.



- Cam, A., Arslan, H. O., & Cigdemoglu, C. (2022). Flipped Learning Model - Learning Style Interaction: Supporting Pre-Service Teachers on Science Teaching Methods and Personal Epistemologies. *Science Education International*, 33(3), 323–334. <https://doi.org/10.33828/sei.v33.i3.8>.
- Chae, S. J. (2021). Medical Students' Satisfaction with Online Flipped Learning by Learning Styles. *Korean Journal of Medical Education*, 33(4), 405. <https://doi.org/10.3946/KJME.2021.208>.
- Davies, R. S., Dean, D. L., & Ball, N. (2013). Flipping the Classroom and Instructional Technology Integration in a College-Level Information Systems Spreadsheet Course. *Educational Technology Research and Development*, 61(4), 563–580. <https://doi.org/10.1007/S11423-013-9305-6/TABLES/10>.
- Demirci, M. (2018). *Uzaktan Eğitimde Öğrenme Stillerine Dayalı Akademik Destek Hizmetlerinin Pedagojik Formasyon Öğrencilerinin Başarisina Etkisi (The Effect of Academic Support Services Based on Learning Style in Distance Education on Pedagogical Formation Students' Achievement)* [Master Thesis, Sakarya University]. YÖK National Thesis Center.
- Dunn, R. & Dunn, K. 1993. *Teaching Secondary Students Through their Individual Learning Styles*, Boston: Allyn & Bacon.
- Flipped Learning Network (FLN). (2014) *The Four Pillars of F-L-I-PTM*
- Giray, L., Gumalin, D., Jacob, J., & Villacorta, K. (2022). Exploring the Online Learning Experience of Filipino College Students During Covid-19 Pandemic. *Jurnal Ilmiah Peuradeun*, 10(1), 227-250. <https://doi.org/10.26811/peuradeun.v10i1.691>
- Gómez-Tejedor, J. A., Vidaurre, A., Tort-Ausina, I., Molina-Mateo, J., Serrano, M. A., Meseguer-Dueñas, J. M., Martínez Sala, R. M., Quiles, S., & Riera, J. (2020). Effectiveness of Flip Teaching on Engineering Students' Performance in the Physics Lab. *Computers & Education*, 144, 103708. <https://doi.org/10.1016/J.COMPEDU.2019.103708>.
- Göğebakan Yıldız, D., Kıyıcı, G., & Altıntaş, G. (2016). Ters-Yüz Edilmiş Sınıf Modelinin Öğretmen Adaylarının Erişileri Ve Görüşleri Açısından İncelenmesi. [A Research into the Flipped Classroom in Terms of the Academic Achievement and Views of the Prospective Teachers]. *Sakarya University Journal of Education*, 6/3.
- Grasha, A.F. (2002). *Teaching with Style: A Practical Guide to Enhancing Learning by Understanding Teaching and Learning Styles*. Alliance Publishers.



- Gündüz, A. Y., Dağhan, G. & Akkoyunlu, B. (2016). *Dönüştürülmüş Öğrenme Ortamlarında Öğrenme Stilleri ile Akademik Başarı İlişkisinin İncelenmesi*. [Investigation of the Relationship between Learning Styles and Academic Achievement in Transformed Learning Environments] 7. Uluslararası Eğitimde Yeni Eğitimler Konferansı (INTE 2016), Viyana, Avusturya.
- Güven, M. (2004). *Öğrenme Stilleri ile Öğrenme Stratejileri Arasındaki İlişki*. [The Relationship between Learning Styles and Learning Strategies] Eskişehir: Anadolu Üniversitesi Eğitim Fakültesi Yayınları.
- Halili, S. H., Sulaiman, S., Sulaiman, H., & Razak, R. (2019). Exploring Students' Learning Styles using Mobile Flipped Classrooms | Estudio de los Estilos de Aprendizaje del Alumnado en Clases Inversas con Móvil. *International and Multidisciplinary Journal of Social Sciences*, 8(2), 105-125.
- Hwang, G.-J., & Lai, C.-L. (2017). Facilitating and Bridging Out-of-Class and in-Class Learning: An Interactive e-Book-Based Flipped Learning Approach for Math Courses. *Educational Technology & Society*, 20(1), 184-197.
- Jonassen, D. H., & Grabowski, B. L. (1993). *Handbook of Individual Differences, Learning, and Instruction*. Lawrence Erlbaum Associates, Inc.
- Karasar, N. (1999). *Bilimsel araştırma yöntemi (9. Baskı)*. [Scientific research method]. Nobel Akademik Yayıncılık.
- Kılıç, E. & Karadeniz, S. (2004). The Effects of Gender and Learning Style on Navigation Strategy and Achievement. *Gazi Eğitim Fakültesi Dergisi*, 3: 129-146.
- Kim, J. Y. (2018). A Study of Students' Perspectives on a Flipped Learning Model and Associations among Personality, Learning Styles, and Satisfaction. *Innovations in Education and Teaching International*, 55(3), 314-324. <https://doi.org/10.1080/14703297.2017.1286998>.
- Kinshuk, C., N. S., C., I. L., & Chew, S. W. (2016). Evolution is not Enough: Revolutionizing Current Learning Environments to Smart Learning Environments. *International Journal of Artificial Intelligence in Education*, 26(2), 561-581. <https://doi.org/10.1007/S40593-016-0108-X>.
- Leatherman, J. L., & Cleveland, L. M. (2020). Student Exam Performance in Flipped Classroom Sections is Similar to that in Active Learning Sections, and Satisfaction with the Flipped Classroom Hinges on Attitudes toward Learning from Videos. *Journal of Biological Education*, 54(3), 328-344. https://doi.org/10.1080/00219266.2019.1575266/SUPPL_FILE/RJBE



