www.ijemst.net

Review of Studies on the Use of the Flipped Learning Model in Science Education

Gamze Comez
Yildiz Technical University, Turkiye

Gulbin Ozkan
Yildiz Technical University, Turkiye

To cite this article:

Comez, G. & Ozkan, G. (2025). Review of studies on the use of the flipped learning model in science education. *International Journal of Education in Mathematics, Science, and Technology (IJEMST), 13*(1), 19-39. https://doi.org/10.46328/ijemst.4369

International Journal of Education in Mathematics, Science and Technology

2025, Vol. 13, No. 1, 19-39 https://doi.org/10.46328/ijemst.4369

Review of Studies on the Use of the Flipped Learning Model in Science Education

Gamze Comez, Gulbin Ozkan

Article Info

Article History

Received:
02 April 2024
Accepted:
10 August 2024

Keywords

Flipped learning
Science education
Review

Abstract

This study aims to investigate the effect of the flipped learning model in science education. Therefore, articles in the Web of Science database were analyzed using the systematic review method. During the research, 1627 data points were obtained using the keyword 'flipped learning.' Articles between 2013 and 2023 were examined during the research process, but no studies were found between 2013 and 2015. The data obtained is limited to science, chemistry, biology, and physics education. A total of 38 articles with the specified criteria were reached. Articles were analyzed based on focus questions. Through article analysis, it was examined in which countries the flipped learning model applied in science education was used, in which years it was applied, at which education level it was applied, and in which disciplines it was applied. Additionally, the study investigated the purposes of using the flipped learning model in science education, and its benefits and disadvantages were determined. The materials, web tools, and research methods used in the flipped classroom model were determined. This study is essential in determining the model's importance and place in science teaching.

Introduction

Science is a course that helps individuals make sense of events occurring within themselves and in nature (Aksoy & Aydin, 2022). In addition, science is a course that cannot be learned by memorizing; the student must be active and expected to acquire questioning and problem-solving behaviors (Aydin & Komurkaraoglu, 2016). For this reason, educators have developed many teaching models so that students can learn more meaningfully and actively (Kilic Uyar & Girgin, 2016). Flipped Learning Model (FLM) is one of these teaching models. FLM is a model that enables the student to be active and take responsibility for their learning, allows the student to learn information outside of school through online or offline applications, and helps students learn in the classroom under the guidance of the teacher and in collaboration with their peers (Adiguzel & Kirmizioglu, 2019; Arslanhan, Bakirci & Altunova, 2022).

FLM aims to enable students to move away from traditional teaching that wants them to be passive (Karakas, 2021). Additionally, FLM allows the teacher to reach every student (Bergman & Sams, 2012). This model implements course content by giving students video lessons, written resources, online or offline homework, and exams (Gonzales, Jeong, Rodriguez & Canada, 2016). Studies to be done outside the classroom can be done with Web 2.0 tools or with documents prepared by the teacher (Kozikoglu, Erbenzer & Ates, 2021). It is also expected that these applications will contribute to the acquisition of 21st-century skills under the headings of "Learning and Innovation Skills," "Digital Literacy Skills," and "Career and Life Skills" that students should have (Cakir & Yaman, 2017).

Chen et al. (2014) stated that FLM consists of four essential components to increase the student's learning level in the flipped classroom and to provide students with 21st-century skills. These components are listed as "flexible learning environment," "learning culture," "designed content," and "professional educator." A flexible learning environment means students should be flexible regarding the time, place, course hours, and subject content. Learning culture means moving from a teacher-centered approach to a student-centered approach. Designed content means that the educator must determine which information will be processed, how, and which material will be used. The professional educator component states that the teacher has more responsibility as they act as a guide.

With FLM, students learn fundamental knowledge at home, and when they are in the classroom, they focus on developing high-level skills such as problem-solving, questioning, and discussion (Arslanhan, Bakirci & Altunova, 2022). Therefore, according to Hayrisever and Orhan (2018), the lesson taught in the classroom with FLM is aimed at the steps of "Apply, Analyze, Evaluate and Create" in Bloom's Taxonomy, while in the Traditional Teaching Model, the lesson taught in the classroom is directed at the steps of "Understand and Remember." It is expected that FLM will positively impact science education, which will raise productive, questioning, and problem-solving individuals of the future.

When the literature is examined, it is seen that FLM has many contributions to the education and training environment. Petridou, Molohidis and Hatzikraniotis (2022) examined the effect of the FLM study conducted during the COVID-19 period on the scientific literacy of high school students. The research showed that it positively affected students' active participation in learning, awareness of scientific applications, and scientific literacy levels, even under distance education conditions. Gundogan Onderoz and Ozdemir (2022) examined the contribution of FLM to 4th-grade students' participation in class and their learning responsibilities. In this action research, when the data collected with the observation form was examined, it was observed that the student's participation in the lesson and their behavior of coming to class on time increased. It was determined that the course taught with FLM was more fun, but some technology-related difficulties occurred during the process.

Solak (2021) examined the effect of the science course taught with FLM on the academic success of 8th-grade students and eliminating misconceptions. As a result of the study, it was concluded that there was a significant difference in the educational success percentages of the students between the experimental and control groups and that it was an effective method in eliminating misconceptions. In the study conducted by Cakir and Yaman (2017) on secondary school students, they examined the effects of flipped classroom applications in science classes on their science achievement and mental risk-taking levels. As a result of the research, it was observed that students' science success increased. However, there was no significant difference between the experimental and control groups in their mental risk-taking levels.

Ros and Laguna (2021) examined the effect of FLM on the scientific education of teacher candidates. As a result of the research, they noticed that the majority of the students not only made a significant improvement in their academic results but also developed positive attitudes towards science lessons.Gonzales et al. (2016) investigated students' performance and perceptions in the flipped learning model. According to the research results, it was concluded that the performances and perceptions of the students to whom flipped education was applied were statistically higher. It has also been stated that many students benefit from individualized learning due to the increased opportunities to pause, rewind, and review lessons.

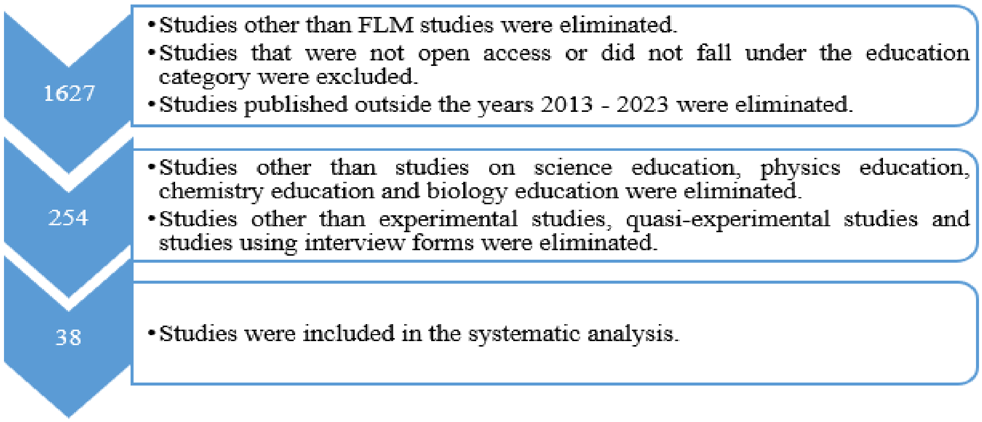
On the other hand, when the literature is examined, some studies show the disadvantages of FLM. For instance, Shi-Chun et al. (2014) pointed out that students with low motivation may struggle with this model and have difficulty accessing tests administered outside the classroom simultaneously. They also highlighted that not every student has the same computer and internet access opportunities, which may hinder effective communication. In another study, Ramírez, Hinojosa, and Rodríguez (2014) examined the advantages and disadvantages of FLM through the perceptions of STEM students. They found that some students experienced technical problems that prevented them from watching videos, asking for more videos from the teacher to learn a subject they did not understand before, and receiving immediate feedback during the self-learning phase outside the classroom. Some students also listed that they had difficulties receiving notifications and that the videos took too long for some of them as a disadvantage of this model. After the literature review, answers were sought to the following questions about FLM:

1. What are the education levels, countries, and years of studies on FLM in science education?
2. What are the purposes of studies on FLM in science education?
3. What are the advantages and disadvantages of applying FLM in science education?
4. What are the materials and web tools used in studies on FLM in science education?
5. What are the variables used in studies on FLM in science education?
6. What is the discipline distribution of studies on FLM in science education?

