



The flipped learning perception scale: A validity and reliability study

Fatmanur Ekinci¹ · Oktay Bektaş² · Melek Karaca³ · Kübra Nur Yiğit⁴

Received: 27 September 2022 / Accepted: 13 March 2023 / Published online: 3 April 2023

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2023

Abstract

This study aims to develop a scale to determine preservice science teachers' perceptions of flipped learning. The present study uses the survey design, a quantitative research method. For content validity, the authors created an item pool of 144 items based on the literature. After being checked by experts, the item pool dropped to 49 items for the five-point Likert-type draft scale. The current study has preferred cluster sampling due to generalization concerns. The accessible population of the study is the preservice science teachers in Türkiye's provinces of Kayseri, Nevşehir, Niğde, Kırşehir, and Konya. We administered the draft scale to 490 preservice science teachers, which is the recommended 10 times the number of items. We also performed explanatory and confirmatory factor analyses to check the scale's construct validity. We ultimately obtained a four-factor structure with 43 items that explain 49.2% of the variance in scores and found the correlation between the criterion and draft scales to be greater than .70, thus ensuring criterion validity. We calculated Cronbach's alpha and composite reliability coefficients to check the reliability of the scale and determined the reliability coefficients for both the overall scale and the sub-factors to be greater than 0.70. As a result, we have obtained a scale consisting of 43 items and four dimensions that explains 49.2% of the variance. This data collection tool can be used by researchers and lecturers to determine preservice teachers' perceptions toward flipped learning.

Keywords Flipped learning · Flipped learning perceptions · Preservice teachers · Scale development · Validity · Reliability

Fatmanur Ekinci is a graduate student with a thesis at Erciyes University.
Melek Karaca is an independent researcher.

✉ Fatmanur Ekinci
fatmanurekinci00@gmail.com

¹ Erciyes University, Kayseri, Turkey

² Ziya Eren Faculty of Education, Erciyes University, Kayseri, Turkey

³ İzmir, Turkey

⁴ Ministry of National Education, Kayseri, Turkey

1 Introduction

The current age has seen rapid changes in communication and technology around the world, with information increasing exponentially, new technologies being produced daily, and a multidimensional competitive environment being present between countries (Hanna, 1998). This competitiveness has made developing new technological opportunities a necessity rather than a privilege, and to keep up with the requirements of the age regarding educational activities, technology needs to be used efficiently. Educational technology was first defined in 1963, and each new definition since then has attempted to provide educational technology with different aspects (An & Oliver, 2021; Li et al., 2014; Mattar, 2018; Yestreb-sky, 2015). Educational technology covers a wide area of factors such as theoretical principles, their applications, and evaluations and holistically addresses these applications (Mattar, 2018). Meanwhile, computer-assisted teaching is accepted as a method for making the learning-teaching process more effective within the general concept of educational technology. Computer-assisted education applications present the content to students through a computer, and students attempt to construct the knowledge learned in this environment using mental exercises and practices (Li et al., 2021). While computer assisted instruction appears as classroom applications in education, it has recently begun to be popularized as a tool in terms of out-of-school applications (Chen, 2003). This has formed the basis for the formation of new orientations and thus new practices, as well, one of these being the flipped learning model.

The flipped learning model is based on the constructivist approach to active learning (Cohen, 2016; Hung, 2015; Prashar, 2015). According to Piaget (1970) and Vygotsky (1978) who formed the basis of the constructivist approach, learning is a process that is based on personal experiences and creates knowledge in the mind. Enabling the use of active learning activities based on the constructivist approach can contribute to students' success and sociability (Von Glasersfeld, 1989; Vygotsky, 1978). In this context, the flipped learning model provides individuals with the opportunity to learn on their own (Flipped Learning Network [FLN], 2014). Students are responsible for their learning to control the learning process (Aburayash, 2021). Teachers, on the other hand, have the role of organizers and guide students in this process (FLN, 2014). The flipped learning model covers all activities done at school and at home. Based on all these explanations, having students be responsible for their learning at home is based on Piaget's cognitive constructivism theory, while the learning a student performs with their friends at school is based on Vygotsky's social constructivism theory and Bandura's cognitive and social constructivism theory (Boudourides, 2003).

The flipped learning model allows students to learn course content outside the classroom. In class, the model provides students with the opportunity to practice over and over. The flipped learning model differs from the teaching styles practiced in traditional classrooms and has been defined as a teaching approach in which the work to be done at home is done at school and the subjects that need to be learned at school are learned at home (Baker & Mentch, 2000). The flipped

learning model strengthens student–student and student–teacher interactions and enables teachers to take into account students’ personal needs (Bergmann & Sams, 2012). According to Bergmann and Sams, flipped learning entails course content outside the classroom being presented with videos and in-class activities and practices being performed as a team. The purpose of the flipped learning model is to provide learning opportunities independent of environment, time, and tools while creating active learning environments where interaction is more prominent (Baker & Mentch, 2000). The COVID-19 pandemic has made the use of technology-based out-of-school methods, techniques, and models mandatory. In addition, flipped learning has demonstrated its high potential for student learning regarding the development and acquisition of the specific transversal competencies needed for the twenty-first century in terms of employability, entrepreneurship, innovation, literacy, and societal contribution (Santos & Serpa, 2020).

The Flipped Learning Network (2014) was founded by Bergman and Sams, who abbreviated the concepts of flexible environment, learning culture, intentional content, and professional educator to “flip” (Fig. 1). The identified the four basic features of the flipped learning model as shown in Fig. 1.

In a *flexible environment*, educators create spaces where students choose where and when they learn with the support of group study. In addition, educators who practice flipped learning are flexible regarding what they expect from students’ learning and learning assessment timelines (FLN, 2014). Concerning *learning culture*, the education process is student-centered. Students actively participate in constructing knowledge and evaluate what they have learned in a personally meaningful way. For *intentional content*, students identify what they need to learn and what materials they need to explore learning on their own. Educators use content that has been designed to maximize classroom time. Meanwhile, the *professional educator* constantly observes and provides feedback to the students during the class, and this is one of the basic components that enable flipped learning to take place.

The features that Bergman and Sams (2012) stated above about flipped learning are explained based on the constructivist approach. We created the items in the draft scale in line with the features Bergman and Sams (2012) determined as a guide for ourselves because this theory puts students at the center of learning, and the literature review was conducted accordingly.



Fig. 1 Dimensions of the flipped learning model (FLN, 2014)

In the related literature, the first appearance of studies on the flipped learning model focused on the classroom environment (Bergmann & Sams, 2012; Butt, 2014; Lage et al., 2010), while more recent studies on this area have noteworthy focused on learning (e.g., Alten et al., 2020). The literature shows flipped learning generally affects students' academic achievement (Debbağ & Yıldız, 2021; Kim et al., 2018; Miles & Foggett, 2016; Seitan et al., 2020; Sletten, 2017), self-regulation skills, self-efficacy perceptions (Alten et al., 2020; Kim et al., 2021; Kozikoğlu et al., 2021; Sletten, 2017), motivation (Challob, 2021; Chung & Lee, 2018; Debbağ & Yıldız, 2021; Karabatak & Polat, 2020; Winter, 2018), and attitudes toward flipped learning (Chung & Lee, 2018; Seitan et al., 2020), with these studies having used flipped learning as an application or action plan. Therefore, while these studies did investigate the effect of the above-mentioned cognitive and affective skills with regard to student development, they did not investigate students' perspectives on or perceptions toward flipped learning.

