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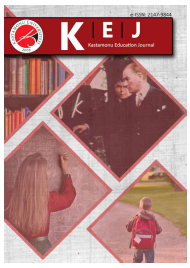

| Research Article / Araştırma Makalesi |

Psychometric Evaluation on Turkish Version of The Approaches and Study Skills Inventory for Students

Öğrenme Yaklaşımları ve Çalışma Becerileri Ölçeğinin Türk Örneklemi Üzerinde Psikometrik Değerlendirmesi[1]

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Keywords

1. Confirmatory analyses
2. Exploratory analyses
3. Psychometric evaluation
4. Approaches and study skills inventory

Anahtar Kelimeler

1. Doğrulayıcı faktör analizi
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Abstract

Purpose: This study aims to analyze the factor structure of the Approaches and Study Skills Inventory for Students (ASSIST) by adapting the second part, which consists of five-point Likert scale, 52 items, and 3 factors (deep, strategic, surface), in Turkish.

Design/Methodology/Approach: For this purpose, firstly one of the authors, Noel Entwistle, was contacted via email, and the necessary permission was received regarding the adaptation of the scale. The English and Turkish versions of the scale, which was translated into Turkish with the help of English and Turkish language experts, were applied to Dokuz Eylül University (DEU) English Language Teacher Education students (N = 46) one week apart.

Findings: It was determined that there was high correlation (r = .805, p=.05) between the scores of the students from both applications. Then, for examining the factor structures of the scale, Exploratory Factor Analysis (EFA) was performed with the data collected from 421 students who are studying at DEU and taking a basic physics course. It was determined that, by removing 5 items with factor loadings below .4 and the difference between factor loadings less than 0.1 from the scale, the scale could be collected under 3 factors compatible with the original factor structure. The scale was subjected to Confirmatory Factor Analysis (CFA) in order to test the compatibility of the three-factor structure of the scale determined by EFA. As a result of CFA, it was determined that the three-factor structure has sufficient compatibility with our data set (χ^2/sd=1.96, RMSEA=.072; CFI=.82, GFI=.78, NFI=.88). Besides, the scale was subjected to discriminant analysis in order to determine how successful the ASSIST was in separating the learning approaches of students and to determine the discriminant functions.

Highlights: With Quadratic Discriminant Analysis, it was concluded that a student assigned to one of the 3 sub-dimensions in the scale could be considered significantly separated from other sub-dimensions, and thus the learning approaches of the students could be determined successfully.

Öz

Çalışmanın Amacı: Bu çalışmanın amacı, öğrenme yaklaşımları ve çalışma becerileri ölçeğinin beşli likert tipi, 52 madde, 3 faktörden (derinsel, stratejik, yüzeysel) oluşan ikinci bölümünün Türkçe uyarlamasının yapılarak, faktör yapısının incelenmesidir.

Materyal ve Yöntem: Bu amaçla ilk olarak yazarlardan Noel Entwistle ile elektronik posta yoluyla iletişim kuruldu ve ölçeğin uyarlanabileceğine ilişkin gerekli izin alındı. İngiliz ve Türk dili uzmanlarından yardım alınarak Türkçeye çevrilen ölçeğin İngilizce ve Türkçe versiyonları Dokuz Eylül Üniversitesi (DEU) İngilizce Öğretmenliği öğrencilerine (N=46) bir hafta arayla uygulandı

Bulgular: Öğrencilerin her iki uygulamadan aldıkları puanlar arasında yüksek düzeyde korelasyon bulunduğu (r= .805, p=.00) belirlendi. Ardından, ölçeğin faktör yapılarının incelenmesi için DEU' de öğrenim gören ve temel fizik dersi alan 421 öğrenciden toplanan veriler ile Açıklayıcı Faktör Analizi yapıldı ve faktör yükleri .4' ün altında ve faktör yükleri arasındaki fark .1' den küçük olan 5 maddenin ölçekten çıkarılması ile ölçeğin orijinal faktör yapısı ile uyumlu 3 faktör altında toplanabileceği belirlendi. Ölçeğin açıklayıcı faktör analizi ile belirlenen üç faktörlü yapısının uyumluluğunu test etmek amacı ile ölçek, doğrulayıcı faktör analizine (DFA) tabii tutuldu. DFA sonunda üç faktörlü yapının veri setimizle yeterli düzeyde uyumlu olduğu belirlendi (χ^2/sd=1.96, RMSEA=.072; CFI=.82, GFI=.78, NFI=.88). Ayrıca ölçeğin öğrencilerin öğrenme yaklaşımlarını birbirinden ayırmada ne derece başarılı olduğunu saptamak ve ayırma fonksiyonlarını belirleyebilmek için ölçek, ayırma analizine tabii tutuldu.

Önemli Vurgular: Yapılan karesel ayırma analizi ile ölçekteki 3 alt boyuttan birine atanan bir öğrencinin, diğer alt boyutlardan anlamlı düzeyde ayrılmış kabul edilebildiği ve böylelikle öğrencilerin öğrenme yaklaşımlarının başarılı şekilde saptanabildiği sonucuna ulaşıldı.