Method

Study Design

In this study, the systematic review method was used. A systematic review is a research method in which studies on specific subjects are examined in detail, and findings are created (Arslan, 2018). With this method, the studies were examined in detail, and answers to the above questions were tried to be determined. The data were searched for studies conducted between 2013 and 2023 by typing the keywords "Flipped Learning and Science Education," "Flipped Classroom and Science Education," and "Science Education," "Flipped Learning," "Flipped Classroom" in the "Web of Science" database. The studies examined were limited to studies in the fields of "science education," "physics education," "chemistry education," and "biology education." The studies' citation subjects and web of science categories were selected as "Education and Educational Research." Open-access studies were included in the research. As a result of the search, 1627 results were obtained. When these results were examined, experimental and quasi-experimental studies investigating the effect of FLM on science education and studies using interview forms or surveys/scales as data collection tools were analyzed. Among a total of 254 studies, 38 studies were used in the systematic review method. No data was found between 2013 and 2015 when the studies were examined. Therefore, these years were excluded from the study. The literature review was completed on March 26, 2023.



Results

The studies were examined on focus questions. The examined articles were systematically arranged in an Excel file, and the following results were obtained:

The First Question States: Distribution of Studies by Years, Education Levels, and Countries

The distribution of studies by years is shown in Figure 1.

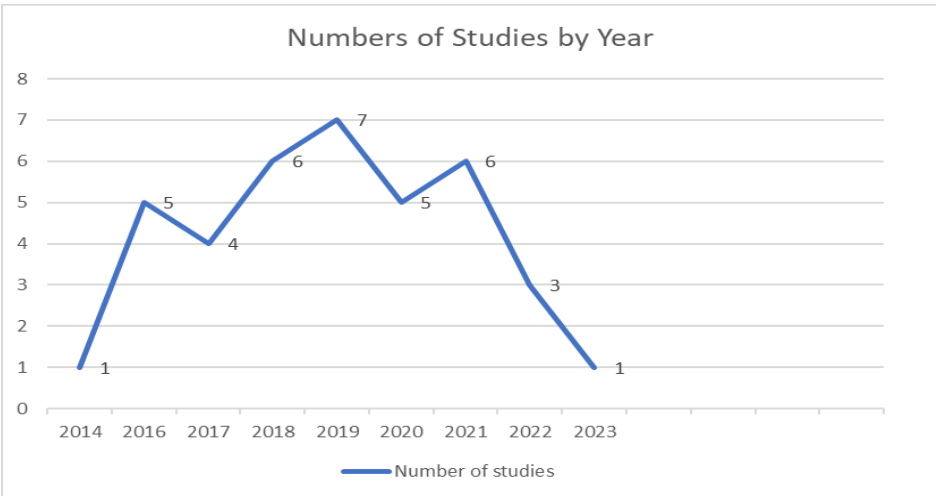


Figure 1. Number of Studies Examined by Years

Based on the research data, it was found that the year 2019 had the highest number of studies on FLM in science education in the Web of Science database, whereas the years 2014 and 2023 had the lowest numbers of studies. Furthermore, studies on FLM show a decline in numbers after 2021. The education levels and countries of the studies are shown in Figure 2 and Figure 3.

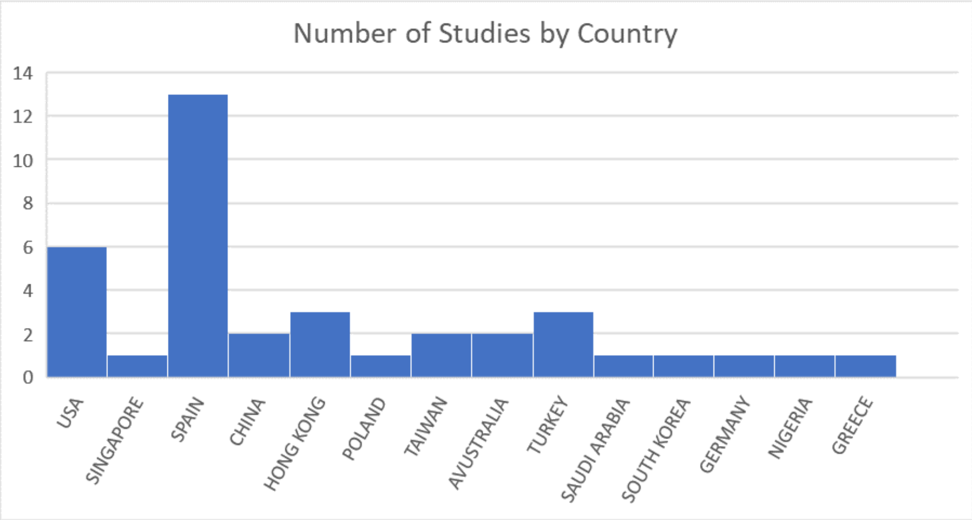


Figure 2. Number of Studies by Country

The number of studies by country is given in Figure 2. Studies on FLM in science education have been mainly conducted in Spain. The USA, Turkey and Hong Kong follow Spain.

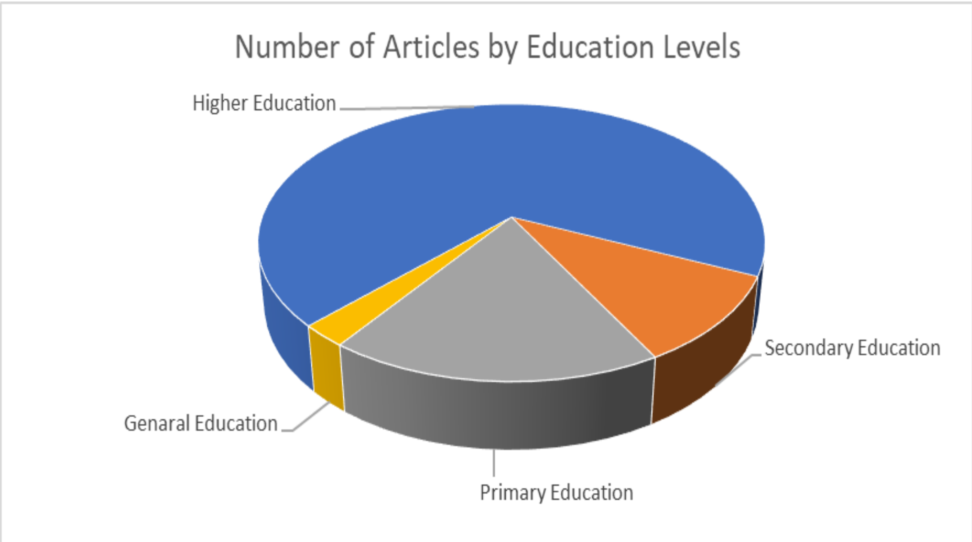


Figure 3. Number of Studies by Education Level

According to research data, higher education is the level where most studies are done. It is seen that most of the studies in the higher education category are carried out with pre-service teachers. The study by Pozo-Sánchez et al. (2021) includes studies conducted in the general category. The general category includes studies conducted at more than one level in the educational levels of researchers.

Table 1. Education Levels of Studies by Years and Countries

	USA	Germany	Australia	China	South Korea	Hong Kong	Nigeria	Spain	Poland	Singapore	Saudi Arabia	Taiwan	Turkey	Greece
2014										HE				
2016	HE(3)							HE(2)						
2017	HE			HE				HE	HE					
2018	HE(2)					PE		PE, HE(2)						
2019			HE(2)			HE		HE(4)						
2020				PE		SE		HE			HE		HE	
2021		HE			SE			G, HE(2)				HE		
2022							HE						PE	SE
2023													PE	

The analysis of education levels of studies on FLM by years and countries is given in Table 1. According to the data, it is seen that there is at least 1 study at the higher education level in countries other than Greece. It is seen that there are studies in Australia, Hong Kong, and Spain in 2019, the year in which the most studies on FLM were conducted. In addition, according to the last date of the literature review, the last study conducted in 2023 was in Turkey.