Meanwhile, students' perceptions toward flipped learning are seen to have frequently been the subject of research in recent years (Almodaires et al., 2019; Kozikoğlu et al., 2021; Murray et al., 2015; Öztürk, 2021; Özüdoğru & Aksu, 2020; Sletten, 2017; Ünal, et al., 2021; Üstün & Çil Düzenli, 2022). Among these studies, Almodaires et al. (2019) tried to determine the perceptions of Kuwaiti teacher candidates regarding the effectiveness of flipped learning. Their study used a scale consisting of closed- and open-ended questions that were designed to explore students' perspectives regarding the effectiveness of using a foreign language in educational technology lessons. As a result of their research, Almodaires et al. determined their participants to have a positive opinion about using foreign languages this way and that it could be a promising approach for improving students' and teachers' learning levels. Almodaires et al. also observed the teacher candidates to have positive attitudes toward flipped learning. Kozikoğlu et al. (2021) examined the link between teachers' self-efficacy perceptions toward flipped learning and their behaviors supporting learner autonomy. For this purpose, they used the Learner Autonomy Support Scale (Oguz, 2013) and the Flipped Learning Teacher Self-Efficacy Perception Scale (Erensayin et al., 2019). As a result, Kozikoğlu et al. (2021) reported teachers to have high self-efficacy perceptions toward flipped learning. Öztürk (2021) aimed to determine teacher candidates' perceptions toward open and distance education by subjecting them to synchronous and asynchronous teaching for one semester using the student barriers to online learning scale to collect data. The research determined no significant difference to be present between the teacher candidates' perceptions of open education and perceptions of distance education. Özüdoğru and Aksu (2020) investigated the effects of flipped learning on preservice teachers' achievements and perceptions of the classroom environment. They saw no significant difference in preservice teachers' perceptions of the classroom environment about being in a flipped classroom or a traditional classroom. Ünal et al. (2021) aimed to determine teachers' perceptions toward the use of flipped learning in middle school classrooms and found that teachers should develop their knowledge and skills regarding the effective use of flipped learning before starting to apply it in their classrooms. They used a 20-item teacher questionnaire designed by Gough et al. (2017) and examined two dimensions of flipped learning to collect the data, with science and mathematics

teachers being found to be more willing to practice flipped learning. Üstün and Çil Düzenli (2022) examined the relationship between teachers' perception levels and attitudes toward mobile learning during the COVID-19 pandemic using the Mobile Learning Perception Level Scale (authors, year) and Mobile Learning Attitude Scale (Uzunboylu & Ozdamli, 2011), which are available in the literature and taking into account variables such as work experience, education level, frequency of Internet use, and gender. When examining the teachers' perception levels and attitudes based on these variables, Üstün and Çil Düzenli (2022) found a significant difference to exist based on education level, while no difference was found based on gender, frequency of Internet use, or work experience.

The literature shows studies to have not examined flipped learning by itself while determining preservice teachers' perceptions toward it but to have also measured their perceptions toward concepts such as self-efficacy, self-regulation, attitude, and classroom environment as well. These studies were not scale-development studies but used pre-existing perception scales to determine perceptions such as the Flipped Learning Teacher Self-Efficacy Perception Scale (Erensayin et al., 2019) and Flipped Learning Self-Regulation Perception Scale (Pintrich & De Groot, 1990). Few scales are found in the literature to directly determine teacher candidates' perceptions toward flipped learning (Gough et al., 2017). In this regard, the current scale development study can be said to be able to fill this gap in the literature. Therefore, increasing the number of scale development studies on teachers' perceptions toward the flipped learning model is considered important for recognizing and increasing the use of the flipped learning model, as well as for providing greater emphasis on teachers' perceptions toward flipped learning. From this point of view, the main focus of this study is to develop a valid and reliable measurement tool that covers all FLIP dimensions for determining preservice teachers' perceptions toward flipped learning, and this is important for two reasons: 1) preservice teachers will be able to question the relationship between the understanding they have in their minds and what they will implement in the future by identifying their perceptions regarding flipped learning, and 2) increasing the number of studies that identify preservice teachers' perceptions toward flipped learning can also increase these teachers' awareness about learning in general. In other words, the awareness of teacher candidates who will take on active roles in the field of education shortly can be increased as a result of determining their perceptions toward the flipped learning model they will use in the future. The merits of teachers who implement the program are directly related to the success of the curriculum (Yeşilyurt, 2013). In this context, in-service training for flipped learning can be given to preservice teachers, and any required arrangements can be made for preservice teachers in these training programs.

In addition to studies on flipped learning, the current study has also examined scale development studies in the educational sciences literature in terms of measurement and evaluation. No information about normality was found for most of the scale development studies (Almodaires et al., 2019; Chang et al., 2021; Hao, 2016b; Jung & Lee, 2022; Keller et al., 2020; Li & Wang, 2021; Seema et al., 2022; Slavec & Drnovšek, 2012; Wang et al., 2016), despite normality being a necessary prerequisite for validity and reliability analyses (Ghasemi & Zahediasl,

2012). As a result of the examinations, some studies only received an expert's opinions for the content validity analysis, but these did not state what corrections had been made as a result of the expert opinion nor which specific items were found suitable for the scale or not (Chang et al., 2021; Hao, 2016b; Keller et al., 2020; Li & Wang, 2021; Seema et al., 2022; Slavec & Drnovšek, 2012; Wang et al., 2016). With regard to checking construct validity, studies were only found to use exploratory factor analysis (Ghazali et al., 2021; Hao, 2016b; Seema et al., 2022) or confirmatory factor analysis (Doyle et al., 2019; Jardim et al., 2021; Wang et al., 2016), with no occurrence of the combined exploratory and confirmatory factor analyses (Almodaires et al., 2019; Li & Wang, 2021; Sangwan et al., 2021; Seema et al., 2022). Criterion validity was also observed to have not been checked in these studies (Jung & Lee, 2022; Keller et al., 2020; Li & Wang, 2021; Sangwan et al., 2021; Seema et al., 2022; Slavec & Drnovšek, 2012; Tzafilkou et al., 2022; Wang et al., 2016), with the studies that did do some check only comparing the results of the scale's analyses (Güvendir Acar & Özkan Özer, 2015). Scale development studies should check the reliability values for each item before performing the validity analyses (Çelik & Bindak, 2005). When examining the relevant literature, however, only the reliability for the whole scale was shown (Jung & Lee, 2022), even though the reliability coefficients should also be reported for each factor (Chang et al., 2021; Kisanga & Ireson, 2016; Jung & Lee, 2022; Sangwan et al., 2021; Seema et al., 2022; Siddiquei & Khalid, 2021; Slavec & Drnovšek, 2012; Wang et al., 2016).

In consideration of these shortcomings in scale development studies, the current study has carried out all these measurement and evaluation processes and included all the listed headings. For this purpose, the study seeks answers to the following sub-problems:

- 1) Is the scale developed here for teacher candidates' perceptions toward flipped learning valid?
- 2) Are the scores obtained from this scale reliable?

2 Method

2.1 Research design

This research uses the survey design, a quantitative research method. The survey design is a sampling design used for making generalizations about an accessible population consisting of a large number of people. The survey design reveals the characteristics of a sample group, such as their interests, attitudes, perceptions, opinions, and/or abilities (Fraenkel & Wallen, 2006), and has been employed here to objectively determine preservice teachers' perceptions about flipped learning. Moreover, this study has also used the survey design because of the need to scan a sample for the validity and reliability study of the draft scale.

2.2 Population and sample

The present study has preferred the cluster sampling method for selecting the participants. Cluster sampling is preferred in large-scale survey studies when creating lists of the number of units that should be included in the sample is difficult (Turk & Borkowski, 2005). This study has excluded first-year students from its scope due to these students having not yet taken courses related to pedagogical learning methods. The accessible population of the research is the approximately 9,600 people who are preservice teachers in their second, third, or fourth year of study at six state universities in the provinces of Kayseri, Nevsehir, Nigde, Kirsehir, and Konya. Several participants at least ten times the number of items ($49 \times 10 = 490$) and 10% of the accessible population size (960) were reached (Pallant, 2020).

2.3 Data collection tools

2.3.1 Reliability

Reliability is the degree to which respondents give consistent answers to items on the scale. Before carrying out the validity studies, Cronbach's alpha of reliability is calculated to determine the reliability of the items on the draft scale. Scale development studies (Bacon et al., 1995) have stated calculating the composite reliability coefficients of Fornell and Larcker (1981), which are based on factor loading and error variance values, to be appropriate in addition to Cronbach's alpha for testing the reliability of the data obtained from the scale. After the validity analyses, this study calculated Cronbach's alpha of reliability for the overall scale and the compound reliability for each factor. The results obtained from a reliability analysis are expected to have a value greater than 0.70 for the scale to be considered reliable (Pallant, 2017).