[A 1575266 SM7816.TIF.](#)

- Lo, C. K., & Hew, K. F. (2020). A Comparison of Flipped Learning with Gamification, Traditional Learning, and Online Independent Study: The Effects on Students' Mathematics Achievement and Cognitive Engagement. *Interactive Learning Environments*, 28(4), 464-481. <https://doi.org/10.1080/10494820.2018.1541910>.
- MacKinnon, G. (2015). Determining useful tools for the Flipped Science Education Classroom. *Contemporary Issues in Technology and Teacher Education (CITE Journal)*, 15(1), 44-55.
- Maloniso, M. (2023). Blended Learning Modality in Teaching Statistics in a Graduate Program of a State University in the Philippines. *Jurnal Ilmiah Peuradeun*, 11(2), 403-424. <https://doi.org/10.26811/peuradeun.v11i2.889>
- Nouri, J. (2016). The Flipped Classroom: For Active, Effective, and Increased Learning - Especially for Low Achievers. *International Journal of Educational Technology in Higher Education*, 13(33), 1-10. <https://doi.org/10.1186/S41239-016-0032-Z>.
- Nwokeji, J. C., & Holmes, T. S. (2017). The Impact of Learning Styles on Student Performance in Flipped Pedagogy. *Proceedings - Frontiers in Education Conference, FIE, 2017-October*, 1-7. <https://doi.org/10.1109/FIE.2017.8190522>.
- O'Flaherty, J., & Phillips, C. (2015). The use of Flipped Classrooms in Higher Education: A Scoping Review. *Internet and Higher Education*, 25, 85-95. <https://doi.org/10.1016/J.IHEDUC.2015.02.002>.
- Peker, M. (2003). Kolb Öğrenme Stili Modeli [Kolb Learning Style Model], *Milli Eğitim Dergisi*, 157, 185-192.
- Prashar, A. (2015). Assessing the Flipped Classroom in Operations Management: A Pilot Study. *Journal of Education for Business*, 90(3), 126-138. <https://doi.org/10.1080/08832323.2015.1007904>.
- Schultz, D., Duffield, S., Rasmussen, S. C., & Wageman, J. (2014). Effects of the Flipped Classroom Model on Student Performance for Advanced Placement High School Chemistry Students. *Journal of Chemical Education*, 91(9), 1334-1339. https://doi.org/10.1021/ED400868X/SUPPL_FILE/ED400868X_S_I_002.DOCX.
- Strayer, J. F. (2012). Learning in an Inverted Classroom Influences Cooperation, Innovation, and Task Orientation. *Learning Environments Research*,

- 15(2), 171–193. <https://doi.org/10.1007/S10984-012-9108-4>.
- Şengel, E. (2016). To FLIP or not to FLIP: Comparative Case Study in Higher Education in Turkey. *Computers in Human Behavior*, 64, 547–555. <https://doi.org/10.1016/J.CHB.2016.07.034>.
- Tabrani, Z. A., Idris, S., Yusoff, M. Z. M., Siswanto, R., & Murziqin, R. (2023). Strategy on boarding school development: between trend and performance analysis. *Multidisciplinary Reviews*, 6(2), 2023013–2023013. <https://doi.org/10.31893/multirev.2023013>
- Taşpınar, M. (2012). *Kuramdan Uygulamaya Öğretim ilke ve Yöntemleri*. [Teaching Principles and Methods from Theory to Practice]. Pegem Akademi.
- Tekin, D. (2020). *Kimyanın Temel Kanunları, Kimyasal Hesaplamalar ve mol Kavramı Ünitelerinin Yapılandırmaçılık Temelli Ters yüz Edilmiş Sınıf Modeli ile Öğretimi*. (Basic Laws of Chemistry Teaching of Chemical Calculations and Mole Concept Units with Constructivism based Inverted Class Model) [Master thesis, Marmara University]. YÖK National Thesis Center.
- Teo, T. W., Tan, K. C. D., Yan, Y. K., Teo, Y. C., & Yeo, L. W. (2014). How Flip Teaching Supports Undergraduate Chemistry Laboratory Learning. *Chemistry Education Research and Practice*, 15(4), 550–567. <https://doi.org/10.1039/C4RP00003J>.
- Usta, A., Bodur, H., Yağız, D. & Sünbül, A. M. (2011). İlköğretim fen Bilgisi Derslerinde Öğrenme Stillere Dayalı Öğretim Etkinliklerinin Öğrenci Erişi ve Tutumlara Etkisi. [The Effect of Teaching Activities Based on Learning Styles on their Achievement and Attitude Related Science Lecture in Primary School]. *Ahmet Keleşoğlu Eğitim Fakültesi Dergisi*, (31), 1-13.
- Werner, L., Denner, J., Campe, S., & Kawamoto, D. C. (2012). The Fairy Performance Assessment: Measuring Computational Thinking in Middle School. *SIGCSE'12 - Proceedings of the 43rd ACM Technical Symposium on Computer Science Education*, 215–220. <https://doi.org/10.1145/2157136.2157200>.
- Wilson, S. G. (2013). The Flipped Class: A Method to Address the Challenges of an Undergraduate Statistics Course. *Teaching of Psychology*, 40(3), 193–199. <https://doi.org/10.1177/0098628313487461>.
- Zereyak, E. (2005). Grasha-Riechmann Öğrenci Öğrenme Stilleri Ölçeğinin Türkçe Uyarlaması. [Adoption Grasha – Riechmann Student Learning Style Survey into the Turkish]. *Eğitim Bilimleri ve Uygulama Dergisi*, 4(8), 117-138.