Purposes of the Studies

The purposes of the studies searched in the Web of Science database were analyzed by generating codes. According to the research data, the codes created were determined as "Understanding level, emotions, comparison, contents, active participation, individual learning, student opinions, and applicability." The numerical distribution of the aims of the studies according to the codes is given in Table 2.

Table 2. Numerical Distribution of the Purposes of the Studies According to Codes

Codes	Number of Studies
Level of Understanding	21
Emotions	16
Active Participation	7
Contents	5
Comparison	5
İndividual Learning	4
Applicability	2
Students' Opinions	1

It is seen that the studies are mainly collected under the code of students' academic levels, which is their understanding level. The level of understanding is followed by research on student emotions. The studies collected under the emotions code consist of studies that investigate students' attitudes, interests, and motivations. The researched studies show whether FLM affects students' active participation in the lesson. The studies targeted under the comparison code include studies on using FLM with STEM or inquiry-based learning models and their comparison by the researcher. The studies collected under the individual learning code include the extent to which students can do their learning before the lesson. The student opinions code includes studies in which students' opinions about FLM were obtained. The studies collected under the applicability code investigate whether it is appropriate for the teacher to apply FLM in classes or lessons.

Advantages and Disadvantages of FLM

The advantages and disadvantages of the studies examined in the Web of Science database are expressed in Table 3 and Table 4.

Table 3. The advantages of FLM in science education according to studies

Authors	Advantages
Teo et al. (2014)	It provides a better understanding of theoretical foundations in the laboratory.
Gonzalez-Gomez et al. (2016a)	It increases students' perception of learning.
Son, (2016)	It reduces laboratory costs and increases academic success and attitude towards science.
Gonzalez-Gomez et al. (2016b)	It increases students' academic success and perception of learning.
Taotao et al. (2016)	Students develop a positive attitude towards the lesson.
Reid, (2016)	It increases student success and course satisfaction.
Bernard et al. (2017)	It increases student satisfaction and teaching efficiency.
Li et al. (2017)	It increases learning success, course satisfaction and cooperative learning skills.
Gonzalez-Gomez et al. (2017)	It increases learning success and interest in the lesson.
Lax et al. (2017)	It helps with topics that require long-term thinking and increases active learning. It allows reaching students at different levels.
Jensen et al. (2018)	Using video as pre-lesson material has a positive impact on students.
Jeong et al. (2018)	It increases participation in the lesson and creates positive emotions towards the lesson.
Srinivasan et al. (2018)	It supports active learning. The use of video increases interest in the lesson.
Ye et al. (2018)	It helps students to actively structure their pre-class knowledge.
Manresa, (2018)	It increases academic success and perception of learning.
Chan et al. (2018)	It allows students to learn at their own pace and prepare for class.
Polo et al. (2019)	It increases motivation and perception.

Authors	Advantages
Gonzalez-Gomez et al. (2019)	It increases self-efficacy, interest in science and scientific content.
Gonzalez-Gomez and Jeong, (2019)	It creates a positive perception of science.
Tomas et al. (2019)	It provides student-centered learning.
Loveys and Riggs, (2019)	It increases success over time and encourages students to prepare for classes and become lifelong learners.
Jeong et al. (2019)	It improves students' skills and increases class participation.
Li et al. (2019)	It increases interest in the lesson.
Jdaitawi, (2020)	It increases the feeling of learning.
Hwang et al. (2020)	It increases learning performance.
Jeong et al. (2020)	It increases students' performance and motivation.
Cakiroglu et al. (2020)	It positively affects scientific process skills and increases students' self-regulation.
Fung, (2020)	It makes it easier to learn the necessary preliminary information for practical work and discussion.
Ros et al. (2021)	It increases academic success and perception of learning.
Schwichow et al. (2021)	It increases academic success and perception of learning.
Lee et al. (2021)	It increases motivation.
Jeong et al. (2021)	Increases awareness and motivation.
Hung et al. (2021)	It increases academic success and perception of learning.
Sanchez et al. (2021)	It increases skills such as environmental education, interaction, time use, active participation and critical thinking.
Petridou et al. (2022)	Increases awareness of scientific practice.
Demir and Oksuz, (2022)	It increases academic success.
Ugwuanyi, (2022)	It increases science learning, active participation and motivation.
Nacaroglu (2023)	Fun, different, instructive, useful, advantageous for students and flexible in terms of classroom applications.

The advantages of the studies carried out are given in Table 3. According to the research data, it has been determined that the use of FLM in science education increases students' academic success, motivation, interest in the lesson, and active participation.

Table 4. Disadvantages of FLM in Science Education according to Studies

Authors	Disadvantages
Bernard et al. (2017)	The lack of applications that can be used offline negatively affects students who have internet access problems.
Li et al. (2017)	Preparing online videos or materials before the lesson can cause a waste of time for the teacher.

Authors	Disadvantages
	Additionally, some students have limited internet access.
Gonzalez-Gomez et al. (2017)	Examination of the material prepared by a professional carefully is time-consuming.
Lax et al. (2017)	It does not create a high increase in academic success for students who do not work outside of school.
Jensen et al. (2018)	Implementation in every institution may not yield the same positive results.
Jeong et al. (2018)	Implementation in every institution may not yield the same positive results.
Ye et al. (2018)	Students may lack the motivation to watch lessons before class.
Chan et al. (2018)	Time constraints and lack of a laboratory to perform.
Tomas et al. (2019)	Students come to class unprepared.
Hwang et al. (2020)	Weak effect on students with low critical thinking tendencies.
Cakiroglu et al. (2020)	Technological inadequacies, technical problems.
Fung, (2020)	Technological inadequacies, technical problems.
Lee et al. (2021)	Time constraint.
Nacaroglu, (2023)	The opinion is that extracurricular practices are tiring.

The disadvantages of the studies carried out are given in Table 4. It is seen that the most common disadvantages of FLM in science education are problems such as technological inadequacies, students' lack of self-discipline, and internet problems.

Materials and Web Tools Used in Studies on FLM

Studies show that online or offline videos are some of the most used materials in FLM. Videos are frequently used as auxiliary material to give students visual and auditory information about the subject before the lesson. This is followed by reading materials - texts, PPTs (PowerPoint presentations), animations, interactive or non-interactive worksheets, concept maps, comics, QR codes, and CDs.

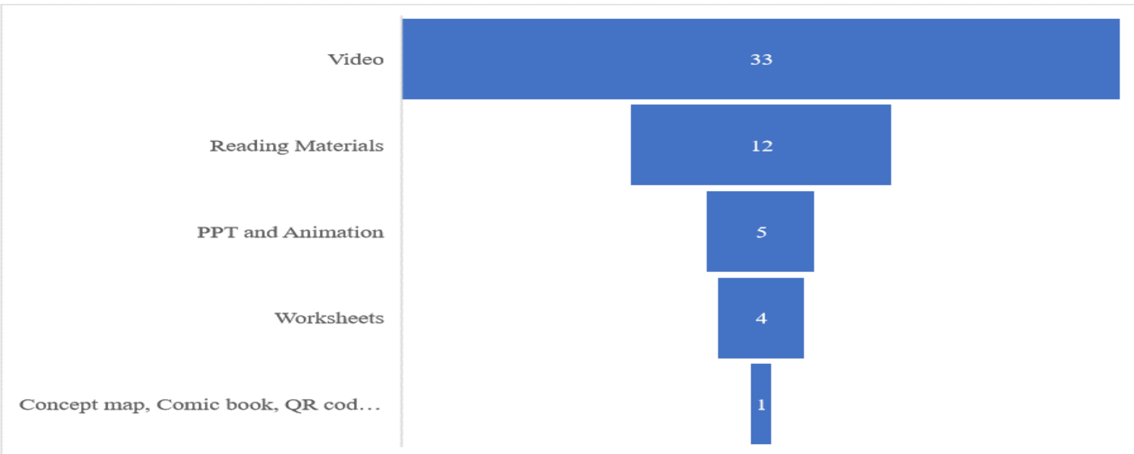


Figure 4. Pre-Lesson and Post-Lesson Materials Used in FLM Studies

The pre-lesson and post-lesson materials used in FLM studies are given in Figure 4. Web tools generally support studies on FLM. In addition to the commonly used web tools, there are also newly produced web tools by researchers. Table 5 shows the usage relationship of web tools according to materials in FLM.