2.3.2 Content validity

Content validity marks the ability of the contents of a measurement tool to exemplify the measured behavior set or the measured features (American Psychological Association [APA], 1954). To ensure the content validity of the draft scale, an item pool was created in line with expert opinions (Table 1). This study aims to develop a five-point Likert-type scale as a data collection tool for determining preservice teachers' perceptions toward flipped learning. The draft version of the scale has 49 items in total, with the scale consisting of 37 positive and 12 negative (reverse-scored) items. Some of the items on the draft scale have been taken directly from Aburayash (2021), FLN (2014), Hao (2016a), Hew and Lo (2018), Seitan et al. (2020), and Şimşek and Yazar (2016). The authors also rearranged the items on the draft scale in line with the feedback from the assessments of science education experts, with the negative statements being highlighted. The science and Turkish language teachers

Table 1 Literature-based item pool

Source	Item pool	Numbers of items
Aburayash, 2021	24	3
Hew & Lo, 2018	10	7
Şimşek & Yazar, 2016	24	1
FLN, 2014	24	33
Hao, 2016a	38	3
Seitan et al., 2020	24	2
Total	144	49

found the items on the draft scale to be appropriate, with the adjustments that were made, as well as the validity, and reliability studies being reported in the Findings section (Table 2).

2.3.3 Construct validity

Construct validity involves the extent to which the measurement tool reveals a feature or construct (Anastasi, 1988). The current study's draft scale attempted to write an equal number of items for each dimension and will conduct exploratory (EFA) and confirmatory factor analyses (CFA) to ensure construct validity. The Bartlett test must be significant and the Kaiser-Meyer-Olkin (KMO) value is expected to be greater than 0.6 (Pallant, 2007) to perform exploratory factor analysis (EFA).

2.3.4 Criterion validity

The study uses the parallel forms method to ensure criterion validity. We administered the draft and criterion scales over a sample different from the study's main one. The validity and reliability studies of the criterion scale were conducted by Gough et al.'s scale (2017). We also examined whether the criterion and draft scales measure similar characteristics using the Pearson correlation coefficient.

2.4 Data collection process

Due to the pandemic conditions providing no direct access to students, the researchers transferred the prepared draft scale to the Google Forms application and sent links to the teacher candidates. This study is based on the participants' voluntary participation. Marking all items on the scale was made mandatory in order not to leave any items blank on the draft scale. Before starting the implementation of the draft scale, an application was handed in to the ethics committee, and the necessary permissions were obtained. During the data collection process, we reached 516 participants and completed this process on June 8, 2022, approximately four months after starting.

Table 2 Arranging the scale items according to expert opinions

The initial state of the item	Revised item according to the opinions of the assessment/evaluation expert	Revised item according to the opinions of the science education experts	Item number in the draft scale
FLIP allows me to interact with my students	(The experts approved this item without making changes)		1
The teacher constantly observes/monitors learners to make appropriate adjustments	I think I will check whether my students watch the videos during FLIP	FLIP is a model where I can control whether my students watch the videos	5
FLIP provides learners with different ways to learn content	During FLIP, I think I will provide different ways for my students to learn	FLIP provides the opportunity to make appropriate adjustments to the activities based on the feedback from my students	9
Teachers physically rearrange learning spaces to fit a lesson or unit to support groups or independent study (divided into 2 separate items)	I think I will organize learning environments for my students to study in groups during FLIP I think I will organize learning environments for my students to study independently during FLIP	FLIP provides the opportunity to organize learning environments for my students to study in groups FLIP offers the opportunity to organize learning environments for my students to study independently	13 17
FLIP creates flexible spaces where learners choose when and where they learn (Divided into 2 separate items)	During FLIP, I think I will create time-flexible spaces for my students to learn During FLIP, I think I will create flexible spaces for my students to learn	FLIP allows me to create time-flexible spaces for my students to learn FLIP allows me to create flexible spaces for my students to learn	25 29
Teachers are flexible in how they assess learner learning and the expectations of learners' timelines for learning (Divided into 2 separate items)	During FLIP, I think I will be flexible in meeting my students' expectations regarding learning timelines During FLIP, I think I will be flexible in how I assess my student's learning	FLIP allows me to be flexible in meeting my students' learning timetable expectations FLIP offers the opportunity to be flexible in how I assess my student's learning	33 37
The learner organizes the environment in which the learning-teaching process will take place through the use of technology	During FLIP, I think my students will organize the technologies in the learning environment	FLIP offers the opportunity to organize the technologies in my students' learning environment	41
FLIP enables learners to study at their own pace	During FLIP, I think my students will work according to their learning speed	FLIP allows my students to study according to their learning speed	44

Table 2 (continued)

The initial state of the item	Revised item according to the opinions of the assessment/evaluation expert	Revised item according to the opinions of the science education experts	Item number in the draft scale
FLIP allows the teacher to differentiate the material according to learners' learning preferences	During FLIP, I think I will make my students use different materials according to their learning preferences	FLIP offers my students the opportunity to use different materials according to their learning preferences	46
FLIP offers my students the opportunity to use different materials according to their learning preferences	During FLIP, I think I will provide my students with different ways, environments, and technologies to specialize in	FLIP allows me to provide different ways, environments, and technologies for my students to specialize	48
FLIP allows learners to reflect on their learning	During FLIP, I think I will allow my students to concentrate on the concepts they have learned	Flip allows my students to concentrate on the concepts they are learning	49
Learning with an inverted classroom strategy provides learners with the opportunity to learn on their own	During FLIP, I think I will provide my students with the opportunity to learn on their own	FLIP allows me to offer my students the opportunity to learn on their own	2
FLIP allows learners to engage in meaningful activities	During FLIP, I think I will allow my students to do activities	FLIP allows me to let my students do more activities	6
Learners do activities differently	(The experts decided to delete the item.)		-
FLIP consciously shifts the teaching process to learner-centered education	During FLIP, I think I will make teaching student-centered	FLIP allows me to make teaching student-centered	10
In FLIP, learners actively construct knowledge	During FLIP, I think my students will actively construct knowledge	FLIP offers my students the opportunity to actively construct knowledge	14
In FLIP, learners prepare and put the study plan into practice	During FLIP, I think my students will put their study plans into practice	FLIP helps my students put their study plans into practice	18
When teaching the reverse classroom strategy, teachers take responsibility for learning	During FLIP, I think I will take responsibility for my students' learning	FLIP allows my students to take responsibility for their learning	22
		FLIP provides an opportunity for me to take responsibility for my students' learning	26

Table 2 (continued)

The initial state of the item	Revised item according to the opinions of the assessment/evaluation expert	Revised item according to the opinions of the science education experts	Item number in the draft scale
In FLIP, the teacher takes measures to ensure that learners come prepared with pre-lesson materials	During FLIP, I think I will take precautions so that my students prepare the necessary materials before the lesson	FLIP allows me to take precautions so my students prepare the necessary materials before the lesson	30
FLIP encourages learning through up-to-date technologies familiar to Generation Z and alpha learners	I think I will encourage my students to use up-to-date technologies during FLIP	FLIP allows me to encourage my students to use up-to-date technologies	34
FLIP makes activities accessible to all learners	During FLIP, I think I will provide my students with access to activities	FLIP allows me to offer my students access to activities	38
Teachers identify what learners need to learn and what materials they need to discover on their own	During FLIP, I think my students will be able to identify the concepts they need to learn	FLIP provides an opportunity for my students to identify the concepts they need to learn	3
(divided into 2 separate items)	During FLIP, I think my students will be able to identify the materials that will be required during their learning	FLIP helps my students gain the ability to identify the materials that will be required during their learning	7
Teachers prioritize concepts used in direct instructions for learners to access on their own	During FLIP, I think I will prioritize concepts my students can access on their own	FLIP allows my students to prioritize concepts they can access on their own	11
Teachers create and/or produce content (usually videos) for learners	During FLIP, I think I will create the content and videos my students will use	FLIP allows my students to create the content and videos they will use	15
FLIP makes content accessible	During FLIP, I think I will allow my students to access the content/videos	FLIP allows me to help my students access content/videos	19
They constantly think about how they can use the Flipped Learning model to help learners develop procedural fluency as well as conceptual understanding	During FLIP, I think I will improve my students' conceptual understanding	FLIP helps me improve my students' conceptual understanding	23
Teachers use informed content to maximize class time	During FLIP, I think I will adjust the in-class activities according to the duration of the lesson	FLIP allows me to arrange in-class activities according to the duration of the lesson	27

Table 2 (continued)

