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Teacher Self-Efficacy Scale Towards Context-Based Science Learning: Validity and Reliability Study

Bağlam Temelli Fen Öğrenimine Yönelik Öğretmen Özyeterlik Ölçeği: Geçerlik ve Güvenirlik Çalışması

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ABSTRACT: This study aims to develop a valid and reliable scale for determining the self-efficacy of teachers toward context-based science education. This study employed a survey design. The sample has formed 433 science teachers working in Kayseri province in the 2020-2021 spring semester. Firstly, an item pool of 85 items was developed by reviewing the literature. Secondly, a five-point Likert-type draft scale consisting of 67 items was developed. Required arrangements have been performed according to expert opinions to provide content validity. Explanatory and confirmatory factor analyses have been run to provide construct validity. As a result of explanatory factor analysis, a structure with four factors as "Learning/Teaching Process", "Self-efficacy Resources", "Academic Self-efficacy" and "Planning Instruction" consisting of 47 items has been reached. Factors have been confirmed by confirmatory factor analysis. Cronbach Alpha internal consistency coefficient has been calculated as 0.98. To provide criterion validity, the Pearson correlation coefficient has been found as 0.86 between the draft and criteria scales. Based on the findings, researchers have determined that the scale was valid and reliable, and they recommended that this scale should be used to determine self-efficacy beliefs towards context-based learning of science teachers.

Keywords: Context-based learning, scale development, science education, self-efficacy.

ÖZ: Bu çalışmanın amacı, öğretmenlerin bağlam temelli fen öğrenimine yönelik özyeterliklerini belirlemede kullanılabilecek geçerli ve güvenilir bir ölçek geliştirmektir. Çalışmada nicel araştırma yönteminin desenlerinden biri olan tarama deseni kullanılmıştır. Tarama desenlerinden ise kesitsel tarama modeli kullanılmıştır. Çalışmanın örneklemini, 2020-2021 eğitim ve öğretim yılında Kayseri ilinde görev yapan 433 fen bilimleri öğretmeni oluşturmuştur. İlk olarak alan yazın taraması yapılarak 85 maddelik madde havuzundan 67 maddelik beşli Likert tipinde taslak ölçek oluşturulmuştur. Ölçeğin kapsam geçerliğini sağlamak için uzman görüşleri alınmış, gelen dönütlere göre gerekli düzenlemeler yapılmıştır. Ölçeğin yapı geçerliğini sağlamak için açımlayıcı ve doğrulayıcı faktör analizleri yürütülmüştür. Açımlayıcı faktör analizi sonucunda "Öğrenme/Öğretme Süreci", "Özyeterlik Kaynakları", "Akademik Özyeterlik" ve "Öğretimi Planlama" olmak üzere dört faktörlü ve 47 maddeden oluşan bir yapıya ulaşılmıştır. Doğrulayıcı faktör analizi ile açımlayıcı faktör analizi sonuçları doğrulanmıştır. Ölçekten elde edilen puanların güvenirliği için, ölçeğin tamamının ve alt faktörlerin Cronbach Alfa iç tutarlık katsayıları hesaplanmıştır. Ölçeğin ölçüt geçerliğini sağlamak için benzer nitelikte bir ölçek belirlenerek iki ölçeğin arasında Pearson korelasyon katsayısı 0.86 bulunmuştur. Yapılan analizler sonucunda, araştırmacılar ölçeğin geçerli ve güvenilir olduğunu belirlemiş ve fen bilimleri öğretmenlerinin bağlam temelli öğrenmeye yönelik öz-yeterliklerini belirlemek amacıyla kullanılmasını önermişlerdir.

Anahtar kelimeler: Bağlam temelli öğrenme, fen eğitimi, özyeterlik, ölçek geliştirme.

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International research institutions such as the Program for International Student Assessment (PISA) and The Trends in International Mathematics and Science Study (TIMSS) reveal that many countries have common problems in science teaching. (Gilbert et al., 2011; Pilot & Bulte, 2006; Yaman, 2009). Intensive curriculum, subjective concepts, the inability of students to associate knowledge with daily life, and not being able to use them in new problem situations are considered the main problems. These problems reduce students' interest in science lessons (Genç et al., 2017; Gilbert, 2006; Yaman, 2009). Research shows that existing problems continue today (Education Monitoring Report (EIR), 2021; Mutual Responbility, 2021; OECD, 2023).To solve these problems, education programs have started to use context-based learning (CBL) (Bahtaji, 2015; Bennett & Lubben, 2006; Çepni 2015; Gilbert, 2006; Knoef, 2017; Tariq ve Saeed, 2021; Ültay & Çalık, 2011).

The CBL is an approach that adopts the relationship between the concepts and daily life events (Ayas et al. 2007; Kutu & Sözbilir, 2011). The CBL expects students to think that the concepts are essential to them. It also aims to build these concepts in their inner world. In addition, it expects students to find their unique solutions to problems with the help of these concepts (Cobos et al., 2017; De Jong, 2008). The use of this approach increases the learning motivations and desires of students and contributes to the occurrence of meaningful and permanent learning (Gilbert, 2006; Gül, 2016; Hırça, 2012; Karslı-Baydere & Aydın, 2019; King et al.,2011; Sevian et al., 2018).

Teachers with academic proficiency in the CBL provide students with contextual skills that they can use in their daily lives and enable them to learn meaningfully. Such teachers can develop their thoughts on the use of this approach in a positive way and include the CBL practices in the teaching process (Ayvacı, 2010; İlhan et al., 2015; Topuz et al., 2013). However, teachers must have sufficient self-efficacy levels to use the CBL effectively in their lessons (Van Driel et al., 2001; Stolk et al., 2009).

The appearance of the self-efficacy concept is based on the social-cognitive theory developed by Albert Bandura. The social cognitive theory states that personal, environmental, and behavioral factors mutually affect each other and this interaction determines the behavior of individuals (Bandura, 1997). Albert Bandura defines self-efficacy as people's beliefs in their ability to regulate and control their actions to overcome a problem that affects their lives (Bandura, 1997; Tschannen-Moran et al.,1998). A person's belief in high self-efficacy is important for motivation, well-being, and personal accomplishment. Mastery experiences, vicarious experiences, social persuasion, and emotional states influence and develop one's self-efficacy belief. Individuals with high self-efficacy can cope with difficulties and stress and be successful in education (Bandura, 1997). On the other hand, teachers' self-efficacy is also important in the learning process. Teachers' self-efficacy is effective in choosing learning approaches that they can use and their willingness to use the approaches. In addition, teachers' self-efficacy is an effective factor in the preparation of learning environments that enable the development of student's cognitive and sensory competencies and in increasing their interest, motivation, and achievement (Elmas et al., 2011; Stolk et al., 2009; Van Driel et al., 2001). While high self-efficacy may positively affect teachers' professional performance and their efforts to reach goals, a low level of belief may cause negative consequences (Bong, 2001; Chemers et al.,2001; Karaoğlu, 2019; Özdemir et al., 2018; Schmitz & Scwarzer, 2000; Schwarzer & Hallum, 2008).

De Putter-Smits et al. (2012) have collected the CBL adequacies of teachers under five headings. These headings are context handling, regulation (arranging the learning process), emphasis on learning (encouraging students for active learning), design (material arrangement), and school innovation (leadership for innovation). They expected that the level of self-efficacy of teachers on these headings would be high. The self-efficacy of teachers is influenced by past experiences, social interactions, physiological and psychological stimulations, and cultural differences (Bandura, 1997). Within this context, the self-efficacy of teachers needs to be determined towards the use of CBL. Therefore, valid and reliable scales should be developed to determine their self-efficacy beliefs regarding the use of CBL (Capa Aydin et al., 2018; Çolak et al., 2017; Karaoğlu, 2019).