Table 5. Usage Relationship of Web Tools according to Materials in FLM

Web Tools	Video	Reading Material	PPT	Animation	Worksheets	Concept Map	Comic Book
Educanon	x	x	x	x			
Screenflow	x	x	x	x			
Doceri	x	x	x	x			
Virtual lab							
Sapling	x	x					
Turning Point App	x				x		
PlayPosit	x						
Ballance	x						
Angry Birds	x						
Kahoot	x	x					
Socrative	x	x					
Quizziz	x	x					
SciEduFİT							
R-SPQ-2F	x	x		x			
Google Forms	x	x					
OpenCourseWare	x	x					x
webex					x		
e-classroom of the Panhellenic School Network					x		
Edpuzzle	x				x		
Whatsapp	x				x		
Khan akademy	x				x		
Education Information Network INF (EBA)	x				x		

According to the data given in Table 5, the web tools used are mostly integrated with video. Comic books are the least used tool.

Variables Used in the Studies

It is seen that studies on the flipped learning model in science education are tried to be supported with different variables. In studies investigating the effect of the flipped classroom model, its comparison with the traditional classroom model was examined as a binary variable.

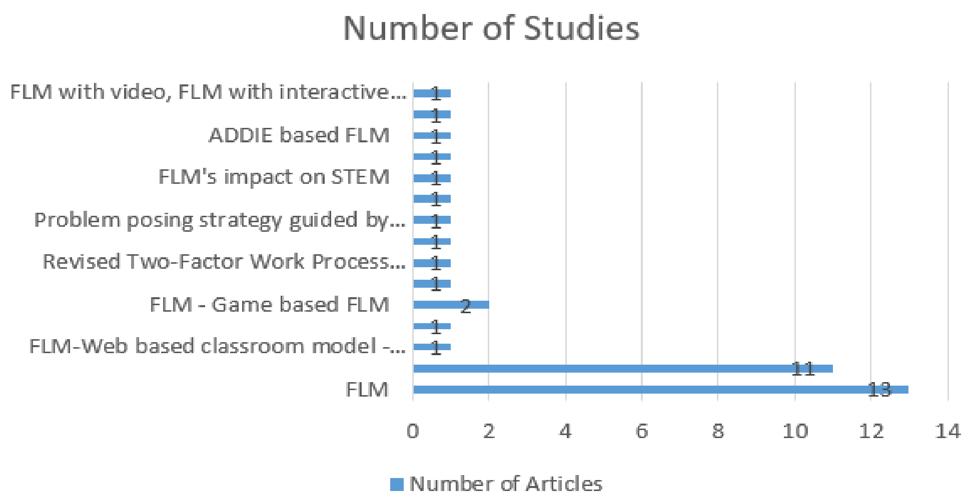


Figure 5. Variables and Numbers of Studies

According to Figure 5, the most used variable is determined to be FLM.

Distribution of Studies by Discipline

The studies conducted are also classified according to distribution of studies by discipline. Figure 6 gives the distribution of studies by discipline.

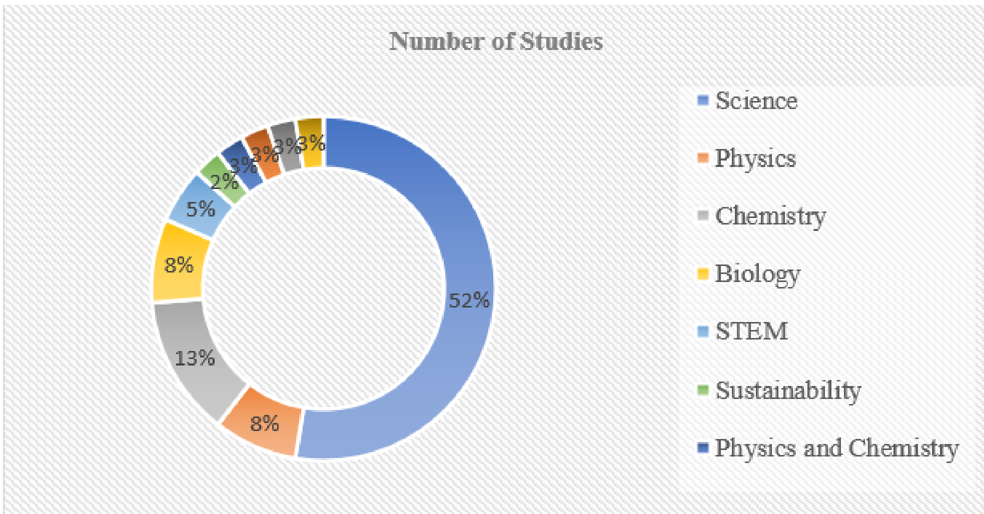


Figure 6. Distribution of Studies by Discipline

When Figure 6 is examined, it is seen that the studies on FLM are primarily done in the field of science with a rate of 52%. Science is followed by chemistry with 13% of studies. Sustainability and STEM topics, which are included in some studies, were included in this study because they are among the subheadings of the field of science.

Discussion and Conclusion

When today's curriculum is examined, it is seen that the learner does not receive the information ready-made; on the contrary, the individual differences of the students are taken into account, and the achievements that enable active participation and questioning in the classroom are included (Colak Yazici & Gundogdu, 2023). Individuals learning by doing and experiencing in the classroom and at their own pace makes the course more interesting. With the advancement of technology, students can access information quickly. For this reason, schools have begun to evolve from being a place where information is directly received to where students actively question or do activities in the classroom over time. (Ultay, Tanriverdi & ve Ultay, 2023). It has been seen from the studies examined that FLM, which is very compatible with today's teaching programs, has been investigated by many countries and researchers. According to general findings, FLM in science education generally meets academic expectations and is still developing in science education. Higher education is the level where FLM is most applied in science education within the scope of the answers sought in the context of research questions because researchers conduct research on students in their classes at the universities where they assist. In addition, it can be said that higher education students have more responsibility awareness than primary and secondary school students. In the studies examined, it was seen that research on FLM in science education has been conducted since 2014. In addition, it can be seen that the number of research studies reached the highest level in 2019 and increased again in 2021 after the decrease in 2020. It can be said that the reason for this situation may be the COVID-19 pandemic, which has affected the whole world since 2019. According to the studies examined, most studies on FLM in science education were conducted in Spain. This situation may be due to the development of similar studies by the same researchers. It can be said that along with Spain, the USA and Turkey are countries that show progress in using FLM in science education. The aims of the studies examined were generally about whether it positively affected the students' understanding levels, which is their academic success. The high academic success of the students will create an idea about the usability of this model in science education. It will allow it to be developed with different subsequent studies. FLM has advantages and disadvantages in science education. Some common advantages seen in the reviewed studies are that it increases academic success, and the sense of learning creates interest in the course and awareness of responsibility and ensures active participation. Some other studies in the literature also support this result. In Aksoy and Aydin's (2022) study on the absorption and reflection of light in the 7th-grade science course, it was stated that the student's academic success in the experimental group increased, and the information was more permanent. In the study conducted by Keskin, Karagolge, and Ceyhun (2021) with 10th-grade students on acids, bases, and salts, they stated that the student's academic success increased, and the students had positive feelings towards the course. Bozdag and Turkoguz (2021), in their study in which the opinions of 5th-grade students about the science course taught with FLM were obtained, concluded that the course was fun and interesting, and students' interest in the course increased. In their study with university students, Talan and Gulsecen (2018) examined the effects of FLM and blended learning on students' self-regulation skills and self-efficacy perceptions. The research showed that it positively affected the students' self-regulation skills in the experimental group. The disadvantages commonly seen in the studies examined are listed as follows: pre-lesson material prepared by the teacher takes time, time constraints, technological and internet inadequacy, and students coming to class unprepared. Studies in the literature support the results obtained. Urfa's (2017) study titled "Application of the Flipped Classroom Model in Science Ethics Course" stated that some students who expressed their opinions about the application of FLM expressed negative opinions because they experienced technical problems. In their study, Gundogan Onderoz and Ozdemir (2022) examined the effect of FLM on primary school students' class participation and learning responsibilities. They concluded that technological inadequacies and limited time create disadvantages in using FLM. In the studies examined, it was observed that the most commonly used out-of-class material was videos. Videos make the topics more visually and aurally understandable. Bergmann and Sams (2012) stated that watching educational videos before class helps students who cannot attend class complete their deficiencies and encourages active learning. Jensen et al. (2018) concluded that videos positively affect FLM learning. It is available in the studies examined that FLM was integrated with web 2.0 tools. Web 2.0 tools researchers use can be listed as "EduCanon, Screenflow, Doceri, Kahoot, Google Forms, Socrative, Quizziz, and Khan Academy." Integrating web 2.0 tools with course materials makes the course more interesting and provides meaningful learning (Colak Yazici & Gundogdu, 2023). It was observed that many different variables were used in the studies examined. However, studies investigating the effect of FLM in science education have been studied more frequently. This variable is followed by studies comparing FLM with the traditional classroom model. In the studies examined in the Web of Science database, the discipline distribution was examined as well. The disciplines in the studies were divided into categories, and ten disciplines emerged. These disciplines can be listed as science, physics, chemistry, biology, STEM, sustainability, science and social sciences, science and mathematics, and science and sustainability. It is seen that studies are most frequently carried out in the science education category in these disciplines. The reason for this situation is that in some studies, research was conducted on physics, chemistry, or biology; however, since the researcher called it "science" in the research content, it was included in the science category.