The initial state of the item	Revised item according to the opinions of the assessment/evaluation expert	Revised item according to the opinions of the science education experts	Item number in the draft scale
Learners pre-study by listening to recorded lessons	During FLJP, I think my students will listen to the previously recorded courses	FLJP offers my students the opportunity to listen to previous lessons recorded	31
Teachers use information technologies to organize the learning materials they look for online	During FLJP, I think I will use information technologies to prepare online materials	FLJP helps me use information technologies to prepare online materials	35
Learners use media players to listen to or watch online multimedia material	(The experts decided to delete the item.)	–	–
FLJP offers the opportunity to work integrated with mobile technologies	During FLJP, I think I will have my students work with their mobile phones	FLJP offers my students the opportunity to work with their mobile phones	39
FLJP ensures that content is relevant to all learners	During FLJP, I think I will enable my students with individual differences to learn	FLJP helps me contribute to students' learning according to their differences	42
Teachers present themselves to all learners in real time for an individual, small group, and classroom feedback as needed (divided into 3 separate items)	During FLJP, I think I will give individual feedback to my students I think I will give feedback to my students working in groups during FLJP During FLJP, I think I will give feedback to my students as a class	FLJP allows me to give individual feedback to my students FLJP allows me to give feedback to my students in groups FLJP allows me to give feedback to all my students as a class	4 8 12
Teachers conduct ongoing assessments throughout class time by observing and recording data to inform future instruction	During FLJP, I think I will make formative assessments by observing my students' learning deficiencies	FLJP allows me to make formative assessments by observing my students' learning deficiencies	16
Teachers work with other teachers, think, and take responsibility for transforming their practices	I think I will collaborate with other teachers during FLJP	FLJP helps me collaborate with other teachers	20
Teachers constantly monitor learners and provide feedback throughout class time (divided into 2 separate items)	During FLJP, I think I can observe my students throughout the lesson During FLJP, I think I will give my students feedback throughout the course	FLJP provides me with the opportunity to observe my students during the lesson FLJP helps me give feedback to my students during the lesson	24–28 28

Table 2 (continued)

The initial state of the item	Revised item according to the opinions of the assessment/evaluation expert	Revised item according to the opinions of the science education experts	Item number in the draft scale
Teachers reflect on their practice, which allows them to connect to make it better	During FLIP, I think I will be a role model to other teachers	FLIP can enable me to be a role model to my colleagues	32
In FLIP, teachers remain the core component of FLIP, although they take on fewer roles	During FLIP, I think I will take my responsibilities to a higher level	FLIP helps me gain a high level of awareness in terms of my responsibilities	36
Teachers guide the effective use of digital tools for learners to properly use the information resources they access	During FLIP, I think I will guide my students to use digital tools effectively	FLIP allows me to guide my students toward using digital tools effectively	40
By teaching the FLIP strategy, teachers find an answer to all questions about decisions on employing this strategy	(The experts decided to delete the item.)		–
Teachers begin the lesson with a question–answer activity about pre-class work	During FLIP, I think I will start the lesson with a question-and-answer activity about pre-class studies	FLIP lets me start the class with a Q&A activity on pre-class work	43
Teachers give quizzes before or at the beginning of the lesson	During FLIP, I think I will do quizzes at the beginning of the lesson	FLIP allows me to do quizzes at the beginning of the lesson to measure readiness	45
(divided into 2 separate items)	During FLIP, I think I will give assignments about the activities before the lesson	FLIP allows me to give assignments about activities before the lesson	47

2.5 Data analysis

The raw data have been numerically coded and analyzed in the programs SPSS.25 and LISREL 8.8; 12 items (Items 4, 11, 13, 14, 19, 21, 22, 23, 24, 38, 41, and 47) on the scale are reverse coded. The *total* variable was formed for each item by adding up the participants' scores for each item from the draft scale. The study as performed validity and reliability analyses, as well as EFA and CFA, due to being a validity and reliability scale development study. The authors also checked whether the items show normal distribution.

Within the scope of this scale development study, the Findings section explains the data collection tool and data analysis processes in detail in order to avoid repetition due to the intention of developing a data collection tool.

3 Findings

3.1 Validity findings

3.1.1 Content validity findings

Before creating the scale items, the literature was examined using words such as flipped learning, scale development, scales related to flipped learning, and dimensions of flipped learning (Aburayash, 2021; FLN, 2014; Hao, 2016a; Hew & Lo, 2018; Seitan et al., 2020; Şimşek & Yazar, 2016). The research examined the social cognitive theory-based item pool and showed it to consist of four sub-dimensions: flexible environment, learning culture, intentional content, and professional educator. As a result of the literature review for each sub-dimension, the appropriate items were brought together, with an item pool of 144 items being created as seen in Table 1.

All statements in the item pool were reviewed by an assessment/evaluation expert, a science education expert, a science teacher, and a Turkish language teacher. As a result of the received feedback, some items were changed and others removed from the draft scale, with a draft scale consisting of 49 items ultimately being obtained (Table 2). The scale was created as a five-point Likert type scale and arranged to include positive and negative statements, with 37 positive and 12 negative items being found on the draft scale.

3.1.2 Normality analysis findings

Statistical values such as mean, mode, median, and standard deviation values regarding total scores are given in Table 3.

Table 3 Descriptive statistical values of the total scores obtained from the scale

	N	Mean	Median	Mode	SD
Total	516	169,07	170	173	19,23

Skewness and kurtosis values were also calculated between ± 2 , which shows no excessive deviation to be present in the scores as these are generally accepted values (Pallant, 2001).

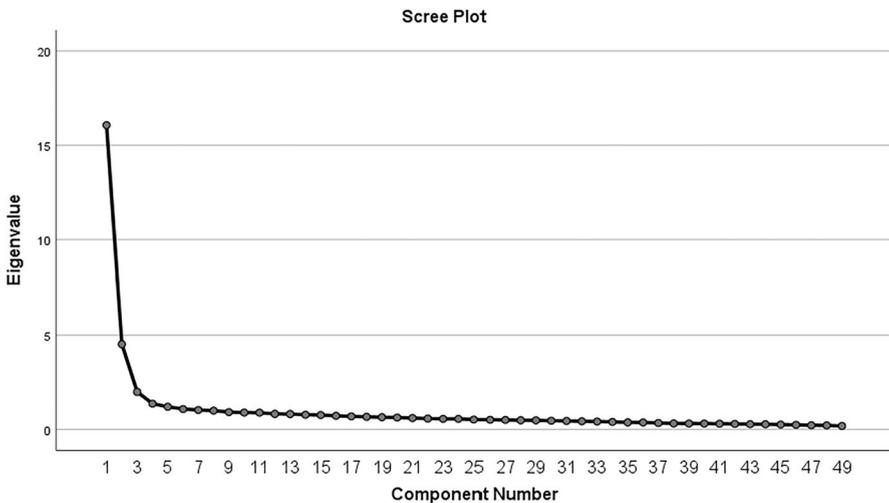
3.1.3 Construct validity findings

This study calculated the reliability of the 49-item draft scale before the construct validity studies, with Cronbach's alpha of reliability being found as $\alpha=0.89$. In addition, the study also checked the reliability coefficients for each item. After ensuring the reliability of the draft, the EFA and CFA were performed to ensure construct validity.

3.1.4 Exploratory factor analysis

The EFA results identified Items 5, 15, 47, 13, 38, 14, 22, 23, 39, and 41 to overlap, and these items were removed from the draft scale before repeating the EFA. The scree plot is given in Fig. 2.

According to the scree plot, the scale has four to five significant factors. The EFA was repeated, this time limiting the scale to five factors without discarding any items by the scree plot and the total variance covered. The analysis was again repeated, this time by removing the overlapping Items 15, 47, 13, 38, 14, 22, and 23. As a result of this last analysis, the KMO was found to be 0.95, and this factor structure

**Fig. 2** Scree plot

explains 52% of the total variance. Next, factor analysis was performed by limiting the scale to four factors without removing any items. The analysis was again repeated by removing the overlapping Items 47, 13, 38, 14, 22, and 23. As a result of this analysis, the KMO was calculated as 0.95, with this factor structure explaining 49.2% of the total variance. All values were compared and the four-factor structure was determined to be the most appropriate. The Bartlett test and KMO value were calculated within the scope of the study, with the analysis results presented in Table 4.

The adequacy of the sample size for the factor analysis was checked first. The KMO value being between 0 and 1 and close to 1 indicates the sample size as being appropriate (Field, 2005; Hutcheson & Sofroniou, 1999). When considering the value obtained in this case (KMO=0.095), the sample can be said to be of sufficient size. Another thing to consider when carrying out a factor analysis is the significance of the value obtained from the Bartlett test (Pallant, 2001). When looking at the obtained data, this condition is seen to have been met. As a result of all these analyses, the total explained variance of the scale is given in Table 5.