Many studies have been completed about the CBL in the literature (Broman, et al., 2020; Cabbar & Şenel 2020; Deveci & Karteri, 2020; Hoşbaş,2018; Karaş & Gül, 2020; King et al., 2011), but the studies executed with teachers are limited l (Dolfing et al., 2020; Kurnaz, 2013; Parchmann et al. 2006). Some of these studies carried out with teachers aim to provide professionel developmant in teaching context-based science curriculum (Dolfing et al., 2020; Kurnaz, 2013; Parchmann et al. 2006). In some studies conducted with teachers on CBL, but they do not have sufficient knowledge about the application of the approach and their use of the approach is limited/These studies suggest that teachers' context-based science teaching competencies should ve increased(Arık Güngör vd., 2023; Ayvacı, 2010; De Putter-Smits et al.,2012; Kurnaz, 2013; Stolk et al., 2011; Topuz et al., 2013; Vos et al., 2011; Wijaya et al., 2015). In addition, although there are scale development and scale adaptation studies for teacher self-efficacy in the literature (Çolak et al., 2017; Denizoğlu, 2008; Hacıömeroğlu, 2020; Bıkmaz, 2002; Şensoy & Aydoğdu, 2008; Tortop &Akyıldız, 2019; Yaman et al., 2018), no study was found to measure teacher self-efficacy towards the use of CBL. On the other hand, these studies did not present detailed explanations about the validity and reliability. Teacher self-efficacy is one of the most important factors in teacher functioning (Soini et al., 2015). Prominent features such as being able to turn crises into opportunities, managing the process well under difficult conditions and having a solid motivation, providing effective guidance and touching the lives of students are related to teacher self-efficacy levels (Demirtaş and Yener, 2019; Marschall, 2022). Researchs conducted; it shows that teachers with high self-efficacy are more willing to apply innovative teaching approaches and are more effective in behavior management (Nie et al., 2013; Thurlings et al., 2015; Zee and Koomen, 2016). This situation reveals the need to determine teacher self-efficacy. Valid and reliable scales are needed to determine teacher self-efficacy. This need also applies to science teachers. Since CBL is a frequently used learning strategy in science education, it is necessary to develop a valid and reliable scale to be used to determine the self-efficacy of science teachers for context-based science teaching. In this context, a scale to be developed will be a resource for the professional development of science teachers. Based on all of these, this study aims to develop a valid and reliable data collection tool that will determine the self-efficacy beliefs of science teachers regarding the use of CBL. The answer has been investigated for the following questions in line with this purpose:

• Is the Context-based Science Learning (CBSL) Teacher Self-efficacy Scale valid?

• Is the Context-based Science Learning (CBSL) Teacher Self-efficacy Scale reliable?

Method

Research Design

The research uses the survey, one of the quantitative research designs. The research also prefers the cross-sectional model belonging to this design. Survey design is the study to determine the participants' affective characteristics and psychomotor skills and is carried out with large samples (Fraenkel et al., 2012). A cross-sectional survey model is a study in which a certain affective or psychomotor feature is measured at once (Fraenkel & Wallen, 2006). Self-efficacy is the affective trait. Therefore, this study develops a scale to determine teachers' self-efficacy beliefs towards the use of CBL and make one measurement at a time. Therefore, this study prefers a cross-sectional survey model.

Population and Sample

The accessible population of the study is science teachers working in Kayseri in the spring term of 2020-2021. For this purpose, the study prefers random sampling. The researchers administered the draft scale to 504 teachers who voluntarily participated in the study at the beginning of the study. The authors excluded 71 participants from the study. Although these participants do not know about context-based learning, they are the ones who mark the items and mark the "Always" or "Never" option in all the items. Therefore, the sample of the study consists of 433 science teachers assigned in Kayseri province. Demographic characteristics of teachers are given in Table 1. The number of participants (433) corresponds to at least 10 percent of the 840 science teachers in the accessible population.

Table 1

Demographic characteristics of teachers

Demographic Variables	Category	Frequency	Percent
Gender	Female	241	55.60%
	Male	192	44.40%
Age	20-30	90	20.80%
	31-40	114	26.30%
	41-50	140	32.30%
	51-60	81	18.70%
	61 and above	8	1.80%
Place of Profession	Province Center	243	56.10%
	District Center	102	23.60%
	Town/Area	38	8.80%
	Village	50	11.50%
Grade Level	Undergraduate	404	93.30%

	Graduate	27	6.20%
	Doctorate	2	0.50%
Professional Experience	1-5 years	76	17.60%
	6-10 years	71	16.40%
	11-15 years	61	14.10%
	16-20 years	76	17.60%
	21-25 years	90	20.80%
	26 years and above	59	13.60%

First, the authors have formed an item pool of 85 items, consisting of 56 positive and 29 negative items (Gelen et al. 2019; Hacıömeroğlu, 2020; Sevian et al., 2018; Tal, et al., 2021; Tortop & Akyıldız, 2018; Yaman & Tulumcu, 2016). The authors rearranged the items in line with the opinions of three experts in science education and reduced them to 67 items. Expert opinions are explained in detail in the "Content Validity" section.

In the first part of the scale form, the authors asked participants if they knew about CBL. They also identify demographic information such as gender, age, place of employment, educational background, and professional experience. In the second part of the scale form, 67 items aim to measure science teachers' self-efficacy beliefs regarding the use of CBL. The authors prepared the draft scale form in a five-point Likert type. The first researcher delivered the draft scale form to the participants electronically. The first and third authors reverse-coded the negative statements in the SPSS 25 program.

Procedure

The authors followed a five-stage process in scale development. While determining the five-stage process, the scale development steps of many researchers were taken into account in the literature (Davis, 1992; Keçe et al., 2020; Pallant, 2020; Sireci et al., 2005; Şahin et al., 2018; Taşkın & Aksoy, 2019). These stages are forming the item pool, seeking expert opinions for content validity, pre-testing, constructing a validity study, reliability analysis, and criterion validity study. The authors explain these stages in detail below.

The Literature Review and Forming an Item Pool

Firstly, the first author has performed the literature review to form an item pool. The first author has examined the theoretical foundations of "Context-Based Science Learning" and "Teacher Self-Efficacy" in this context. De Putter-Smits et al. (2012) identified context-based learning competencies as context handling, regulation, emphasis, design, and school innovation. On the other hand, Bandura (2018) stated that teacher self-efficacy is affected by "mastery experiences", "vicarious experiences", "verbal persuasion" and "psychological situations". Therefore, the authors created the item pool by considering the context-based learning competencies and self-efficacy factors. For example, the "material arrangement" competency and the "direct experiences" factor were considered to create the item "I can make effective use of materials in the CBSL". While creating the item pool, the first author took the written

opinions of 53 science teachers in Kayseri via Google Form about the characteristics that teachers should have while using the CBL. For this aim, two questions have been asked. The first was “What is the CBL?” and the second was “What are the competencies that teachers should have while using the CBL?” Some answers are as follows: (1) The teacher should be able to write context-based questions. (2) The teacher should be able to make an assessment based on context”. The authors have utilized the thoughts of the teachers while writing the scale items. Some items are described by Hacıömeroğlu (2020), Yaman et al. (2018), Colak et al. (2017), and Tortop & Akyıldız (2018) because the items were suitable for socio-cognitive theory and the CBL competencies. For example, Yaman et al. (2018) have employed the item “I am at a level to take part in projects related to STEM education." The authors have arranged this item as “I can take part in project studies related to the CBSL.” The competency of “school innovation” and the factor of “mastery experiences” were considered to write this item. In addition, the studies of Sevian et al., 2018 and Tal et al., 2021 were also used when creating the items. Table 2 presents the scale items and the CBL competencies and sources of self-efficacy.

Table 2

Evaluation of items in terms of the CBL competencies and self-efficacy factors

Items	Competencies	Factors
I have adequate knowledge about the CBSL (1).	School innovation	Mastery experiences
I can express my opinion in discussions related to the CBSL (2).	School innovation	Verbal persuasion
I have difficulty in time management when using the CBSL (3).	Regulation	Mastery experiences
I can help my colleagues to use the CBSL (4).	School innovation	Verbal persuasion
I can discuss current subjects by using the CBSL (5).	Emphasis	Verbal persuasion
I may not create a suitable environment for cooperative studies by using the CBSL (6).	Regulation	Mastery experiences
I can ensure that students need the subject they will learn by using the CBSL (7).	Emphasis	Verbal persuasion
I can perform the CBSL activities more effectively with my previous experience (8).	Regulation	Mastery experiences
I can prepare a measuring tool consisting of context-based questions (9).	Context handling	Mastery experiences
I may not provide students to put forward their opinions by using the CBSL (10).	Regulation	Verbal persuasion
In the process of using the CBSL, I find it difficult to develop students' social skills (11).	Regulation	Verbal persuasion
I can do the CBSL more effectively by reviewing previous CBSL activities (12).	Regulation	Vicarious experiences
I can share my teaching responsibility with students by	Regulation	Verbal persuasion

the CBSL (13).		
I can solve problems that arise when planning for CBSL (14).	Design	Mastery experiences
I can provide students to structure their knowledge by using the CBSL (15).	Emphasis	Mastery experiences
I can utilize sources related to the CBSL effectively (16).	School innovation	Vicarious experiences
I can identify examples of everyday life that attract students' attention when using the CBSL (17).	Context handling	Mastery experiences
I cannot develop material that can be used in the CBSL activities (18).	Design	Mastery experiences
I can select materials that can be used in CBSL (19).	Design	Mastery experiences
I can't increase the attention of students towards a lesson in CBSL (20).	Regulation	Verbal persuasion
I become excessively stressed in CBSL (21).	Regulation	Psychological conditions
I can use an example to be selected from daily living while starting to lesson in CBSL (22).	Context handling	Mastery experiences
I can write context-based questions (23).	Context handling	Mastery experiences
I become anxious in CBSL (24).	Regulation	Psychological conditions
I can determine examples of daily living suitable for the level of students in CBSL (25).	Context handling	Mastery experiences
I can explain with justifications why CBSL is needed (26).	School innovation	Verbal persuasion
I can prepare a lesson plan suitable for CBSL (27).	Design	Mastery experiences
I can determine examples of daily living suitable for the subject of a lesson in CBSL (28).	Context handling	Mastery experiences
I can decide for which gains CBSL can be used (29).	Emphasis	Mastery experiences
30. I can provide students can apply their gained knowledge in a new situation (30).	Emphasis	Verbal persuasion
I can manage the learning process effectively in CBSL (31).	Regulation	Mastery experiences
I consider the advice of other people in my CBSL applications (32).	Regulation	Vicarious experiences
I can develop the self-development skills of students in CBSL (33).	Regulation	Mastery experiences
I can increase the motivation of students in CBSL (34).	Regulation	Vicarious experiences
I become excited about CBSL (35).	Regulation	Psychological conditions
I can give examples from daily life in CBSL (36).	Context handling	Mastery experiences
I search for application examples for CBSL (37).	School innovation	Mastery experiences
I can produce solutions that may be met in CBSL applications (38).	Regulation	Mastery experiences
I constrain in preparing a lesson plan suitable for	Design	Mastery experiences