This study is expected to give researchers ideas about the purposes of using FLM in science education, its variables, materials and web tools, advantages and disadvantages, education levels, and discipline distribution. According to the studies reviewed, recommendations for researchers who will use FLM in science education are as follows:

- It was observed that the studies examined were mainly conducted at the higher education level. Therefore, there is a need for more studies at the primary and secondary education levels.
- Studies should be conducted for the experienced science teachers who use FLM in science education.
- The studies examined showed that more studies are needed to support students' inquiry-based learning. Studies that use FLM in science education and encourage inquisitive thinking should be conducted.

Studies Reviewed

Bernard, P., Bros, P., & Migdał-Mikuli, A. (2017). Influence of blended learning on outcomes of students attending a general chemistry course: summary of a five-year-long study. *Chemistry Education Research and Practice, 18*, 682. doi:10.1039/c7rp00040e

Chan, Y. C., Chung, K. L., & Hew, K. F. (2018). An Exploratory Study of Using the Next Generation Science Standards (NGSS) to flip Hong Kong Secondary School Science Education. *2018 2. Uluslararası e-toplum, e-eğitim ve e-teknoloji konferansı (ICSET 2018)*, 10-15. doi:10.1145/3268808.3268817

Cakiroglu, U., Guven, O., & Saylan, E. (2020). Flipping the experimentation process: influences on science process skills. *Education Tech Research Dev, 68*, 3425-3448. doi:10.1007/s11423-020-09830-0

Fung, C. H. (2020). How Does Flipping Classroom Foster the STEM Education: A Case Study of the FPD Model. *Tech Know Learn, 25*, 479-507. doi:10.1007/s10758-020-09443-9

Gonza´lez-Go´mez, D., Jeong, J. S., Rodri´guez, D. A., & Can˜ada-Can˜ada, F. (2016). Performance and Perception in the Flipped Learning Model: An initial approach to evaluate the effectiveness of a new teaching methodology in a general science classroom. *Journal of Science Education and Technology*, 450-459. doi:10.1007/s10956-016-9605-9

González Gómez, D., Cañada Cañada, F., Jeong, J. S., & Picó, A. G. (2017). La enseñanza de contenidos científicos a través de un modelo «Flipped»: Propuesta de instrucción para estudiantes del Grado de Educación Primaria. *Enseñanza de las Cien-cias, 35*(2), 71-87. doi:10.5565/rev/ensciencias.2233

González-Gómez, M., & Jeong, J. S. (2019). EduSciFIT: A Computer-Based Blended and Scaffolding Toolbox to Support Numerical Concepts for Flipped Science Education. *Education Science, 9*(2), 116. doi:10.3390/educsci9020116

González-Gómez, D., Jeong, J. S., & Cañada-Cañada, F. (2022). Enhancing science self-efficacy and attitudes of Pre-Service Teachers (PST) through a flipped classroom learning environment. *Interactive Learning Environments, 30*(5), 896-907. doi:10.1080/10494820.2019.1696843

Guven Demir, E., & Oksuz, Y. (2022). Donusturulmus Sinif ve Revize Edilmis Donusturulmus Sinif Modellerinin Akademik Basari ve Planlama Becerisine Etkisinin Karsilastirilmasi. [Comparison of the Effects of Transformed Classroom and Revised Transformed Classroom Models on Academic Achievement and Planning Skills] *Hacettepe University Journal of Education, 37*(2), 523-540. doi: 10.16986/HUJE.2021067072

Gyeong-Geon, L., Young-Eun, J., & Hun-Gi, H. (2021). The effects of cooperative flipped learning on science achievement and motivation in high school students. *International Journal of Science Education, 43*(9), 1381–1407. doi:10.1080/09500693.2021.1917788

Hung, H. C., & Young, S. C. (2021). Unbundling teaching and learning in a flipped thermal physics classroom in higher education powered by emerging innovative technology. *Australasian Journal of Educational Technology, 37*(4), 89-99. doi:10.14742/ajet.6059

Hwang, G. J., Chang, S. C., Yanjie, S., & Hsieh, M. C. (2021). Powering up flipped learning: An online learning environment with a concept map-guided problem-posing strategy. *Journal of Computer Assisted Learning, 37*(2), 429 – 445. doi:10.1111/jcal.12499

Jdaitawi, M. (2020). Does Flipped Learning Promote Positive Emotions in Science Education? A Comparison between Traditional and Flipped Classroom Approaches. *The Electronic Journal of e-Learning, 18*(6), 516–524. doi:10.34190/JEL.18.6.004

Jensen, J., Holt, E., Sowards, J., Heath Ogden, T., & West, R. (2018). Investigating Strategies for Pre-Class Content Learning in a Flipped Classroom. *Journal of Science Education and Technology, 27*(6), 523-535. doi:10.1007/s10956-018-9740-6

Jeong, J. S., González-Gómez, D., & Cañada-Cañada, F. (2016). Students' Perceptions and Emotions Toward Learning in a Flipped General Science Classroom. *25*, 747-758. doi:10.1007/s10956-016-9630-8

Jeong, J. S., Cañada-Cañada, F., & González-Gómez, D. (2018). The Study of Flipped-Classroom for Pre-Service Science Teachers. *Education Science, 8*(4), 163. doi:10.3390/educsci8040163

Jeong, J. S., González-Gómez, D., Conde-Núñez, M., & Picó, A. (2019). Examination of students' engagement with r-spq 2f of learning approach in flipped sustainable science course. *Journal of Baltic Science Education, 18*(6), 880-891. doi:10.33225/jbse/19.18.880

Jeong, J. S., González-Gómez, D., & Yllana Prieto, F. (2020). Sustainable and Flipped STEM Education: Formative Assessment Online Interface for Observing Pre-Service Teachers' Performance and Motivation. *Education Science, 10*(10), 283. doi:0.3390/educsci10100283

Jeong, J., González-Gómez, D., Conde-Núñez, M. J., Sánchez-Cepeda, J. S., & Yllana-Prieto, F. (2021). Improving Climate Change Awareness of Preservice Teachers (PSTs) through a University Science Learning Environment. Education Science, 11(2), 78. doi:10.3390/educsci11020078

Lax, N., Morris, J., & Kolber, B. (2017). A partial flip classroom exercise in a large introductory general biology course increases performance at multiple levels. *Journal of Biological Education, 51*(4), 412-426. doi:10.1080/00219266.2016.1257503

Li, M., Lai, C. W., & Szeto, W. M. (2019). Whiteboard Animations for Flipped Classrooms in a Common Core Science General Education Course. *5th International Conference on Higher Education Advances (HEAd'19)*, 929-938. doi:10.4995/HEAd19.2019.9250

Li, Y. B., Zheng, W. Z., & Yang, F. (2017). Cooperation Learning of Flip teaching style on the MBA Mathematics Education Efficiency. *EURASIA J Math Sci Tech Ed., 13*(10), 6963–6972. doi:10.12973/ejmste/76878

Long, T., Logan, J., & Waugh, M. (2016). Students' Perceptions of the Value of Using Videos as a Pre-class Learning Experience in the Flipped Classroom. *TechTrends, 60*, 245-252. doi:10.1007/s11528-016-0045-4

Loveys, B., & Riggs, K. (2019). Flipping the laboratory: improving student engagement and learning outcomes in second-year science courses. *International Journal of Science Education, 41*(1), 64-79. doi:10.1080/09500693.2018.1533663

Manresa, S. T. (2018). Flipped Classroom: Un modelo pedagógico eficaz en el aprendizaje de Science Flipped Classroom: An effective pedagogical model in Science learning. *Revista Iberoamericana de Educación, 76*(1), 9-22.