According to Table 5, the 43 items obtained from the analysis results of the scale are seen to be grouped under four factors according to the EFA and explain 49.29% of the total variance. An explained variance corresponding to a value between 40%-60%, indicates a strong factor structure (Scherer et al., 1988), with the obtained value of 49% showing the scale to be sufficient. When considering the dimensions of FLIP, the item contents of the four factors were examined, with the first factor (i.e., flexible environment) consisting of 15 items, the second factor (Intentional Content) consisting of 6 items, the third factor (Learning Culture) consisting of 16 items, and the fourth factor (Professional Educator) consisting of 6 items.

3.1.5 Confirmatory factor analysis

CFA was carried out using the package program LISREL 8.8 over the four-factor structure from the EFA. The standardized values of the scale that was obtained as a result of the CFA are given in Fig. 3, with the fit indices being given in Table 6.

To make sense of the standardized values in Fig. 3 regarding the CFA, the *t* values were first examined (Jöreskog & Sörbom, 1996). When considering the *t* values, a red color should be considered to show that item as being problematic (Jöreskog & Sörbom, 1996). As a result of the analysis, no red arrows were found with regard to the *t* values. Next, the factor loading values for each item are expected to be checked, and this value should be 0.30 or greater. When looking at Fig. 3, all these values are seen to be greater than 0.30.

Table 4 KMO value for the scale

Kaiser–Meyer–Olkin Sampling Adequacy		0,950
Bartlett Test of Sphericity	Approximate chi-square value	10,905,576
	Df	903
	Sig	0,000

Table 5 Total explained variance

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loading
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	14,964	34,800	34,800	14,964	34,800	34,800	10,545
2	3,162	7,354	42,154	3,162	7,354	42,154	5,075
3	1,707	3,969	46,123	1,707	3,969	46,123	12,054
4	1,363	3,169	49,292	1,363	3,169	49,292	6,674
5	1,110	2,581	51,874				
6	1,057	2,458	54,332				
7	1,004	2,335	56,667				
8	,965	2,243	58,910				
9	,889	2,068	60,978				
10	,870	2,022	63,000				
11	,853	1,983	64,983				
12	,792	1,842	66,825				
13	,778	1,810	68,635				
14	,738	1,717	70,352				
15	,690	1,604	71,957				
16	,683	1,589	73,545				
17	,653	1,519	75,064				
18	,636	1,480	76,544				
19	,627	1,457	78,001				
20	,602	1,400	79,401				
21	,562	1,307	80,708				
22	,543	1,263	81,971				
23	,524	1,220	83,190				
24	,513	1,194	84,384				
25	,498	1,157	85,541				
26	,469	1,091	86,632				
27	,456	1,061	87,693				
28	,450	1,046	88,739				
29	,433	1,008	89,747				
30	,424	,985	90,732				
31	,402	,935	91,667				
32	,377	,876	92,544				
33	,367	,853	93,396				
34	,346	,804	94,200				
35	,328	,763	94,963				
36	,318	,740	95,703				
37	,310	,722	96,424				
38	,292	,680	97,104				
39	,281	,653	97,757				

Table 5 (continued)

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loading
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
40	,277	,645	98,402				
41	,258	,601	99,003				
42	,231	,537	99,540				
43	,198	,460	100,000				

As a result of the performed EFA, the Prospective Teachers' Flipped Learning Perceptions Scale was found to have a four-factor structure and these factors have been confirmed by the CFA. As a result, the final version of the developed scale consists of four factors and 43 items.

3.1.6 Criterion validity findings

We determined Gough et al.'s (2017) scale as the criterion scale. The items measuring similar objectives in the criterion and draft scales were identified by two science education and assessment/evaluation experts. We selected 12 items from the draft scale (Items 1, 2, 6, 10, 17, 19, 25, 26, 31, 33, 42, and 49) and 13 items from the criterion scale (Items 1, 2, 3, 5, 6, 9, 10, 11, 12, 14, 15, 16, and 17). The reason for making these choices was that the draft scale covers all four dimensions of FLIP learning, whereas the criterion scale has a narrower coverage. We administered the draft and criterion scales to 130 people different from the research sample. We did not include participants who responded randomly to the items in the analysis process so as not to adversely affect the reliability and validity. Thus, we continued the analysis with 118 individuals and performed a correlation analysis by calculating the total scores (Table 7), with the Pearson correlation coefficients being used to determine the relationship between the total scores of the scales (Pallant, 2017).

To ensure criterion validity, the Pearson correlation coefficient is expected to have a value greater than 0.70 (Pallant, 2017). When examining Table 7, the value of the correlation coefficient between the draft scale and the criterion scale was found to be 0.746, and thus criterion validity was ensured. We determined the criterion and draft scales to measure similar objectives in terms of determining teachers' perceptions toward flipped learning.

3.1.7 Reliability Findings

The reliability coefficient before the validity analysis was 0.89. As a result of the EFA, we removed the overlapping items from the scale. After the validity studies, we recalculated Cronbach's alphas of reliability for the 43-item scale and its sub-factors. In addition, we checked the composite reliability for the overall scale and

Table 6 The goodness-of-fit indexes of the scale (Schumacker & Lomax, 2004)

Fit index	Acceptable limit	Perfect fit limit	Value of the scale	The scale's fit decision
NFI	=0.90 and up	0.95 and up	0,96	Excellent
NNFI	=0.90 and up	0.95 and up	0,97	Excellent
CFI	=0.95 and up	0.97 and up	0,97	Excellent
IFI	=0.90 and up	0.95 and up	0,97	Excellent
RFI	=0.90 and up	0.95 and up	0,95	Excellent
RMSEA	between 0.50 and =0.80	=0.000 and <0.050	0,06	Acceptable
χ^2/sd	It must be less than 3		2,82	Excellent

Table 7 Pearson correlation coefficient results between the scales

Scale	Correlation	Draft scale	Criterion scale
Draft Scale	Pearson correlation	1	0,746
	Significance Value	–	0,000
	Number of Persons	118	118

each factor (Table 8). Cronbach's alpha of reliability for the overall scale is 0.92 and the composite reliability is 0.96.

Table 8 shows Cronbach's alpha of reliability and composite reliability for each sub-dimension to be greater than 0.70 (Pallant, 2017), with the AVE value of around 0.5 being evidence of composite reliability (Hair et al., 2011). When considering all these findings, the internal consistency can be said to be sufficient, and removing the six items (Items 47, 13, 38, 14, 22, and 23) from the scale to be appropriate.

4 Discussion and conclusion

This study aimed to develop a scale for use in determining preservice teachers' perceptions toward flipped learning and to carry out the scale's validity and reliability tests.

Checking for normal distribution is important for the validity and reliability analyses in scale development studies (Ghasemi & Zahediasl, 2012). As in other scale development studies (Pedaste et al., 2021; Sangwan et al., 2021; Tzafilkou et al., 2022), our study examined whether the total scores showed normal distribution. Within the scope of the research, all the scores obtained by all the participants in the study were calculated, and the total scores are understood to be normally distributed.

Content, construct, and criterion validity studies were carried out to test the validity of the developed scale. We scanned the literature on flipped learning based on the constructivist approach. Many scale development studies were not based on a philosophy (Chang et al., 2021; Morgado et al., 2017; Sangwan et al., 2021; Seema et al., 2022). As with other scientific studies, however, scale development studies should have a philosophical stance upon which the research is based (Ornstein & Hunkins, 1993). As a result of the literature review, an item pool was created and

Table 8 Reliability of the flipped learning perception scale's factors and sample items

Factors	Items	Alpha	CR	AVE	Sample item
Flexible Environment	15	0,91	0,88	0,34	It provides time-flexible spaces for students to learn
Designed Content	6	0,82	0,88	0,55	Restricts the teacher from helping students access content/videos
Learning Culture	16	0,90	0,89	0,34	It provides students with the opportunity to learn on their own
Professional Educator	6	0,82	0,82	0,44	It helps the teacher to gain high-level awareness in terms of responsibilities
Total	43	0,92	0,96	0,38	

submitted to expert control, after which the draft scale was finalized. Many studies (Hao, 2016b; Keller et al., 2020; Li & Wang, 2021; Slavec & Drnovšek, 2012; Wang et al., 2016) made no mention of which regulations were followed, even when only a sentence or two stated which expert controls had been made. The changes and arrangements to the items as a result of the expert controls in this study are given in Table 2. Expert controls are important in terms of the scale being suitable for the research and its language being understandable (Muijs, 2004), and Table 2 is thought to be able to set an example for future researchers who will conduct scale development studies in terms of content validity.