CBSL (39).		
I can provide an increase of self-confidence of students in CBSL (40).	Regulation	Mastery experiences
I can provide students solve their problems of daily living in CBSL (41).	Emphasis	Vicarious experiences
I can follow the agenda for purpose of CBSL (42).	School innovation	Vicarious experiences
I can have a task in project studies related to CBSL (43).	School innovation	Mastery experiences
I don't think to reuse it when I am constrained in CBSL (44).	Regulation	Mastery experiences
I can develop the cognitive skills of students in CBSL (45).	School innovation	Mastery experiences
I can apply CBSL in a classroom environment (46).	Regulation	Mastery experiences
I can increase the curiosity of students about a lesson in CBSL (47).	Regulation	Verbal persuasion
I can reach the targets of the lesson in CBSL (48).	Emphasis s	Mastery experiences
I can develop the communication skills of students in CBSL (49).	Regulation	Verbal persuasion
I am constrained in making evaluations in CBSL (50).	Regulation	Mastery experiences
I constrain in using materials in CBSL (51).	Regulation	Mastery experiences
I can develop myself for purpose of CBSL (52).	School innovation	Mastery experiences
I can increase the interest of students in science in CBSL (53).	School innovation	Mastery experiences
I can develop the sensory skills of students in CBSL (54).	Regulation	Mastery experiences
I can get students to make applications where they can use their preliminary knowledge in CBSL (55).	Emphasis	Mastery experiences
I can make guidance to students in CBSL (56).	Regulation	Mastery experiences
I can develop myself for purpose of CBSL (57).	School innovation	Mastery experiences
I can use the time effectively in CBSL (58).	Regulation	Mastery experiences
Advice from other people doesn't influence me in CBSL (59).	School innovation	Verbal persuasion
I can develop my professional performance through CBSL (60).	School innovation	Mastery experiences
I can provide meaningful learning for students in CBSL (61).	Emphasis	Mastery experiences
62. I can answer the questions related to CBSL (62).	School innovation	Verbal persuasion
I can decide which methods/techniques can be used in CBSL (63).	Emphasis	Mastery experiences
I am adequately equipped for CBSL (64).	School	Mastery experiences

	innovation	
I can provide students to make associations between preliminary knowledge and life experiences in CBSL (65).	Context handling	Mastery experiences
I enjoy CBSL (66).	Regulation	Psychological conditions
I can design an activity suitable for CBSL (67).	Emphasis	Mastery experiences

Content Validity

Expert opinion has been applied for providing content validity of the draft scale. The draft scale has been examined by three experts in science education who have scale development (U1, U2 and U3) and context-based learning approach studies (U2 and U3), and arrangements have been made in line with feedback from experts. Experts have evaluated the scale for the aspect of characteristics of form, meaning, and content validity. Some examples from expert opinions are presented in Table 3.

Table 3

Examples related to expert opinion

Expert	Item Pool	Expert Recommendation	Arranged Form
U1, U2	I think current subjects can be discussed in CBSL.	*I can declare opinion in discussions related to CBSL.*	I can declare opinion in discussions related to CBSL.
U1, U2	I don't think that using CBSL would help students understand scientific research processes.	U1: *Remove it because it is an item measuring attitude, not self-efficacy.* U2: *It may be removed because it is an item not related to the teacher.*	The item was removed.
U1, U2	I believe in that I can develop myself in the use of CBSL.	U1: *I can develop myself on the use of CBSL.* U2: *On which side can it be developed?*	I can't develop myself for purpose of applying to CBSL.
U1, U2	I believe in that I would provide meaningful learning for students by using CBSL.	U1: *Remove it because it is an item measuring attitude, not self-efficacy.* U2: *This item doesn't measure the academic self-efficacy of a teacher, but focuses on students' self-efficacy.*	The item was removed.
U1	I don't believe that I can share the responsibility of teaching with students by using CBSL.	*Remove it because it is an item measuring attitude, not self-efficacy.*	The item was removed.
U2	I think that making a design suitable for CBSL is difficult.	*There is another item having the same meaning.*	The item was removed.
U2, U3	I cannot create an aim suitable for CBSL.	U2: *Creating gain isn't among the task of the teacher. Adapt this approach to objectives in the program.* U3: *Creating objectives may not be understood by teachers.*	The item was removed.

U1	I can provide students be interested in technical and scientific subjects by developing their interest in a lesson by using CBSL.	*Technique and science may be handled separately. Technology is also a product of science, therefore only the second can also be used.*	I can increase the interest of students in science in CBSL.
U1, U3	I can determine contexts that take the attention of students while using BTFÖ.	U1: *Word of context may not be understood.* U3: *Use another word instead of a word of context.*	I can determine examples of daily living which take the attention of students while using CBSL.
U1, U3	Persuasion and encouragement from others are the greatest factors in the development of my belief about the usability of CBSL.	U1: *Remove it because it is an item measuring attitude, not self-efficacy.* U3: *I take into account the advice of other people in my CBSL implementations.*	I take into account the advice of other people in my CBSL implementations.

Preparing Draft Scale and Administration

The items have been arranged in the light of feedback coming from experts in the field of science education who have studies on scale development and context-based learning approach and have been ranked randomly before the process. Participants aren't influenced by the administration process; the purpose of the study has been mentioned at the beginning of the scale form and explanations related to CBSL haven't been made.

The pilot study has been conducted and the draft scale has been administered to 18 science teachers. Information has been collected from teachers about answering time of scale, understandability of items, and if it is suitable for the teachers. The result has been reached from the opinion of teachers that 67 items were understandable and suitable for teachers and that duration is adequate. The draft scale has been administered to the sample and validity and reliability analyses have been performed by considering data.

Descriptive Analysis

Skewness and kurtosis values have been looked at to understand if scores obtained from answers that science teachers have given to the draft scale showed normal distribution or not. Being skewness and kurtosis values of items between (+2) and (-2) demonstrates that scores were distributed normally (George & Mallery, 2003).

Construct Validity

To provide construct validity, firstly explanatory factor analysis (EFA) and subsequently confirmatory factor analysis (CFA) have been executed. Kaiser Mayer Olkin (KMO) and Barlett Test (Barlett Test of Sphericity) have been examined to execute EFA and to understand if data is distributed normally and to understand if it is studied with an adequate sample. We have considered that the KMO value was above 0,70 and the Barlett test was significant (Kline, 2005; Pallant, 2020; Seçer, 2017). Also, items, having an Eigen-value of more than one, have been determined to determine the number of factors, and we have considered that the factor loading of each item became

at least 0,30 (Seçer, 2017; Turgut & Baykul, 1992). To determine the ideal factor structure, the "direct oblimin" method has been applied. We considered that loading values weren't superposed in the distribution of data in factors as a result of rotation. The higher the variance ratios obtained, the stronger the factor structure of a scale. It is recommended that variance would be above 40% for significant factors (Kline, 2005; Scherer et al., 1988). Also, factor names have been given by considering the items. If factor structure appeared as a result of EFA analysis is suitable has been checked by using CFA. Although it was recommended that the sample be divided into two randomly and EFA and CFA be applied to different samples, it is expressed that making analyses on a single sample wouldn't cause any problem. (Worthington & Whittaker, 2006). Doğan et al. (2017) have indicated that results obtained when EFA and CFA were performed with the same sample and results obtained when it was applied to different halves of a sample were similar. For this purpose, both EFA and CFA have been applied to the data of a group of 433 persons, and afterward, the sample group has been divided into two randomly as 200-233 persons, and EFA has been applied to the data of the group of 233 persons and CFA has been applied on data of the group of 200 persons. Results obtained in both situations have been compared. The suitability of the model has been evaluated by taking criteria of RMSEA, CFI, GFI, and chi-square as a measure in CFA. While EFA has been tested by SPSS 25.0 program, LISRELL 8.7 program has been used for applying CFA.