Nacaroglu, O., Bektas, O., & Tuysuz, M. (2023). Examining the Emotional Semantic Orientation of Gifted Students Towards the Flipped Learning Model. *Technology, Knowledge and Learning, 28*, 117-142. doi:10.1007/s10758-021-09581-8

Petridou, E., Molohidis, A., & Hatzikraniotis, E. (2022). Assessing Students' Ability to Apply the Control of Variables Strategy When Engaged with Inquiry-Based Worksheets during. *Education Science, 12*, 668. doi: https://doi.org/10.3390/educsci12100668

Pozo-Sánchez, S., López-Belmonte, J., Cabrera, A. f., & López-núñez, J. A. (2021). Aplicación trietápica del flipped learning en el área de las ciencias. *Campus Virtuales, 10*(1), 35-47.

Reid, S. (2016). A flipped classroom redesign in general chemistry. *Chemistry Education Research and Practice, 17*, 914–922. doi: 10.1039/c6rp00129g

Ros, G., & Laguna, M. T. (2021). Influence of the flipped classroom in the scientific training of pre-service teachers: benefits in the teaching-learning process, attitudes, and expectations towards science attitudes and expectations towards science. *Revista de Investigación Educativa, 39*(2), 463-482. doi:https://doi.org/10.6018/rie.374121

Schwichow, M., Hellmann, K. A., & Mikelskis-Seifert, S. (2022). Pre-service Teachers' Perception of Competence, Social Relatedness, and Autonomy in a Flipped Classroom: Effects on Learning to Notice Student Preconceptions. *Journal of Science Teacher Education, 33*(3), 282-302. doi:10.1080/1046560X.2021.1913332

Srinivasan, S., Gibbons, R., Murphy, K., & Raker, J. (2018). Flipped classroom use in chemistry education: results from a survey of postsecondary faculty members. *19*, 1307–1318. doi: 10.1039/c8rp00094h

Son, J., Narguizian, P., Beltz, D., & Desharnais, R. (2016). Comparing Physical, Virtual, and Hybrid Flipped Labs for General Education Biology. *Online Learning, 20*(3), 228-243.

Teo, T. W., Tan, K., Yan, Y. K., Teo, Y. C., & Yeo, L. W. (2014). How flip teaching supports undergraduate chemistry laboratory learning. *Chemistry Education Research and Practice, 15*, 550-567. doi:10.1039/c4rp00003j

Tomas, L., Evans, N., Doyle, T., & Skamp, K. (2019). Are first-year students ready for a flipped classroom? A case for a flipped learning continuum. *Int J Educ Technol High Educ, 16*(5). doi:10.1186/s41239-019-0135-4

Ugwuanyi, C. S. (2022). Developing Sound Knowledge of Basic Science Concepts in Children Using Flipped Classroom: A case of simple repeated measures. *Education and Information Technologies, 27*, 6353-6365. doi:10.1007/s10639-021-10850-3

Ye, S.-H., Hsiao, T.-Y., & Sun, C.-T. (2018). Using commercial video games in flipped classrooms to support physical concept construction. *Journal of Computer Assisted Learning, 34*, 602-614. doi:10.1111/jcal.12267

Zamora-Polo, F., Corrales-Serrano, M., Sánchez-Martín, J., & Espejo-Antúnez, L. (2019). Nonscientific University Students Training in General Science Using an Active-Learning Merged Pedagogy: Gamification in a Flipped Classroom. *Education Science, 9*(4), 297. doi:10.3390/educsci9040297

References

Aksoy, I., & Aydin, A. (2022). The Effect of Flipped Classroom Model on Teaching of the Reflection in Mirrors and Absorption of Light Unit in the 7th Grade Science Lesson. *Karaelmas Journal of Educational Science, 10*(2022), 203-223.

Arslan, A. (2018). Sistematik Derleme ve Meta-Analizi. [Systematic review and analysis.] *Acta Medica Alanya, 2*(2), 62-63. doi:10.30565/medalanya.439541

Arslanhan, A., Bakirci, H., & Altunova, N. (2022). Fen Bilgisi Ogretmenlerinin Ters Yuz Ogretim Modeli Hakkindaki Gorusleri.[Science Teachers' Opinions About the Flipped Teaching Model] *Journal of Computer and Education Research, 10*(19), 26-49. doi:10.18009/jcer.1017574

Aydin, A., & Komurkaraoglu, S. (2016). Isık ve Ses Unitesinin Ogretiminde Jigsaw Tekniginin Bilgilerin Kalicilik Duzeylerine Etkisinin Incelenmesi ve Bu Teknik Hakkinda Ogrenci Gorusleri. [Examination of the Effect of the Puzzle Technique on the Permanence Levels of Knowledge in the Teaching of Light and Sound Unit and Student Opinions About This Technique], *Kastamonu Educational Journal, 24(1), 335-352.*

Barnard, M., Dehon, E., Compretta, C., Notebaert, A., Sparkmon, W., Meyer, E., . . . Rockhold, R. (2020).

Development of a competency model and tailored assessment method for high school science teachers utilizing a flipped learning approach. *Association for Educational Communications and Technology, 68*, 2595-2614. doi:https://doi.org/10.1007/s11423-020-09782-5

Bergman, J., & Sams, A. (2012). Flip Your Classroom Reach Every Student in Every Class Every Day. International society for technology in education.

Bernard, P., Bros, P., & Migdał-Mikuli, A. (2017). Influence of blended learning on outcomes of students attending a general chemistry course: summary of a five-year-long study. *Chemistry Education Research and Practice, 18*, 682. doi:10.1039/c7rp00040e

Bishop, J., & Verleger, M. A. (2013). The flipped classroom: A survey of the research. *2013 ASEE National Conference Proceedings*, (s. 1-18). Atlanta. doi:10.18260/1-2--22585

Bozdag, H. C., & Turkoguz, S. (2021). 5. sinif fen bilimleri dersi ogrencilerinin ters yuz sinif modeline yonelik gorusleri. [Opinions of 5th grade science students towards the flipped classroom model] *International Journal of New Trends in Arts, Sports & Science Education (IJTASE), 10*(2), 83-104.

Ceylan, E., & Hamzaoglu, E. (2022). Turkiye'de Fen Bilimleri Egitimi Alanlarinda Ters Yuz Ogrenme Yaklasiminin Kullanildigi Lisansustu Tezlerin Incelenmesi.[Examination of Postgraduate Theses Using the Flipped Learning Approach in Science Education in Turkey], *Anatolian Cultural Research Journal, 6(1), 31-41*.https://doi.org/10.15659/ankad.v6i1.195

Chan, Y. C., Chung, K. L., & Hew, K. F. (2018). An Exploratory Study of Using the Next Generation Science Standards (NGSS) to flip Hong Kong Secondary School Science Education. *International E-Society, E-Education and E-Technology Conference (ICSET 2018), 10-15. doi:10.1145/3268808.3268817*

Chen, Y., Wang, Y., Kinshuk, & Chen, N.-S. (2014). Is FLIP enough? Or should we use the FLIPPED model instead? *Computers & Education, 79*, 16-27. doi:ISSN 0360-1315

Cakir, E., & Yaman, S. (2017). Fen Bilimleri Dersinde Ters Yuz Sinif Uygulamalarinin Ogrencilerin Fen Basarilari ve Zihinsel Risk Alma Becerilerine Etkisi.[The Effect of Flipped Classroom Applications in Science Class on Students' Science Achievement and Mental Risk-Taking Skills] *Journal of Science Education, 5(2), 130-142.* https://dergipark.org.tr/en/pub/fbod/issue/71996/1158038

Cakiroglu, U., Guven, O., & Saylan, E. (2020). Flipping the experimentation process: influences on science process skills. *Education Tech Research Dev, 68*, 3425-3448. doi:10.1007/s11423-020-09830-0

Colak Yazici, S., & Gundogdu, B. (2023). An investigation of postgraduate theses involving the use of flipped classroom model in science fields. *International Journal of Duzce Educational Sciences, 1*(1), 20-35.