To ensure the construct validity of the draft scale, the study first performed EFA and then CFA. The authors determined the KMO value of the draft scale to be 0.95, the scale to have four factors and 43 items, and the items to explain 49.2% of the total variance. When examining the literature on this subject, although different acceptable ranges have been adopted, multi-factorial studies should have an explained variance of at least 40% or higher (Kline, 2011; Scherer et al., 1988). The determined factor structure was then confirmed using CFA. The factors were called flexible environment, learning culture, intentional content, and professional educator and are compatible with the dimensions of FLIP, being the basic concept studied here. For example, students create flexible spaces in a flexible environment where they choose when and where they learn. The developed scale includes items such as “FLIP allows the creation of flexible spaces for students to learn” and “FLIP provides the teacher with the opportunity to be flexible in evaluating students’ learning” in the factor of a flexible environment. The items on the scale and the definitions of the FLIP dimensions are compatible with each other, and the theoretical foundations of the scale we have developed here are solid. We also based the scale on the constructivist approach concerning all the dimensions of FLIP.

EFA and CFA were carried out with the data obtained from the same sample to ensure construct validity. The EFA results revealed a structure consisting of 43 items and four factors explaining 49.29% of the variance, and the CFA confirmed this. The total explained variance corresponding to a value between 40 and 60% indicates a scale to have a strong factor structure (Scherer et al., 1988), and the 49.2% value obtained here indicates the scale to be sufficient. In many of the studies, exploratory factor analysis had been performed while confirmatory factor analysis had not (Ghazali et al., 2021; Hao, 2016b; Seema et al., 2022), even though the distribution of the EFA-determined items to the factors should be verified using CFA in scale development studies (Schumacker & Lomax, 2004). This study did use CFA to confirm the factor structure revealed by EFA, thus the study is important in terms of helping researchers who want to develop a scale realize the necessity of CFA.

For checking the criterion validity, the draft and criterion scales were applied to the same sample simultaneously, after which the correlation coefficients were examined. The related literature shows few scale development studies to have occurred that used criterion validity (Chang et al., 2021; Erol & Karakaya, 2020; Snell & Lau, 2020; Tunç & Şenel, 2021). When examining the literature, only Gough et al.’s (2017) scale was available to be chosen as the criterion scale; Gough et al.’s scale has 17 items, but they did not clearly explain the number of dimensions in the scale. The scale developed in this study has a 4-factor

structure consisting of 43 items. As a result of the correlation analysis, a high-level positive relationship was shown to exist between the two scales, thus ensuring criterion validity.

This study performed reliability analyses before and after the validity checks. To determine the reliability of the scores obtained from the draft scale, Cronbach's alpha of reliability for the first version of the overall draft scale was calculated as 0.89. In addition, the reliability coefficients were checked for each of the 49 items in the draft scale. The literature has a few good examples in which the reliability coefficient for each item were checked before the validity studies (Çelik & Bindak, 2005; Karaca & Bektaş, 2022). This analysis is important for scale development studies in terms of showing the consistency the developed scale and the items on the scale have with each other as well as the consistency with which the people answered the items on the two versions of the scale (Fraenkel & Wallen, 2006).

After performing the validity analysis, we calculated Cronbach's alpha of reliability and composite reliability for the final version of the scale and each factor. Cronbach's alpha of reliability for the overall scale is 0.92, while the reliability coefficients for the factors have been calculated as 0.91 for the flexible environment, 0.82 for intentional content, 0.90 for learning culture, and 0.82 for the professional educator. The composite reliability for the overall scale is 0.96, with the reliability coefficients for the factors having been calculated as 0.88 for the flexible environment, 0.88 for intentional content, 0.89 for learning culture, and 0.82 for the professional educator. Although the reliability coefficient is generally reported for the overall scale in the literature, some studies performed no reliability analyses for the sub-factors (Pedaste et al., 2021; Seema et al., 2022; Tzafilkou et al., 2022). Calculating the reliability coefficients of the sub-factors in the scale is important for being able to see whether the items in a factor are consistent with one another (Pallant, 2017). The reliability coefficient for the final version of the overall draft scale was higher than for the first version. This shows the decision to discard the overlapping items from the scale to have been the right one. This value also shows that the items on the draft scale are perfectly reliable (Pallant, 2017). Our study calculated the composite reliability coefficients in addition to Cronbach's alpha of reliability; however, few scale development studies are found to do this, especially in the field of education. Calculation and comparison of the reliability values of a measurement tool using two different analyses provide stronger evidence for the reliability of a scale. However, the AVE values of the scale we developed did not fully meet the required value. Therefore, we can say that the convergent validity of the scale should be strengthened (Hair et al., 2014). In addition, the fact that the composite reliability coefficients are greater than the AVE values in our scale is strong evidence for construct validity (Byrne, 2016).

As a result, this study has developed a measurement tool using validity and reliability checks that is useful for determining individuals' perceptions toward flipped learning. In particular, this measurement tool can be used by researchers and lecturers to determine preservice teachers' perceptions toward flipped learning.

4.1 Limitations and recommendations

This study has been limited to teacher candidates. Comparative research can be done by applying the developed scale to different samples such as teachers and graduate students. Teacher-student perspectives can be compared by adding questions for the student population.

The scale developed in this study has a Likert-type structure. By adding open-ended questions to the scale, a more comprehensive measurement tool suitable for mixed-methods research can be developed.

This study has also been limited to four provinces in Central Anatolia. The same scale can be applied to different geographical regions of Türkiye, and thus more comprehensive results can be obtained regarding perceptions toward flipped learning, seeing as it is affected by sociocultural factors

Data Availability The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

References

- Aburayash, H. (2021). The students' attitudes toward the flipped classroom strategy and relationship to self-learning skills. *Journal of Education and Learning (EduLearn)*, 15(3), 450–457. <https://doi.org/10.11591/edulearn.v15i3.18132>
- Almodaires, A. A., Alayyar, G. M., Almsaud, T. O., & Almutairi, F. M. (2019). The effectiveness of flipped learning: A quasi-experimental study of the perceptions of Kuwaiti pre-service teachers. *International Education Studies*, 12(1), 1913–9039. <https://doi.org/10.5539/ies.v12n1p10>
- Alten, D. C. D., Phielix, C., Janssen, J., & Kester, L. (2020). Self-regulated learning support in flipped learning videos enhances learning outcomes. *Computer & Education*, 158, 0360–1315. <https://doi.org/10.1016/j.compedu.2020.104000>
- American Psychological Association (APA). (1954). *Technical recommendations for psychological tests and diagnostic techniques*. Author.
- An, T., & Oliver, M. (2021). What in the world is educational technology? Rethinking the Field from the Perspective of the Philosophy of Technology. *Learning, Media and Technology*, 46(1), 6–19. <https://doi.org/10.1080/17439884.2020.1810066>
- Anastasi, A. (1988). *Psychological testing* (8th ed.). Macmillan Publishing Company.
- Bacon, D. R., Sauer, P. L., & Young, M. (1995). Composite reliability in structural equations modeling. *Educational and Psychological Measurement*, 55(3), 394–406.
- Baker, J. W., & Mentch, M. W. (2000). IMOWA curriculum materials. <http://www.imowa.org/curricula/flip/>
- Bergmann, J., & Sams, A. (2012). *In flip your classroom; reach every student, in every class, every day*. ISTE.
- Boudourides, M. A. (2003). Constructivism, education, science, and technology. *Canadian Journal of Learning and Technology*, 29(3), 1–16.
- Butt, A. (2014). Student views on the use of a flipped classroom approach: Evidence from Australia. *Business Education & Accreditation*, 6(1), 33–43.
- Byrne, B. M. (2016). *Structural equation modeling with AMOS: Basic concepts, applications, and programming*. Routledge.
- Çelik, H. C., & Bindak, R. (2005). Examining the attitudes of primary school teaching department students towards mathematics according to various variables. *Kastamonu Journal of Education*, 13(2), 27–436.