Criterion Validity

Another method for providing validity is to make a criterion validity study. Criterion validity is that item scores show similarity with another measuring tool, which we think has characteristics that item measures (Büyüköztürk et al., 2021). In this study, the method of parallel forms has been used for providing criterion validity and "teachers' self-efficacy belief scale towards applying structuring approach" with a correlation coefficient of 0.92 developed by Eskici and Özen (2018) used within this context. The reason for choosing this scale is that it is a scale measuring self-efficacy of teachers towards an approach similar to the draft scale. The criterion scale has been obtained with items measuring the same gains compared to the draft scale by removing items that measure different gains in the criterion scale. After applying both scales to participants in the sample, correlation coefficients between scores obtained from the criterion scale have been obtained with item scores measuring the same gains compared to the draft scale by removing items that measure different gains in the criterion scale. While looking at correlation coefficients, we have aimed to determine the correlation between the scale scores (Pallant, 2017). Being the correlation between the draft scale and the criterion scale between 0.70-0.90 as an absolute value has been defined as high, being between 0.69-0.30 has been defined as moderate, and being between 0.30-0.01 has been defined as a low level of relationship (Büyüköztürk et al., 2021).

Reliability of Draft Scale Scores

In this study, Cronbach alpha internal correlation coefficient, reliability coefficient belonging to sub-factors, and corrected total item score correlation values have been looked for to calculate the reliability of the draft scale. When Cronbach's alpha value is above 0.70, it can be told that the reliability of the scores is high (Pallant, 2020). To describe the relationship between the score of any item and the total score of

test items, corrected total item score correlation is utilized. Being this value high and positive shows that the scale has internal consistency (Pallant, 2020).

Ethical Procedures

The pilot application of the scale was carried out by obtaining an 'Ethics Committee Permission Certificate' from Erciyes University Social and Human Sciences Scientific Research and Publication Ethics Committee and 'MEB Research Permit' from the Provincial Directorate of National Education where the application will be carried out. Following the permissions, the application was started by obtaining informed consent from the participants.

Results

Descriptive Analysis of the Draft Scale

We have examined if item scores showed a normal distribution. Skewness and kurtosis values have been examined within this context.

Table 4

Skewness and kurtosis values of draft scale items

Item No	Skewness	Kurtosis	Item No	Skewness	Kurtosis	Item No	Skewness	Kurtosis
M1	-1.07	0.35	M22	-1.28	0.43	M47	-1.07	0.03
M2	1.11	2.92	M23	-1.34	0.59	M48	-1	-0.17
M3	-0.89	0.03	M25	-0.80	-0.44	M49	-1	-0.15
M4	-0.84	-0.06	M27	-0.35	-0.79	M50	-0.67	-0.65
M6	-0.81	-0.56	M30	-0.81	-0.55	M51	-0.85	-0.55
M7	-1	-0.31	M31	-1.45	2.32	M52	-1.15	0.30
M8	-0.48	4.44	M33	-0.62	-0.67	M53	-1.07	-0.36
M9	-0.91	-0.26	M34	-0.86	-0.50	M54	-1.27	0.21
M10	-0.97	-0.1	M35	0.18	0.93	M55	-0.96	-0.36
M11	-0.85	-0.59	M36	-0.53	-0.72	M56	-1.26	0.48
M12	0.2	0.92	M38	-0.78	-0.71	M58	-0.27	-0.69
M13	-0.83	-0.41	M40	-0.71	-0.62	M61	-0.98	-0.17
M15	-0.81	-0.46	M41	-0.92	-0.32	M63	-0.72	-0.54
M17	-0.71	-0.78	M43	-0.50	-0.85	M65	-0.94	-0.19
M19	-0.34	-0.67	M45	-1.05	-0.07	M67	-0.07	-0.34
M20	-0.91	-0.26	M46	-0.77	-0.82			

Table 4 indicates that skewness and kurtosis values have occurred between +2 and -2 (Pallant, 2020). Therefore, it can be said that item scores showed a normal distribution.

Construct Validity

Explanatory factor analysis applied to the same sample group

EFA has been executed four times to determine factors of items in the draft scale. To determine the suitability of data for factor analysis, KMO and Barlett tests have been considered (Table 5). The result of the Barlett test demonstrates that item scores showed a normal distribution. KMO value was found as 0.973. Therefore, the selected sample size is adequate for determining factors (Pallant, 2020).

Table 5

KMO and Bartlett Test Value According to First-Factor Analysis

Kaiser-Meyer-Olkin Sample Adequacy.		.973
Bartlett Sphericity Test	Approximate Chi-Square	20126.090
	df	1431
	Significance Value	.000

The extraction values of 67 items have been looked at as a result of first-factor analysis and values have been presented in Table 6. Extraction values are above 0.30, and there is no need to exclude any item from the scale (Pallant, 2020).

Table 6

Extraction Values of Items in Draft Scale According to First-Factor Analysis

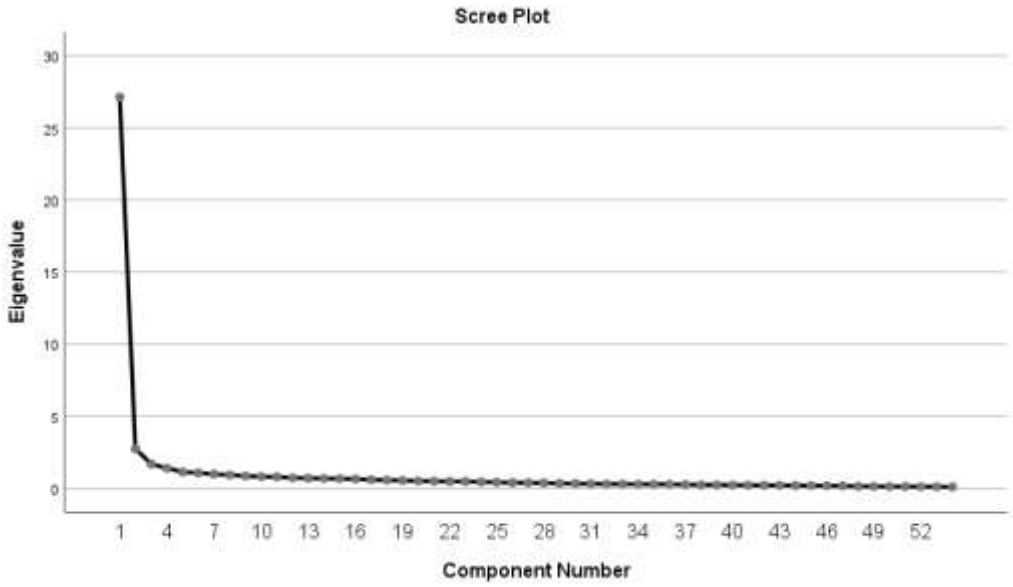
Item No	Extraction	Item No	Extraction	Item No	Extraction
M1	0.83	M24	0.54	M47	0.74
M2	0.52	M25	0.54	M48	0.74
M3	0.82	M26	0.63	M49	0.82
M4	0.77	M27	0.59	M50	0.72
M5	0.78	M28	0.53	M51	0.80
M6	0.74	M29	0.42	M52	0.77
M7	0.70	M30	0.77	M53	0.63
M8	0.59	M31	0.61	M54	0.61
M9	0.57	M32	0.54	M55	0.79
M10	0.77	M33	0.63	M56	0.74
M11	0.74	M34	0.75	M57	0.74
M12	0.66	M35	0.74	M58	0.64
M13	0.66	M36	0.63	M59	0.66
M14	0.57	M37	0.69	M60	0.52

M15	0.75	M38	0.80	M61	0.78
M16	0.55	M39	0.56	M62	0.72
M17	0.70	M40	0.66	M63	0.64
M18	0.57	M41	0.74	M64	0.65
M19	0.48	M42	0.44	M65	0.79
M20	0.74	M43	0.64	M66	0.60
M21	0.50	M44	0.60	M67	0.55
M22	0.64	M45	0.68		
M23	0.60	M46	0.73		

Nine factors have been found as a result of the first-factor analysis. These nine factors meet 66.15% of the explained variance. If an item is loaded under more than one factor and the factor load difference of that item in these two factors is less than 0.10, it means that the item will be overlapped (Pallant, 2020). Therefore, 13 different items that overlapped first-factor analysis have been excluded from the analysis and factor analysis has been repeated for a second time. Six different items that overlapped in the second-factor analysis have been excluded from the analysis. To determine the number of factors as a result of the second-factor analysis, the Scree Plot graph has been examined. The slope accumulation curve of items after the second-factor analysis has been given in Figure 1. Each space between two points starting from the point where the inclining trend was seen means a factor (Çokluk et al., 2010).