Fendos, J. (2018). US experiences with STEM education reform and implications for Asia. *International Journal of Comparative Education and Development, 20*(1), 51-66. doi:https://doi.org/10.1108/İJCED-10-2017-0026

Fung, C. H. (2020). How Does Flipping Classroom Foster the STEM Education: A Case Study of the FPD Model. *Tech Know Learn, 25*, 479-507. doi:10.1007/s10758-020-09443-9

Gonza´lez-Go´mez, D., Jeong, J. S., Rodri´guez, D. A., & Can˜ada-Can˜ada, F. (2016). Performance and Perception in the Flipped Learning Model: An Initial Approach to Evaluate the Effectiveness of a New Teaching Methodology in a General Science Classroom. *Journal of Science Education and Technology*, 450-459. doi:10.1007/s10956-016-9605-9

González Gómez, D., Cañada Cañada, F., Jeong, J. S., & Picó, A. G. (2017). La enseñanza de contenidos científicos a través de un modelo «Flipped»: Propuesta de instrucción para estudiantes del Grado de Educación Primaria. *Enseñanza de las Cien-cias, 35*(2), 71-87. doi:10.5565/rev/ensciencias.2233

González-Gómez, D., Jeong, J. S., & Cañada-Cañada, F. (2022). Enhancing science self-efficacy and attitudes of Pre-Service Teachers (PST) through a flipped classroom learning environment. *Interactive Learning Environments, 30*(5), 896-907. doi:10.1080/10494820.2019.1696843

González-Gómez, M., & Jeong, J. S. (2019). EduSciFIT: A Computer-Based Blended and Scaffolding Toolbox to Support Numerical Concepts for Flipped Science Education. *Education Science, 9*(2), 116. doi:10.3390/educsci9020116

Gundogan Onderoz, F., & Ozdemir, S. M. (2022). Tersyuz Ogrenme Yonteminin Ilkokul Ogrencilerinin Derse Katilimlarina ve Ogrenme Sorumluluklarina Katkisi Uzerine Bir Arastirma. [A Research on the Contribution of Flipped Learning Method to Primary School Students' Lesson Participation and Learning Responsibilities], *Mustafa Kemal University Faculty of Education Journal, 6(10), 146*-168. https://doi.org/10.56677/mkuefder.1194547

Guven Demir, E., & Oksuz, Y. (2022). Donusturulmus Sinif ve Revize Edilmis Donusturulmus Sinif Modellerinin Akademik Basari ve Planlama Becerisine Etkisinin Karsilastirilmasi. [Comparison of the Effects of Transformed Classroom and Revised Transformed Classroom Models on Academic Achievement and Planning Skills] *Hacettepe University Journal of Education, 37*(2), 523-540. doi: 10.16986/HUJE.2021067072

Gyeong-Geon, L., Young-Eun, J., & Hun-Gi, H. (2021). The effects of cooperative flipped learning on science achievement and motivation in high school students. *International Journal of Science Education, 43*(9), 1381-1407. doi:10.1080/09500693.2021.1917788

Hayirsever, F., & Orhan, A. (2017). Ters Yuz Edilmis Ogrenme Modelinin Kuramsal Analizi. [Theoretical Analysis of the Flipped Learning Model]. *Mersin University Faculty of Education Journal, 14(2), 572-596.* doi:10.17860/mersinefd.431745

Hung, H. C., & Young, S. C. (2021). Unbundling teaching and learning in a flipped thermal physics classroom in higher education powered by emerging innovative technology. *Australasian Journal of Educational Technology, 37*(4), 89-99. doi:10.14742/ajet.6059

Hwang, G. J., Chang, S. C., Yanjie, S., & Hsieh, M. C. (2021). Powering up flipped learning: An online learning environment with a concept map-guided problem-posing strategy. *Journal of Computer Assisted Learning, 37*(2), 429 – 445. doi:10.1111/jcal.12499

Jdaitawi, M. (2020). Does Flipped Learning Promote Positive Emotions in Science Education? A Comparison between Traditional and Flipped Classroom Approaches. *The Electronic Journal of e-Learning, 18*(6), 516-524. doi:10.34190/JEL.18.6.004

Jensen, J., Holt, E., Sowards, J., Heath Ogden, T., & West, R. (2018). Investigating Strategies for Pre-Class Content Learning in a Flipped Classroom. *Journal of Science Education and Technology, 27*(6), 523-535. doi:10.1007/s10956-018-9740-6

Jeong, J. S., González-Gómez, D., Conde-Núñez, M., & Picó, A. (2019). Examination of students' engagement with r-spq 2f of learning approach in flipped sustainable science course. *Journal of Baltic Science Education, 18*(6), 880-891. doi:10.33225/jbse/19.18.880

Jeong, J. S., González-Gómez, D., & Yllana Prieto, F. (2020). Sustainable and Flipped STEM Education:

Formative Assessment Online Interface for Observing Pre-Service Teachers' Performance and Motivation. *Education Science, 10*(10), 283. doi:0.3390/educsci10100283

Jeong, J. S., Cañada-Cañada, F., & González-Gómez, D. (2018). The Study of Flipped-Classroom for Pre-Service Science Teachers. *Education Science, 8*(4), 163. doi:10.3390/educsci8040163

Jeong, J. S., González-Gómez, D., & Cañada-Cañada, F. (2016). Students' Perceptions and Emotions Toward Learning in a Flipped General Science Classroom. *25*, 747-758. doi:10.1007/s10956-016-9630-8

Jeong, J., González-Gómez, D., Conde-Núñez, M. J., Sánchez-Cepeda, J. S., & Yllana-Prieto, F. (2021). Improving Climate Change Awareness of Preservice Teachers (PSTs) through a University Science Learning Environment. *Education Science, 11*(2), 78. doi:10.3390/educsci11020078

Karakas, G. (2021). Turkiye' de Ters Yuz Edilmis Ogrenme Ile Ilgili Yapilan Lisansustu Tezlerin Tematik, Metodolojik ve Istatistiksel Acidan Incelenmesi. [Thematic, Methodological and Statistical Examination of Postgraduate Theses on Flipped Learning in Turkey].Istanbul.

Keskin, E., Karagolge, Z., & Ceyhun , I. (2021). Ters Yuz Sinif Yonteminin 10. Sinif Ogrencilerinin ‘‘Asitler, Bazlar ve Tuzlar’’ Unitesindeki Akademik Basarilarina Etkisinin Incelenmesi. [Examining the Effect of the Flipped Classroom Method on the Academic Achievement of 10th Grade Students in the "Acids, Bases and Salts" Unit] *The Journal of Science Education, 9*(1), 58-88.