- Challob, A. I. (2021). The effect of flipped learning on EFL students' writing performance, autonomy, and motivation. *Education and Information Technologies*, 26(4), 3743–3769. <https://doi.org/10.1007/s10639-021-10434-1>
- Chang, C. W., Cheng, S. S., Chang, I. W., Liaw, F. R., & Cheng, C. C. (2021). The development of “Early Childhood Education & Care Curriculum Framework Implementation Scale” in Taiwan. *Hungarian Educational Research Journal*, 11(4), 377–395. <https://doi.org/10.1556/063.2021.00041>
- Chen, C. (2003). A constructivist approach to teaching: implications in teaching computer networking. *Information Technology, Learning and Performance Journal*, 21(2), 17. <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.126.6353&rep=rep1&type=pdf>. Accessed 08.04.2022.
- Chung, E. J., & Lee, B. H. (2018). The effects of flipped learning on learning motivation and attitudes in a class of college physical therapy students. *Journal of Problem-Based Learning*, 5(1), 2508–9145. <https://doi.org/10.24313/jpbl.2018.5.1.29>
- Cohen, M. E. (2016). The flipped classroom as a tool for engaging discipline faculty in collaboration: A case study in library-business collaboration. *New Review of Academic Librarianship*, 22(1), 5–23. <https://doi.org/10.1080/13614533.2015.1073162>
- Debbag, M., & Yıldız, S. (2021). Effect of the flipped classroom model on academic achievement and motivation in teacher education. *Education and Information Technologies*, 26(3), 3057–3076. <https://doi.org/10.1007/s10639-020-10395-x>
- Doyle, M., Foster, B., & Yukhymenko-Lescroart, M. A. (2019). Initial development of the perception of information literacy scale (PILS). *Communications in Information Literacy*, 13(2), 205–227. <https://doi.org/10.15760/comminfolit.2019.13.2.5>
- Erensayin, E., Güler, Ç., & Erensayin, E. (2019). *The validity and reliability of the flipped learning teacher self-efficacy scale* [Verbal announcement]. Ispac 3. International Congress of Social and Human Sciences Full Text Book (s.395–399), Van.
- Erol, M., & Karakaya, I. (2020). Development of language awareness scale regarding daily life. *International Journal of Assessment Tools in Education*, 7(4), 535–548. <https://doi.org/10.21449/ijate.647488>
- Field, A. (2005). *Discovering statistics using SPSS for windows*. Sage Publications.
- Flipped Learning Network (2014). *Definition of flipped learning*. Retrieved from www.Flippedlearning.Org/Definition
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18, 39–50.
- Fraenkel, J. R., & Wallen, N. (2006). *How to design and evaluate research in education*. McGraw-Hill.
- Ghasemi, A., & Zahediasl, S. (2012). Normality tests for statistical analysis: a guide for non-statisticians. *International Journal of Endocrinology and Metabolism*, 10(2), 486–489. <https://doi.org/10.5812/ijem.3505>
- Ghazali, N., Nordin, M. S., & Tunku Ahmad, T. B. (2021). Development and validation of student's MOOC-efficacy scale: Exploratory factor analysis. *Asian Journal of University Education*, 17(4), 327–339. <https://doi.org/10.24191/ajue.v17i4.16182>
- Gough, E., Dejong, D., Grundmeyer, T., & Baron, M. (2017). K-12 teacher perceptions regarding the flipped classroom model for teaching and learning. *Journal of Educational Technology Systems*, 45(3), 390–423. <https://doi.org/10.1177/0047239516658444>
- GüvendirAcar, M., & ÖzkanÖzer, Y. (2015). Examining the articles on scale development and adaptation in scientific journals published in the field of education in Turkey. *Electronic Journal of Social Sciences*, 14(52), 23–33.
- Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed, a silver bullet. *Journal of Marketing Theory and Practice*, 19(2), 139–152. <https://doi.org/10.2753/MTP1069-6679190202>
- Hair, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, G. V. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review*, 26(2), 106–121. <https://doi.org/10.1108/EBR-10-2013-0128>
- Hanna, D. E. (1998). Higher education in an era of digital competition: Emerging organizational models. *Journal of Asynchronous Learning Networks*, 2(1), 66–95.
- Hao, Y. (2016a). Middle school students' flipped learning readiness in foreign language classrooms: Exploring its relationship with personal characteristics and individual circumstances. *Computers in Human Behavior*, 59, 295–303. <https://doi.org/10.1016/j.chb.2016.01.031>
- Hao, Y. (2016b). Exploring undergraduates' perspectives and flipped learning readiness in their flipped classrooms. *Computers in Human Behavior*, 59, 82–92. <https://doi.org/10.1016/j.chb.2016.01.032>

- Hew, K. F., & Lo, C. K. (2018). Flipped classroom improves student learning in health professions education: A meta-analysis. *BMC Medical Education*, 18(38), 2–12. <https://doi.org/10.1186/s12909-018-1144-z>
- Hung, H. T. (2015). Flipping the classroom for English language learners to foster active learning. *Computer Assisted Language Learning*, 28(1), 81–96. <https://doi.org/10.1080/09588221.2014.967701>
- Hutcheson, G., & Sofroniou, N. (1999). *The multivariate social scientist*. Sage.
- Jardim, J., Pereira, A., & Bártolo, A. (2021). Development and psychometric properties of a scale to measure resilience among Portuguese university students: Resilience scale-10. *Education Science*, 11(61), 1–8. <https://doi.org/10.3390/educsci11020061>
- Jöreskog, K. G., & Sörbom, D. (1996). *LISREL 8: User reference guide*. Uppsala University.
- Jung, I., & Lee, J. (2022). Open thinking as a learning outcome of open education: Scale development and validation. *Distance Education*, 43(1), 119–138. <https://doi.org/10.1080/01587919.2021.2020620>
- Karabatak, S., & Polat, H. (2020). The effects of the flipped classroom model designed according to the ARCS motivation strategies on the students' motivation and academic achievement levels. *Education and Information Technologies*, 25(3), 1475–1495. <https://doi.org/10.1007/s10639-019-09985-1>
- Karaca, M., & Bektaş, O. (2022). Self-regulation scale for science: a validity and reliability study. *International Journal on Social and Education Sciences (IJonSES)*, 4(2), 236–256. <https://doi.org/10.46328/ijonSES.302>
- Keller, J. M., Uçar, H., & Kumtepe, A. T. (2020). Development and validation of a scale to measure volition for learning. *Open Praxis International Council for Open and Distance Education*, 12(2), 161–174. <https://doi.org/10.5944/openpraxis.12.2.1082>
- Kim, M., Roh, S., & Ihm, J. (2018). The relationship between non-cognitive student attributes and academic achievements in a flipped learning classroom of a pre-dental science course. *Korean Journal of Medical Education*, 30(4), 339–346. <https://doi.org/10.3946/kjme.2018.109>
- Kim, N. H., So, H. J., & Joo, Y. J. (2021). Flipped learning design fidelity, self-regulated learning, satisfaction, and continuance intention in a university flipped learning course. *Australasian Journal of Educational Technology*, 37(4), 1–19. <https://doi.org/10.14742/ajet.6046>
- Kisanga, D., & Ireson, G. (2016). Test of e-learning-related attitudes (TeLRA) scale: Development, reliability and validity study. *International Journal of Education and Development Using ICT*, 12(1), 20–36.
- Kline, R. B. (2011). *Principles and practice of structural equation modeling*. The Guilford Press.
- Kozikoğlu, İ, Erbenzer, E., & Ateş, G. (2021). The relationship between teachers' perceptions of flipped learning self-efficacy and their behaviors to support learner autonomy. *Journal of Atatürk University Kazım Karabekir Faculty of Education*, 42, 344–366. <https://doi.org/10.33418/ataunikkfd.796531>
- Lage, M. J., Platt, G. J., & Treglia, M. (2010). Inverting the Classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education*, 31(1), 30–43. <https://doi.org/10.1080/00220480009596759>
- Li, N., Verma, H., Skevi, A., Zufferey, G., Blom, J., & Dillenbourg, P. (2014). Watching MOOCs together: Investigating co-located MOOC study groups. *Distance Education*, 35(2), 217–233. <https://doi.org/10.1080/01587919.2014.917708>
- Li, H., Zhang, H., & Zhang, Y. (2021). Design of computer-aided teaching network management system for college physical education. *Computer-Aided Design and Applications*, 18(4), 152–162. <https://doi.org/10.14733/cadaps.2021.S4.152-162>
- Li, J. & Wang, Q. (2021). Development and validation of a rating scale for summarization as an integrated task. *Wang Asian-Pacific Journal of Second and Foreign Language Education*, 6(11), 2–21. <https://doi.org/10.1186/s40862-021-00113-6>
- Mattar, J. (2018). Constructivism and connectivism in education technology: Active, situated, authentic, experiential, and anchored learning. *Revista Iberoamericana De Educación a Distancia*, 21(2), 201–217. <https://doi.org/10.5944/ried.21.2.20055>
- Miles, C. A., & Foggett, K. (2016). Supporting our students to achieve academic success in the unfamiliar world of flipped and blended classrooms. *Journal of University Teaching & Learning Practice*, 13(4), 2. <https://doi.org/10.53761/1.13.4.2>
- Morgado, F. F. R., Meireles, J. F. F., Neves, C. V., Amaral, C. S. S., & Ferreira, M. E.C. (2017). Scale development: Ten main limitations and recommendations to improve future research practices. *Psicologia: Reflexão e Crítica*, 30(3), 1–20. <https://doi.org/10.1186/s41155-016-0057-1>