Figure 1

Scree Plot Graph According to Second-Factor Analysis



A breakpoint is seen between 0-5 according to Figure 1. This situation shows that the number of factors is less than five. The number of factors was limited to four and a third-factor analysis was performed again. and one more item showing overlapping has also been excluded from the draft scale, and factor analysis has been

conducted on the draft scale of a total of 47 items for the fourth time. Explained variance values of the four-factor scale have been given in Table 7.

Table 7

Explained Variance Values of Factors in Draft Scale

Factor	Characteristic Value	Variance Percent	Total Variance Percent
1st Factor	25.57	54.41	54.41
2nd Factor	1.80	3.84	58.25
3rd Factor	1.61	3.42	61.67
4th Factor	1.37	2.92	64.59

Table 7 states that 47 items have been collected under four factors having an Eigenvalue of greater than 1 (Pallant, 2020). The total variance value related to the four-factor scale is 64.59%. Being total variance ratio owned by the scale between 40% and 60% is an indication that the factor structure was powerful (Scherer et al., 1988; Kline, 2005). Items collected under four factors and their load values have been presented in Table 8.

Table 8

Items and Their Load Values

Item No	Item	Load Values of Factors			
		1st Factor	2nd Factor	3rd Factor	4th Factor
49	I can develop the communication skills of students in CBSL.	1.00			
52	I can provide an increase of self-confidence of students in CBSL.	0.96			
56	I can make guidance for students in CBSL.	0.91			
48	I can reach the targets of the lesson in CBSL.	0.90			
61	I can provide meaningful learning for students in CBSL.	0.88			
65	I can provide students can make an association between their preliminary knowledge and life experiences in CBSL.	0.86			
10	I may not provide students to put forward their own opinions in CBSL.	0.83			
47	I can increase the curiosity of students towards lessons in CBSL.	0.83			
11	I constrain in developing social skills of students in CBSL.	0.79			
7	I can provide students need the subject they will learn in CBSL.	0.79			
55	I can get students to make applications where they can use	0.78			

	their preliminary knowledge in CBSL.				
20	I cannot increase the interest of students towards the lessen CBSL.	0.78			
51	I constrain in using materials in CBSL.	0.78			
41	I can provide students can solve problems of daily living in CBSL.	0.77			
6	I may not create an environment for cooperative studies of students in CBSL.	0.75			
15	I can provide students to structure their knowledge in CBSL.	0.75			
34	I can increase the motivation of students in CBSL.	0.74			
22	I can use an example selected from daily life in CBSL while starting a lesson.	0.70			
30	I can provide students would apply the knowledge gained in CBSL to a new situation.	0.69			
38	I can solve problems that may be faced in CBSL applications.	0.67			
23	I can write context-based questions.	0.67			
53	I can increase the interest of students in science in CBSL.	0.66			
46	I can apply CBSL in a classroom environment.	0.64			
45	I can develop the cognitive skills of students in CBSL.	0.59			
54	I can develop the sensory skills of students in CBSL.	0.59			
33	I can develop the self-management skills of students in CBSL.	0.44			
50	I constrain in making evaluations in CBSL.	0.43			
13	I can share my teaching responsibility with students through CBSL.	0.43			
58	I can use time effectively in CBSL.	0.42			
31	I can manage the learning process effectively in CBSL.	0.38			
12	I can perform CBSL more effectively by examining sample applications.		0.74		
35	I get excited in CBSL.		0.70		
8	I can perform my CBSL applications more effectively with my previous experiences.		0.45		
2	I can declare opinion in discussions related to CBSL.			0.81	
4	I can help my colleagues in CBSL.			0.70	
3	I constrain in time management in CBSL.			0.67	
1	I have adequate academic knowledge of context-based science education.			0.66	
27	I can prepare a lesson plan suitable for CBSL.				0.73
40	I can decide for which gains CBSL can be used.				0.57

43	I would be happy to have a task in project studies related to CBSL.	0.54
36	I can give examples from daily life in CBSL.	0.52
9	I can prepare a measuring tool consisting of context-based questions.	0.52
25	I can determine examples of daily living suitable for the level of a student in CBSL.	0.52
19	I can choose materials that can be used in CBSL.	0.51
17	I can determine examples of daily living which attract the interest of students in CBSL.	0.45
67	I can design activities suitable for CBSL.	0.36
63	I can decide which method/techniques can be used in CBSL.	0.34

Table 8 displays those 30 items that have been collected under the first factor. Similarly, three items under the second factor, four items under the third factor, and 10 items under the fourth factor have been grouped. While naming factors, the semantic suitability of the content of items included under factors is considered (Çakır, 2014). When the first factor is examined, we have seen that it contains items expressing the self-efficacies of teachers towards applying the CBL in the process of learning-teaching. Therefore, the first factor has been named as "Teaching-Learning Process". Because expressions related to self-efficacy resources from which teachers are influenced in the second factor, we have named "Self-adequacy Resources". Expressions related to academic adequacy of teachers towards the CBL approach are included in the third factor, which we have named "Academical Self-efficacy". Items related to the self-efficacy of teachers in planning education are included in the fourth factor, which we have named "Planning Education".

Explanatory factor analysis applied to different sample groups

After EFA and CFA have been run on the same sample, the sample group of 433 persons has been randomly divided into two groups of 200-233 participants. EFA has been run on data from the group of 233 persons and CFA has been conducted on data from 200 persons. EFA has been executed four times to determine factors in the draft scale. KMO value and Barlett test results have been presented in Table 9. KMO value found as 0.91 as a result of the analysis demonstrate that the selected sample size is adequate for determining factors.

Table 9

KMO Value and Bartlett Test for The First-Factor Analysis in The Different Samples

Kaiser-Meyer-Olkin Sample Adequacy.		.906
Bartlett Globality Test	Approximate Chi-Square	16076.68
	Df	2211
	Significance Value	.000

The extraction values of 67 items have been presented in Table 10. The extraction values are above 0.30 (Pallant, 2020).

Table 10

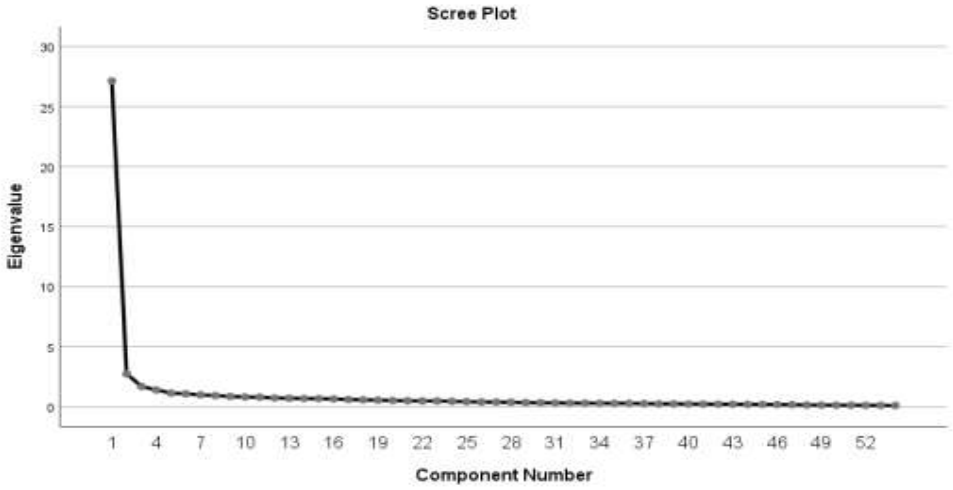
Extraction Values According to First-Factor Analysis in the Different Samples

Item No	Extraction	Item No	Extraction	Item No	Extraction
M1	0.82	M24	0.68	M47	0.83
M2	0.66	M25	0.72	M48	0.76
M3	0.72	M26	0.75	M49	0.89
M4	0.79	M27	0.74	M50	0.76
M5	0.61	M28	0.74	M51	0.84
M6	0.89	M29	0.64	M52	0.78
M7	0.75	M30	0.84	M53	0.76
M8	0.59	M31	0.66	M54	0.76
M9	0.73	M32	0.66	M55	0.88
M10	0.83	M33	0.84	M56	0.76
M11	0.81	M34	0.69	M57	0.76
M12	0.78	M35	0.63	M58	0.81
M13	0.75	M36	0.69	M59	0.81
M14	0.69	M37	0.86	M60	0.61
M15	0.84	M38	0.69	M61	0.88
M16	0.76	M39	0.69	M62	0.77
M17	0.75	M40	0.71	M63	0.77
M18	0.79	M41	0.86	M64	0.77
M19	0.62	M42	0.79	M65	0.81
M20	0.86	M43	0.79	M66	0.54
M21	0.57	M44	0.81	M67	0.47
M22	0.77	M45	0.79		
M23	0.74	M46	0.85		

We have found 14 factors as a result of the first analysis. These 14 factors meet 75.05% of the variance. Twelve different items that overlapped in the first-factor analysis have been excluded from the analysis and factor analysis has been repeated for the second time. Five different items that overlapped in the second-factor analysis have been excluded from the analysis. Scree Plot graphs have been looked at as a result of the second-factor analysis to determine the number of factors.