Kilic Uyar, E., & Girgin, S. (2016). Insan ve Cevre Konularini Kavramaya, Bilgilerin Kaliciligina ve Cevreye Karsi Tutuma Jigsaw Tekniginin Etkisi. [The Effect of Jigsaw Technique on Understanding Human and Environmental Issues, Permanence of Information and Attitude towards the Environment] *e-Kafkas Egitim Arastirmalari Dergisi, 3*(3), 8-18. *e-Kafkas Journal of Educational Research, 3(3), 8-18.*

Kirmizioglu, H. A., & Adiguzel, T. (2019). Kozikoglu, I., Erbenzer, E., & Ates, G. (2021). Ogretmenlerin Ters Yuz Ogrenme Oz- Yeterlik Algilari Ile Ogrenen Ozerkligini Destekleme Davranislari Arasindaki Iliski. [The Relationship Between Teachers' Self-Efficacy Perceptions in Flipped Learning and Their Learner Autonomy Supporting Behaviors] *Ataturk University Kazim Karabekir Faculty of Education Journal (42), 344-366.*

Lax, N., Morris, J., & Kolber, B. (2017). A partial flip classroom exercise in a large introductory general biology course increases performance at multiple levels. *Journal of Biological Education, 51*(4), 412-426. doi:10.1080/00219266.2016.1257503

Li, M., Lai, C. W., & Szeto, W. M. (2019). Whiteboard Animations for Flipped Classrooms in a Common Core Science General Education Course. *5th International Conference on Higher Education Advances (HEAd'19)*, 929-938. doi:10.4995/HEAd19.2019.9250

Li, Y. B., Zheng, W. Z., & Yang, F. (2017). Cooperation Learning of Flip teaching style on the MBA Mathematics Education Efficiency. *EURASIA J Math Sci Tech Ed., 13*(10), 6963-6972. doi:10.12973/ejmste/76878

Long, T., Logan, J., & Waugh, M. (2016). Students' Perceptions of the Value of Using Videos as a Pre-class Learning Experience in the Flipped Classroom. *TechTrends, 60*, 245-252. doi:10.1007/s11528-016-0045-4

Loveys, B., & Riggs, K. (2019). Flipping the laboratory: improving student engagement and learning outcomes in second year science courses. *International Journal of Science Education, 41*(1), 64-79. doi:10.1080/09500693.2018.1533663

Manresa, S. T. (2018). Flipped Classroom: Un modelo pedagógico eficaz en el aprendizaje de Science Flipped

Classroom: An effective pedagogical model in Science learning. *Revista Iberoamericana de Educación, 76*(1), 9-22.

Nacaroglu, O., Bektas, O., & Tuysuz, M. (2023). Examining the Emotional Semantic Orientation of Gifted Students Towards the Flipped Learning Model. *Technology, Knowledge and Learning, 28*, 117-142. doi:10.1007/s10758-021-09581-8

Petridou, E., Molohidis, A., & Hatzikraniotis, E. (2022). Assessing Students' Ability to Apply the Control of Variables Strategy When Engaged with Inquiry-Based Worksheets during. *Education Science, 12*, 668. doi: https://doi.org/10.3390/educsci12100668

Pozo-Sánchez, S., López-Belmonte, J., Cabrera, A. f., & López-núñez, J. A. (2021). Aplicación trietápica del flipped learning en el área de las ciencias. *Campus Virtuales, 10*(1), 35-47.

Ramírez, D., Hinojosa, C., & Rodríguez, F. (2014). Advantages And Disadvatages Of Flipped Classroom: STEM Students' Perceptions. *ICERI2014 Proceedings*, 121-127.

Reid, S. (2016). A flipped classroom redesign in general chemistry. *Chemistry Education Research and Practice, 17*, 914-922. doi: 10.1039/c6rp00129g

Ros, G., & Laguna, M. T. (2021). Influence of the flipped classroom in the scientific training of pre-service teachers: benefits in the teaching-learning process,attitudes and expectations towards scienceattitudes and expectations towards science. *Revista de Investigación Educativa, 39*(2), 463-482. doi:https://doi.org/10.6018/rie.374121

Schwichow, M., Hellmann, K. A., & Mikelskis-Seifert, S. (2022). Pre-service Teachers' Perception of Competence, Social Relatedness, and Autonomy in a Flipped Classroom: Effects on Learning to Notice Student Preconceptions. *Journal of Science Teacher Education, 33*(3), 282-302. doi:10.1080/1046560X.2021.1913332

Shi-Chun, D., Ze-Tian, F., & Yi, W. (2014). The Flipped Classroom–Advantages and Challenges. *Proceedings of the 2014 International Conference on Economic Management and Trade Cooperation (EMTC 2014)*, 17-20.

Solak, B. (2021). Ters Yuz Edilmis Ogrenme Modelinin Fen Bilimleri Dersinde Kullanilmasi: Maddenin Isi Ile Etkilesimi. [Using the Flipped Learning Model in Science Class: Interaction of Matter with Heat]. İstanbul.

Son, J., Narguizian, P., Beltz, D., & Desharnais, R. (2016). Comparing Physical, Virtual, and Hybrid Flipped Labs for General Education Biology. *Online Learning, 20*(3), 228-243.

Srinivasan,, S., Gibbons, R., Murphy, K., & Raker , J. (2018). Flipped classroom use in chemistry education: results from a survey of postsecondary faculty members. *19*, 1307-1318. doi: 10.1039/c8rp00094h

Talan, T., & Gulsecen, S. (2018). Ters-Yuz Sinif ve Harmanlanmis Ogrenmede Ogrencilerin Oz-Duzenleme Becerilerinin ve Oz-Yeterlik Algilarinin Incelenmesi. [Examining Students' Self-Regulation Skills and Self-Efficacy Perceptions in Flipped Classroom and Blended Learning] *Turkish Journal of Computer and Mathematics Education, 9(3), 563-580. Turk Bilgisayar ve Matematik Egitimi Dergisi, 9*(3), 563-580.

Teo, T. W., Tan, K., Yan, Y. K., Teo, Y. C., & Yeo, L. W. (2014). How flip teaching supports undergraduate chemistry laboratory learning. *Chemistry Education Research and Practice, 15*, 550-567. doi:10.1039/c4rp00003j

Tomas, L., Evans, N., Doyle, T., & Skamp, K. (2019). Are first year students ready for a flipped classroom? A case for a flipped learning continuum. *Int J Educ Technol High Educ, 16*(5). doi:10.1186/s41239-019-0135-4

Turan, Z. (2023). Evaluating Whether Flipped Classrooms Improve Student Learning in Science Education: A Systematic Review and Meta- Analysis. *Scandinavian Journal of Educational Research, 67*(1), 1-19. https://doi.org/10.1080/00313831.2021.1983868

Ugwuanyi, C. S. (2022). Developing Sound Knowledge of Basic Science Concepts in Children Using Flipped Classroom: A case of simple repeated measures. *Education and Information Technologies, 27*, 6353-6365. doi:10.1007/s10639-021-10850-3

Urfa, M. (2017). Bilim Etigi Ogretiminde Ters Yuz Sinif Modelinin Uygulanmasi.[Application of the Flipped Classroom Model in Science Ethics Teaching]. *Master's Thesis.*

Uyar, E. K., & Girgin, S. (2016). Insan ve Cevre Konularini Kavramaya, Bilgilerin Kaliciligina ve Cevreye Karsi Tutuma Jigsaw Tekniginin Etkisi.[The Effect of Jigsaw Technique on Understanding Human and Environmental Issues, Permanence of Information and Attitude towards the Environment]. *e – Kafkas Educational Research Journal, 3(3), 8-18.*

Ultay, E., Tanriverdi, A., & Ultay, N. (2023). Fen Bilimleri Dersi Kapsaminda Ters Yuz Ogrenme Modeliyle Ilgili Yapilan Calismalarin Betimsel Icerik Analizi. [Descriptive Content Analysis of Studies Conducted on the Flipped Learning Model within the Scope of Science Course] *Studies in Educational Research and Development, 7*(1), 42-63.

Unluturk, Ayse Ozlem. (2022). Ters yuz ogrenme ile elde ettigi okul disi fen egitiminin degiskenleri hakkinda incelemeler.[Investigations on the variables of out-of-school science education achieved through flipped learning] *KMU, Institute of Science, Department of Mathematics and Science Education, Master's Thesis.*

Ye, S.-H., Hsiao, T.-Y., & Sun, C.-T. (2018). Using commercial video games in flipped classrooms to support physical concept construction. *Journal of Computer Assisted Learning, 34*, 602-614. doi:10.1111/jcal.12267

Zamora-Polo, F., Corrales-Serrano, M., Sánchez-Martín, J., & Espejo-Antúnez, L. (2019). Nonscientific University Students Training in General Science Using an Active-Learning Merged Pedagogy: Gamification in a Flipped Classroom. *Education Science, 9*(4), 297. doi:10.3390/educsci9040297

Author Information

Gamze Comez
https://orcid.org/0000-0003-4106-0360
Yildiz Technical University
Turkiye
Contact e-mail: *gamzecomez34@gmail.com*

Gulbin Ozkan
https://orcid.org/0000-0001-8390-5259
Yildiz Technical University
Turkiye