- Muijs, D. (2004). Multivariate analysis: Using multiple linear regression to look at the relationship between several predictors and one dependent variable. In *doing quantitative research in education with SPSS* (pp. 159–184). SAGE Publications.
- Murray, D., Koziniec, T., & McGill, T. (2015). Student perceptions of flipped learning. In *ACE*, 160, 57–62.
- Oguz, A. (2013). Developing a Scale for Learner Autonomy Support. *Educational Sciences: Theory and Practice*, 13(4), 2187–2194.
- Ornstein, A. C., & Hunkins, F. P. (1993). *Curriculum: Foundations, principles and issues* (2nd ed.). Allyn and Bacon.
- Öztürk, M. (2021). Pre-service teachers' perceptions towards open and distance education: asynchronous and synchronous online learning. *Ahmet Keleşoğlu Journal of the Faculty of Education*, 3(2), 216–230. Retrieved from <https://dergipark.org.tr/en/pub/akef/issue/65129/1001751>. Accessed 04.01.2022.
- Özüdöğru, M., & Aksu, M. (2020). Pre-service teachers' achievement and perceptions of the classroom environment in flipped learning and traditional instruction classes. *Australasian Journal of Educational Technology*, 36(4), 27–43. <https://doi.org/10.14742/ajet.5115>
- Pallant, J. (2001). *SPSS survival manual*. Open University Press.
- Pallant, J. (2007). *SPSS survival manual a step by step guide to data analysis using SPSS for windows* (3rd ed.). Open University Press.
- Pallant, J. (2017). *SPSS user guide*. Am Publishing.
- Pallant, J. (2020). *SPSS survival manual: a step-by-step guide to data analysis using IBM SPSS* (7th ed.). Routledge. <https://doi.org/10.4324/9781003117452>
- Pedaste, M., Baucaal, A., & Reinsenk, E. (2021). Towards a science inquiry test in primary education: development of items and scales. *Pedaste et al. International Journal of STEM Education*, 8(1), 1–19. <https://doi.org/10.1186/s40594-021-00278-z>
- Piaget, J. (1970). *Structuralism*. Basic Books.
- Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of educational psychology*, 82(1), 33.
- 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>
- Sangwan, A., Sangwan, A., & Punia, P. (2021). Development and validation of an attitude scale towards online teaching and learning for higher education teachers. *TechTrends*, 65, 187–195. <https://doi.org/10.1007/s11528-020-00561-w>
- Santos, A. I., & Serpa, S. (2020). Flipped classroom for an active learning. *Journal of Education and E-Learning Research*, 7(2), 167–173. <https://doi.org/10.20448/journal.509.2020.72.167.173>
- Scherer, R. F., Wiebe, F. A., Luther, D. C., & Adams, J. S. (1988). Dimensionality of coping: factor stability using the ways of coping questionnaire. *Psychological Reports*, 62(3), 763–770. <https://doi.org/10.2466/pr0.1988.62.3.763>
- Schumacker, R. E., & Lomax, R. G. (2004). *A beginner's guide to structural equation modeling* (pp. 1–8). Taylor & Francis.
- Seema, R., Heidmets, M., Konstabel, K., & Varik-Maasik, E. (2022). Development and validation of the digital addiction scale for teenagers (DAST). *Journal of Psychoeducational Assessment*, 40(2), 293–304. <https://doi.org/10.1177/07342829211056394>
- Seitan, W. I., Ajlouni, A. O., & Al-Shara'h, N. D. A. (2020). The impact of integrating flipped learning and information and communication technology on the secondary school students' academic achievement and their attitudes towards it. *International Education Studies*, 13(2), 1–10. <https://doi.org/10.5539/ies.v13n2p1>
- Siddiquei, N. L., & Khalid, R. (2021). Development and validation of learning style scale for e-learners. *SAGE Open*, 11(2), 1–15. <https://doi.org/10.1177/21582440211022324>
- Şimşek, Ö., & Yazar, T. (2016). Education technology standards self- efficacy (ETSSE) scale: a validity and reliability study. *Eurasian Journal of Education Research*, 63, 311–334. <https://doi.org/10.14689/ejer.2016.63.18>
- Slavec, A., & Drnovšek, M. (2012). A perspective on scale development in entrepreneurship research. *Economic and Business Review*, 14(1), 39–62. <https://doi.org/10.15458/2335-4216.1203>
- Sletten, S. R. (2017). Investigating flipped learning: Student self-regulated learning, perceptions, and achievement in an introductory biology course. *Journal of Science Education and Technology*, 26(3), 347–358. <https://doi.org/10.1007/s10956-016-9683-8>

- Snell, R. S., & Lau, K. H. (2020). The development of a service-learning outcomes measurement scale (S-LOMS). *Metropolitan Universities*, 31(1), 44–77. <https://doi.org/10.18060/23258>
- Tunç, E. B., & Şenel, S. (2021). Development of test-taking strategies scale: High school and undergraduate form. *International Journal of Contemporary Educational Research*, 8(4), 116–129. <https://doi.org/10.33200/ijcer.888368>
- Turk, P., & Borkowski, J. J. (2005). A review of adaptive cluster sampling: 1990–2003. *Environmental and Ecological Statistics*, 12, 55–94. <https://doi.org/10.1007/s10651-005-6818-0>
- Tzaflikou, K., Perifanou, M., & Economides, A. A. (2022). Development and validation of students' digital competence scale (SDiCoS). Tzaflikou et al. *International Journal of Educational Technology in Higher Education*, 19(30), 1–20. <https://doi.org/10.1186/s41239-022-00330-0>
- Ünal, A., Ünal, Z., & Bodur, Y. (2021). Using flipped classroom in middle schools: teachers' perceptions. *Journal of Research in Education*, 30(2), 90–112. <https://files.eric.ed.gov/fulltext/EJ1301256.pdf>. Accessed 04.01.2022.
- Üstün, A. B., & Çil Düzenli, B. (2022). Investigation of teachers' perception levels and attitudes towards mobile learning during the Covid-19 pandemic process. *Educational Reflections*, 6(1), 24–39. <https://dergipark.org.tr/en/pub/eduref/issue/69172/1059976>. Accessed 04.01.2022.
- Uzunboyulu, H., & Ozdamli, F. (2011). Teacher perception for m-learning: Scale development and teachers' perceptions. *Journal of Computer Assisted Learning*, 27(6), 544–556.
- Von Glasersfeld, E. (1989). Facts and the self from a constructivist point of view. *Poetics*, 28(4–5), 435–444. [https://doi.org/10.1016/0304-422X\(89\)90041-7](https://doi.org/10.1016/0304-422X(89)90041-7)
- Vygotsky, L. S. (1978). *Mind and society: The development of higher mental processes*. Harvard University Press.
- Wang, M. T., Fredricks, J. A., Ye, F., Hofkens, T. L., & Linn, J. S. (2016). The math and science engagement scales: Scale development, validation, and psychometric properties. *Learning and Instruction*, 43, 16–26. <https://doi.org/10.1016/j.learninstruc.2016.01.008>
- Winter, J. W. (2018). Performance and motivation in a middle school flipped learning course. *TechTrends*, 62(2), 176–183. <https://doi.org/10.1007/s11528-017-0228-7>
- Yeşilyurt, E. (2013). Teacher candidates' perceptions of teacher self-efficacy. *Electronic Journal of Social Sciences*, 12(45), 88–104. <https://dergipark.org.tr/en/download/article-file/70461>. Accessed 04.23.2022.
- Yestrebky, C. L. (2015). Flipping the classroom in a large chemistry class research university environment. *Procedia- Social and Behavioral Sciences*, 191, 1113–1118. <https://doi.org/10.1016/j.sbspro.2015.04.370>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.