Figure 2

Scree Plot Graph According to Second-Factor Analysis



The slope accumulation curve of items after the second-factor analysis has been given in Figure 2. The breakpoint is seen between 0-5 according to Figure 2. This situation demonstrates that the number of factors was less than five. The number of factors has been limited to four and factor analysis has been run again for the third time. Three items showing overlapping have been excluded from the draft scale and factor analysis has been run to the draft scale of a total of 47 items. The explained variance values of the four-factor scale have been performed in Table 11.

Table 11

Explained Variance Values in Draft Scale for Different Sample

Factor	Characteristic Value	Variance Percent	Total Variance Percent
1st Factor	25.69	54.66	54.66
2nd Factor	1.76	3.75	58.41
3rd Factor	1.58	3.37	61.77
4th Factor	1.44	3.07	64.85

When Table 11 is examined, we have seen that 47 items have accumulated under four factors having the Eigenvalue of greater than 1 (Pallant, 2020). The total variance value related to the four-factor scale is 64.85%. Scale items collected under four factors and their load values have been given in Table 12.

Table 12

Items Located under Factors and Their Loading Values

Item No	Item	Load Values of Factors			
		1st Factor	2nd Factor	3rd Factor	4th Factor
49	I can develop the communication skills of students in CBSL.	0.79			
52	I can provide an increase self-confidence of students in CBSL.	0.82			
56	I can make guidance for students in CBSL.	0.85			
48	I can reach the targets of the lesson in CBSL.	0.88			
61	I can provide meaningful learning for students in CBSL.	0.87			
65	I can provide students can make an association between their preliminary knowledge and life experiences in CBSL.	0.86			
10	I may not provide students to put forward their own opinions in CBSL.	0.83			
47	I can increase the curiosity of students towards lessons in CBSL.	0.91			
11	I constrain in developing social skills of students in CBSL.	0.90			
7	I can provide students need the subject they will learn in CBSL.	0.88			
55	I can get students to make applications where they can use their preliminary knowledge in CBSL.	0.83			
20	I cannot increase the interest of students towards the lessen CBSL.	0.88			
51	I constrain in using materials in CBSL.	0.83			
41	I can provide students can solve problems of daily living in CBSL.	0.87			
6	I may not create an environment for cooperative studies of students in CBSL.	0.81			
15	I can provide students to structure their knowledge in CBSL.	0.90			

34	I can increase the motivation of students in CBSL.	0.89			
22	I can use an example selected from daily life in CBSL while starting a lesson.	0.67			
30	I can provide students would apply the knowledge gained in CBSL to a new situation.	0.81			
38	I can produce solutions for problems that may be faced in CBSL applications.	0.83			
23	I can write context-based questions.	0.82			
53	I can increase the interest of students in science in CBSL.	0.76			
46	I can apply CBSL in a classroom environment.	0.72			
45	I can develop the cognitive skills of students in CBSL.	0.81			
54	I can develop the sensory skills of students in CBSL.	0.69			
33	I can develop the self-management skills of students in CBSL.	0.46			
50	I constrain in making evaluations in CBSL.	0.60			
13	I can share my teaching responsibility with students through CBSL.	0.79			
58	I can use time effectively in CBSL.	0.82			
31	I can manage the learning process effectively in CBSL.	0.85			
12	I can perform CBSL more effectively by examining sample applications.		0.46		
35	I get excited in CBSL.		0.71		
8	I can perform my BTFÖ applications more effectively with my previous experiences.		0.45		
2	I can declare opinion in discussions related to CBSL.			0.633	
4	I can help my colleagues in CBSL.			0.67	
3	I constrain in time management in CBSL.			0.63	
1	I have adequate academic knowledge of context-based science education.			0.72	
27	I can prepare a lesson plan suitable for CBSL.				0.56
40	I can decide for which gains CBSL can be used.				0.65
43	I would be happy to have a task in project studies related to CBSL.				0.61
36	I can give examples from daily life in CBSL.				0.67

9	I can prepare a measuring tool consisting of context-based questions.	0.67
25	I can determine examples of daily living suitable for the level of a student in CBSL.	0.66
19	I can choose materials that can be used in CBSL.	0.51
17	I can determine examples of daily living which attract the interest of students in CBSL.	0.70
67	I can design activities suitable for CBSL.	0.46
63	I can decide which method/techniques can be used in CBSL.	0.52

Table 12 indicates that 30 items have been collected under the first factor. Also, three-item under the second factor, four items under the third factor, and 10 items under the fourth factor have been grouped. We have seen results of EFA performed with both sample groups are close to each other.

Confirmative Factor Analysis Applied to Data of the Same and Different Sample Groups

CFA has been conducted on data of the same and different sample groups. Firstly, the results of the chi-square test have been looked at. The value of 3.284 has been obtained for data of the same sample when the chi-square value (3222.58) was divided by the df value (981), which is the degree of freedom, and the value of 2.210 has been obtained for data of the different sample when chi-square value (2272.60) was divided by the df value (1028), which is the degree of freedom. If the obtained value is five or below, the structure is acceptable (Hooper & Mullen, 2008; Şimşek, 2007). Therefore, it can be said that obtained values are acceptable for the analysis. Also, RMSEA values (0.073 in the same sample and 0.078 in the different sample) below 0.080 demonstrate that the determined model is within the acceptable limit (Seçer, 2017). CFA models applied to data of the same and different samples have been given in Figure 3a and Figure 3b.

Figure 3a

CFA Model of the Same Sample Data

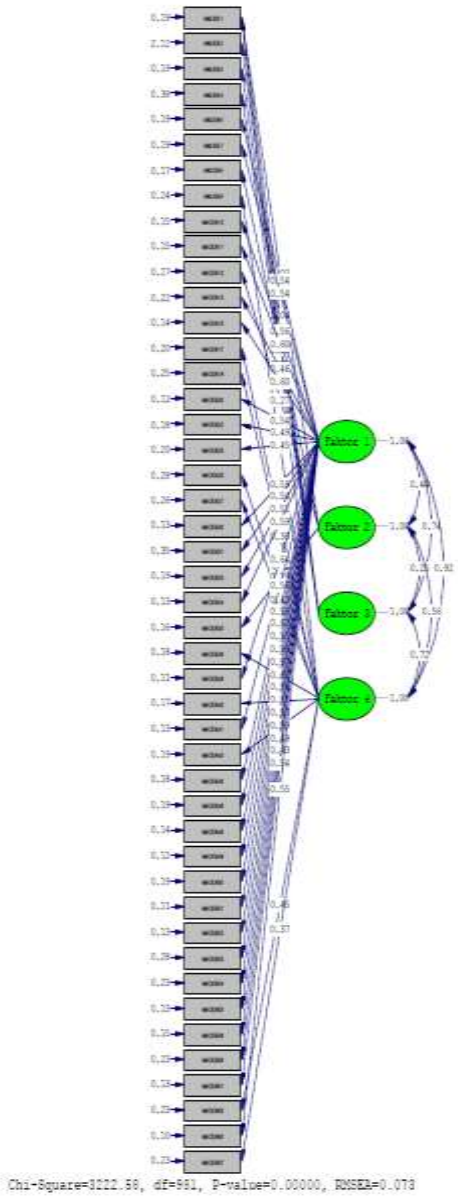
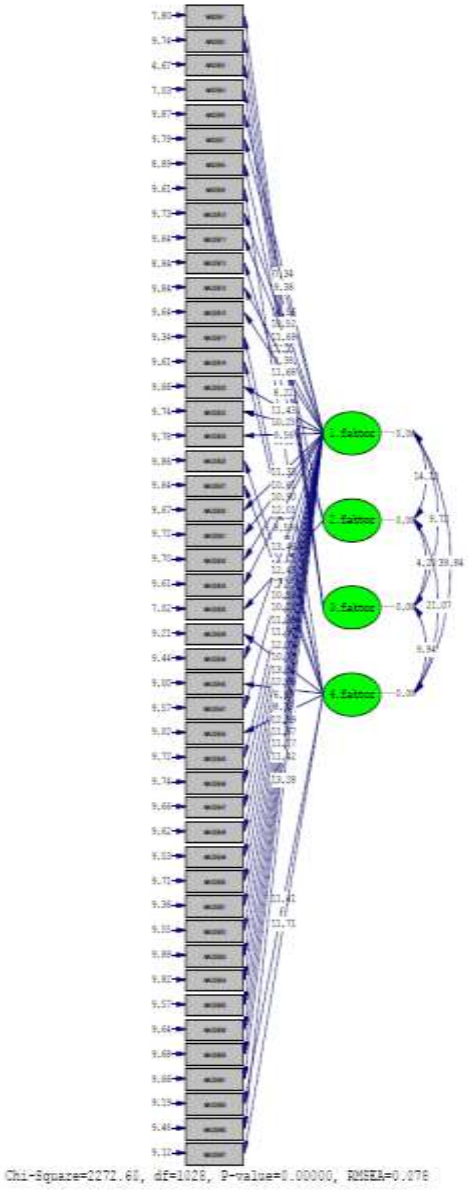


Figure 3b

CFA Model of Different Sample



Model fit indices for data of the same and different samples to confirm the four-factor structure have been indicated in Table 13.

Table 13

Correlation Values Obtained as a Result of CFA

DFA Results	*χ2*	*Sd*	*χ2/sd*	*RMSEA*	*GFI*	*CFI*	*IFI*
Same sample	3222.58	981	3.284	0.073	0.76	0.98	0.98
Different sample	2272.60	1028	2.210	0.078	0.70	0.97	0.97

The values of GFI (The goodness of fit index) are 0.76 and 0.70. This value above 0.70 shows the applicability of the determined model (Durkan, 2017). For this

reason, the GFI values of the study are within the acceptable range. Being CFI and IFI values above 0.95 for both analyses mean that correlation between data of the factor model is perfect (Sümer, 2000; Bentler, 1990). The data of the same and different samples have been confirmed, and a draft scale having a structure of 47 items and four factors has been developed.

Criterion Validity

To provide criterion validity of the draft scale, the relationship between the draft scale and the criterion scale has been considered. For this aim, the criterion scale has been performed on 100 participants. The correlation has been calculated by the Pearson test and has been shown in Table 14.

Table 14

Results of Correlation Coefficient between Draft Scale and Criterion Scale

Scale	Correlation	Draft	Criterion
Draft	Pearson Correlation	1.000	.862**
	Significance Value	.	.000
	Number of Persons	100	100
Criterion	Pearson Correlation	.862**	1.000
	Significance Value	.000	.
	Number of Persons	100	100

**Correlation is significant at 0.01 level.

The correlation coefficient between the draft scale and the criterion scale has been found as 0.86. This value shows that the draft scale provided criterion validity.

Reliability

Cronbach Alpha reliability coefficient has been calculated after providing construct validity and we have found α =0.98. When the total correlation of items belonging to each item in the draft scale was examined, we have seen that each item has a positive value between 0.31 and 0.84 and close to one. This situation means that the internal consistency of items is high (Büyüköztürk et al., 2021). Besides, the reliability coefficient belonging to each factor has been calculated and the results have been presented in Table 15.

Table 15

Reliability Coefficients of Factors

Factors	Cronbach Alpha Coefficient
1st Factor: Learning/Teaching Process	0.98
2nd Factor: Self-adequacy Resources	0.70
3rd Factor: Academical Self-adequacy	0.82
4th Factor: Planning Education	0.91

Table 15 displays that the reliability coefficient of each factor is above 0.70. For this reason, it can be told that the scores obtained from the draft scale are reliable (Pallant, 2020).

Discussion and Conclusion

A valid and reliable scale has been developed in this study to determine the self-efficacies of science teachers toward CBL.

Discussion on Validity

Content, construct, and criterion validities have been controlled for the validity study of the draft scale. Expert opinion has been obtained for content validity. The route used in many investigations in which context validity study has been made in the scale development process in the literature (Biçer et al., 2018; Bolat et al., 2021; Candaş & Özmen, 2020; Davis, 1992; Gözüm & Güneş. 2018; Ocak & Hocaoğlu, 2020) has been followed in the current research. A group of field experts has evaluated items. In this direction. some items have been extracted and revisions have been made for some items. It can be said that the content validity of the current study is high by taking feedback into account.

EFA and CFA have been applied to provide construct validity. KMO value and Barlett test results have been looked at to determine the suitability of the current study for factor analysis. Similar studies are performing a factor analysis in the literature (Buldur & Alisinanoğlu, 2020; İnaltekin & Saka, 2019; Kurnaz & Bayraktar, 2012; Yıldırım, 2015; Tepe et al., 2020). In the light of these studies, being KMO value of the sample group of 433 as 0.973, and being KMO value of the sample group of 233 as 0.906 may be the proof that the study is suitable for factor analysis in both situations (Bryman & Cramer, 1999; Şeker et al., 2004). As a result of EFA, the explained variance value of the scale has been calculated as 64% for the same sample and 65% for a different sample. According to Henson and Roberts (2006), values of 52% and above should be provided for variance in scale studies. Therefore, this variance value declared is at an acceptable level. There should be a minimum of two acceptable items in each factor in factor analysis. The more there are items under each factor the higher reliability of the scale and the explaining capability of factors (Seçer, 2017). In the EFA applied on both the same sample and the different sample, 30 items under the first factor, three factors under the second factor, four items under the third factor, and 13 items under the fourth factor demonstrate that factors of the scale are acceptable. CFA has been performed for each group separately both on the same group and a different

group for confirmation of four factors. Factors have been confirmed for both situations and obtained results were similar. There are discussions related to the use of the same sample for CFA in the literature. Worthington and Whittaker (2006) have suggested that data structure would be put forward experimentally when AFA and DFA are performed on the same sample. But, Fabrigar et al. (1999) have recommended that samples would be divided into two randomly and AFA would be made in one and DFA in the other. Analyses containing both applications have been made in the current research. and similar results have been found. Therefore, it can be said that different sample groups aren't compulsory for AFA and DFA and that each item and factor in the scale has a feature of the ability to measure the desired character within the context of the scale. This situation has a quality to confirm that results of EFA and CFA made with the same sample and results obtained when they are applied to different halves of a sample were similar in the study of Doğan et al. (2017).

To determine the criterion validity of the scale, a scale developed by Eskici & Özen (2013) and measuring similar adequacies in this research has been used. The correlation between items included in the two scales has been looked at for criterion validity. The result that the current scale has provided criterion validity has been reached by finding the value of the Pearson correlation coefficient as 0.862. This result may result from that the scale selected as a criterion is a scale measuring the adequacy of teachers on BTÖ, which is a scale measuring the adequacy of teachers about structuring approach and which is a social structuring approach of the scale within the context of the study. The status of both scales measuring similar characteristics proves that criterion validity was high. Although there are researches in which criterion validity studies were made in the literature (Ergün, 2021; Güçer et al., 2020; Keçe et al., 2020; Varinlioğlu & Bektaş; 2020), it seems that they are in a limited number. However, Cureton (1951) has put forward that validity, expressed as the degree of the scale for serving its purpose, can be determined by criterion validity most suitably. Shepard (1993) has expressed that criterion validity is an important type of validity for diagnostic and evaluation decisions in case a correlation appears especially between scale performance in practice and aimed criterion. For this reason, performing a criterion validity study and being criterion validity provided by the study may prove that the developed scale validity was high.

Discussion on Reliability

Cronbach Alpha coefficient has been calculated as 0.98 for the whole of the scale and calculated as 0.98, 0.70, 0.82, and 0.91 for each factor, respectively. Because calculated values are 0.70 and above, which is the acceptable reliability coefficient in scales (Anastasi, 1982; Büyüköztürk, 2020), it can be told that scores obtained from the scale are reliable. When item-total correlation was examined for each item, it has been seen that values were between 0.31 and 0.84. When item-total correlation was examined, it can be told that items in the scale were consistent with each other because having scores of 0.20 and above means that they were consistent and made a positive contribution to reliability (Büyüköztürk, 2020). When scale development and adaptation studies are examined, similar methods have been met for determining reliability in almost all studies (Aka, 2016; Biçer et al., 2018; Demirci, 2017; Günşen & Uyanık, 2020; Kurnaz & Bayraktar, 2012; Ocak & Hocaoğlu, 2021; Özlü et al., 2013). It is seen

that Cronbach Alpha internal correlation coefficients were calculated above 0.70, and item-total correlation values were positive, and they are values close to one in the present study as in the mentioned studies. This status may be sourced from that context validity was provided by a literature survey and expert opinions while creating items of the scale. Creating items of a quality, which can sample the subject content of the scale in a balanced way and which provides context validity increases validity and reliability of measuring results (Ercan & Kan, 2004).

The scale contains items including the whole of context-based education efficacies (context use, arranging learning process, education emphasis, material usage, and leadership for innovation) and the whole of resources of teacher self-efficacy (direct experiences, indirect livings, verbal persuasion, psychological situations) (Bandura, 1984; De Putter-Smits et al., 2012). We have seen that items include adequate context selection suitable for students and how they will be used. subject selection suitable for the context (context usage), encouraging students for active learning, students' having their responsibility of learning and being teacher in a guide position (arranging learning process), combining knowledge with science-technology-public instead of describing only science subjects in lessons (emphasizing education) and self-efficacy resources (verbal persuasion, direct experiences and indirect livings) were collected under the first factor, "Learning/Teaching Process". This situation has a feature to explain why thirty items were collected under the first factor. According to Gilbert (2006), it is expected from teachers to create suitable learning environments for the learning process would be effective. Also, Bandura (1994) has expressed that the key to the teaching and learning process being successful is the belief of the teacher towards his/her influence on the success of students and towards his/her adequacy in teaching. Moving from there, we have stated that the first factor includes items that can measure the self-efficacies of the teaching/learning process of science teachers toward CBL.

We have seen items expressing three (direct experiences. indirect living and psychological situations) of four basic resources influencing self-efficacy belief suggested by Bandura (1984) have been collected under the second factor named "Self-efficacy Resources". Although this situation seems like a limitation, a factor should consist of at least three items and factor loads should also be high so that a factor can be stable (Ford et al., 1986; Hogarthy et al., 2005; Maccallum et al., 1999). Also, it is accepted that internal correlation coefficients of 0.70 and above is the adequate level for the reliability of internal correlation coefficients (Pallant, 2020). Therefore. it can be said that the second factor is reliable and highly valid and contained items that can measure the self-efficacy resources of science teachers towards CBL. In addition, the remaining three items in the second factor may be sourced from the latest items that were excluded from the scale and excluded items are the items included by this factor when items were mixed and applied to the sample group. Though an increasing number of questions increases the sensitivity of the scale, it may cause mixing of errors in measuring tools because it would influence situations such as tiredness, boredom, inability to catch time, etc. (Baştürk, 2018).

Teachers applying a context-based learning approach should know the approach and should have adequacy for sharing the knowledge they have (leadership for innovation) (De Putter- Smits, 2012). It is seen that the items related to this dimension of adequacy and two self-efficacy resources (direct experiences and verbal persuasion)

were collected under the third factor named "Academical Self-efficacy". Being a person's self-efficacy belief high supports that he/she would be consistent and strong against difficulties as well as the increase in moral level, making cognitive decisions (Bandura, 1997; Pajares, 2002). For this reason, it can be said that the inclusion of the third factor including items that measure the academic self-efficacy of teachers is important.

According to Berns & Erickson (2001), teachers should plan lessons to be suitable for the developmental level of students, their social and cultural environment, and their psychological development in BTFÖ, and they should consider this criteria. It is seen that items including their adequacies of material prepared according to the needs of the class and material update when necessary (material arrangement) and two self-efficacy resources (direct experiences and indirect living) have been collected under the fourth factor named "Planning Education". It can be indicated that the fourth factor is also important and required for the self-efficacy scale for containing items measuring the self-efficacy of planning education in context-based learning by starting the road from the definition of self-efficacy by Bandura (1986) as the belief of a person towards the ability to plan the required activities and processes successfully.

Conclusion

Consequently, we have said that the developed self-efficacy scale can be used to determine the self-efficacy of science teachers in context-based learning and that it is a valid and reliable tool at the same time.

Recommendations

A scale, confidence of which has been proven, can be used for measuring the self-efficacy of science teachers towards a context-based learning approach.

Depending on the limitations of the research conducted, the following suggestions are offered:

- The study has been performed only with teachers located in Kayseri province. Studies can be conducted with a different province and larger sample.
- The study can also be conducted with teachers in different branches apart from science teachers.

Depending on the findings of the research conducted, the following suggestion is offered:

- Having a small number of items under the factor of "Self-efficacy Resources" in the scale may cause remaining inadequate in measuring related characteristics. Therefore, a scale study may be conducted by expanding resources from which teacher self-efficacy is influenced.

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Statement of Responsibility

Büşra Arık Güngör and Oktay Bektaş in conceptualization, design, data collection, analysis, and literature review; Sibel Saraçoğlu in supervision, data analysis, and critical review. All authors participated in writing and critical review.

Conflicts of Interest

The authors have no conflict of interest to disclose.

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ANNEX 1. BAĞLAM TEMELLİ ÖĞRENME YAKLAŞIMINA YÖNELİK ÖĞRETMEN ÖZYETERLİK ÖLÇEĞİ

Öğrenme/Öğretme Süreci

1. BTFÖ'de öğrencilerin iletişim becerisini geliştirebilirim.
2. BTFÖ'de öğrencilerin özgüvenlerinin artmasını sağlayabilirim.
3. BTFÖ'de öğrencilere rehberlik edebilirim.
4. BTFÖ'de dersin hedeflerine ulaşabilirim.
5. BTFÖ'de öğrencilerin anlamlı öğrenmelerini sağlayabilirim.
6. BTFÖ'de öğrencilerin ön bilgisi ile yaşam tecrübeleri arasında ilişki kurmalarını sağlayabilirim.
7. BTFÖ'de öğrencilerin kendi fikirlerini ortaya koymalarını sağlayamayabilirim.
8. BTFÖ'de öğrencilerin derse karşı meraklarını artırabilirim
9. BTFÖ'de öğrencilerin sosyal becerilerini geliştirmekte zorlanırım.
10. BTFÖ'de öğrencilerin öğrenecekleri konuya ihtiyaç duymalarını sağlayabilirim.
11. BTFÖ'de öğrencilerin ön bilgilerini kullanabilecekleri uygulamalar yaptırabilirim.
12. BTFÖ'de öğrencilerin derse karşı ilgilerini artıramam.
13. BTFÖ'de materyal kullanmakta zorlanırım.
14. BTFÖ'de öğrencilerin günlük yaşam problemlerini çözmelerini sağlayabilirim.
15. BTFÖ'de öğrencilerin işbirlikli çalışmalarına uygun ortam oluşturamayabilirim.
16. BTFÖ'de öğrencilerin bilgilerini yapılandırmasını sağlayabilirim.
17. BTFÖ'de öğrencilerin motivasyonlarını artırabilirim.
18. BTFÖ'de derse başlarken günlük hayattan seçilen bir örnek kullanabilirim
19. BTFÖ'de öğrencilerin edindikleri bilgileri yeni durumda uygulamalarını sağlayabilirim.
20. BTFÖ uygulamalarında karşılaşılabilecek problemlere çözüm üretebilirim.
21. Bağlam temelli soru yazabilirim.
22. BTFÖ'de öğrencilerin bilime yönelik ilgilerini artırabilirim.
23. BTFÖ'yü sınıf ortamında uygulayabilirim.
24. BTFÖ'de öğrencilerin bilişsel becerilerini geliştirebilirim.
25. BTFÖ'de öğrencilerin duyuşsal becerilerini geliştirebilirim.
26. BTFÖ'de öğrencilerin kendini yönetme becerilerini geliştirebilirim.
27. BTFÖ'de değerlendirme yapmakta zorlanırım.
28. BTFÖ ile öğretme sorumluluğumu öğrencilerle paylaşabilirim.
29. BTFÖ'de zamanı etkili biçimde kullanabilirim.
30. BTFÖ'de öğrenme sürecini etkili biçimde yönetebilirim.

Özyeterlik Kaynakları

31. BTFÖ'yü örnek uygulamaları inceleyerek daha etkili gerçekleştirebilirim
32. BTFÖ'de heyecanlanırım.
33. BTFÖ uygulamalarımı geçmişteki deneyimlerim ile daha etkili gerçekleştirebilirim.

Akademik Özyeterlik

34. Bağlam (Yaşam) temelli fen öğrenimi konusunda yeterli akademik bilgiye sahibim.
35. BTFÖ ile ilgili tartışmalarda görüş belirtebilirim.
36. BTFÖ'de meslektaşlarıma yardım edebilirim.
37. BTFÖ'de zaman yönetiminde zorlanırım.

Öğretimi Planlama

38. BTFÖ'ye uygun ders planı hazırlayabilirim.
39. BTFÖ'nün hangi kazanımlar için kullanılabileceğine karar verebilirim.
40. BTFÖ ile ilgili proje çalışmalarında görev almak beni mutlu eder.
41. BTFÖ'de günlük hayattan örnekler verebilirim.
42. Bağlam temelli sorulardan oluşan ölçme aracı hazırlayabilirim.
43. BTFÖ'de öğrenci düzeyine uygun günlük yaşam örnekleri belirleyebilirim.
44. BTFÖ 'de kullanılabilecek materyal seçebilirim.
45. BTFÖ'de öğrencilerin ilgilerini çekecek günlük yaşam örnekleri belirleyebilirim.
46. BTFÖ'ye uygun etkinlik tasarlayabilirim.
47. BTFÖ'de hangi yöntem/tekniklerin kullanılabileceğine karar verebilirim