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INTRODUCTION

In the literature, the concept of learning approaches is first encountered in the study of Marton and Saljo (1976). In this study, the University of Gothenburg students were asked to read an article and answer the related topic questions. In the study, some students saw the article they read as a text that needed to be memorized to answer the questions that were expected to be asked. From this point, it was concluded that these students conceptualized learning as accepting knowledge as it is without establishing relationships between facts. Marton and Saljo (1976a; 1976b) called this situation "surface learning". Other students, on the other hand, tried to understand the underlying meaning of the article by considering it as a whole and associating the new ideas it contains with previous knowledge and experiences. This second situation has been defined as "deep learning". In the research conducted after this qualitative study, results that support the findings of Marton and Saljo were revealed, and learning approaches were considered in two dimensions (Morgan, 1993; Chin & Brown, 2000; Trigwell & Prosser, 2004; Ünal & Çoban, 2008; Özkan and Selçuk, 2014 and Çolak, 2015).

While Biggs (1978) and Entwistle and Ramsden (1983), on the other hand, produced similar results in their studies on university students, they also mention the third dimension of learning approaches. In his research, Biggs (1978) mentions these approaches: utilizing, internalizing, and achieving. Entwistle and Ramsden (1983) refer to these dimensions as reproducing, meaning, and achieving or strategic. The first dimension, which Biggs refers to as "utilization" and Entwistle and Ramsden as "reproducing", forms the basis of the surface learning approach. There is direct information transfer and subject dependence here. Since learning is considered an externally imposed task (Lucas, 2001), the acquired information is transferred to the cognitive structure in the form of irregular small stacks, which prevents understanding of the subject (Biggs, 1999). As a result, learning becomes necessary, and the work is not enjoyed—fear of failure in exams functions as short-term motivation. The second dimension, called "internalization" or "meaning", is related to the deep learning approach. Students in this group associate the new knowledge they have learned with their previous experiences (Offir, Lev and Bezalel, 2008) and critically review the learning product they have acquired (Beattie, Collins and McInnes, 1997). Students in this group study because of their interest in the subject or internal motivation and try to grasp the underlying meaning of everything they read. Learning provided by this high level of effort often brings high academic success. Many studies that are conducted support this situation (Byrne, Flood and Willis, 2002; Ekinci, 2009; Batı, Tetik and Gürpınar, 2010; Beşoluk and Önder, 2010; Çolak and Cırık, 2016 and Beyaztaş, and Şahin, 2017). Also, a third dimension of the learning approach, which Biggs called "achieving" Entwistle and Ramsden called "strategic", is mentioned in the studies. In this approach, it was determined that students might prefer deep or surface learning, depending on the situation, to be successful by getting high grades, not to understand the subject or internalize knowledge (Reid, Duvall and Evans, 2007). They are motivated by the sense of competition in the environment (Newble & Entwistle, 1986). However, when the relevant literature is reviewed, it is seen in some studies that this approach is considered a studying approach rather than a learning approach, and thus the strategic approach is not included (Marton & Saljo, 1976; Morgan, 1993; Trigwell & Prosser, 2004; Ünal & Çoban, 2008; Özkan and Selçuk, 2014 and Çolak, 2015).

According to Ramsden (2003), the learning approach is the relationship between the student and the learning task he/she performs and is shaped according to the learner's reaction to the learning-teaching environment (Fry, Ketteridge and Marshall 2003). Depending on the content, the difficulty level, the duration of the subject, and whether it arouses curiosity, the learner can sometimes prefer a deep or surface approach (Marshall & Case, 2005). In other words, learning can occur differently in different environments.

Students who reach university age bring the learning approaches they have taken from their previous lives. It is mainly their previous experience that determines which approach to use during new learning. However, while this situation is seen as an individual difference, it is not fixed. If the individual perceives that the teaching environment has changed, he/she can also rearrange his/her approach. However, classroom environments where appropriate resources are not used, learning materials are not attractive, rote-based assessment methods are used, and the teacher is always active cause students to prefer the surface approach (Çelik, 2013; Spencer, 2003). As a result, they graduate from higher education as individuals who do not research, do not ask, cannot think critically, and are used to memorizing instead of thinking (Çelik, 2013).

Some students are more successful than others because they prefer meaningful or rote learning; in other words, it stems from differences in learning approaches. In meaningful learning, new knowledge is associated with the previous ones, while in rote learning, it is transferred to the cognitive structure in the form of irregular small stacks (Okebukola, 1990). Instead of trying to understand, these students repeat everything as it is. For this reason, they have difficulty remembering details for a long time and fail to apply the knowledge they have acquired to real-life problems (Entwistle & Ramsden, 1983; BouJaoude, Sallaum and Abd-El-Khalick, 2004). Besides, while more effective and permanent learning products are obtained with meaningful learning, it seems impossible to realize this situation by rote learning (She, 2005). For this reason, it is of great importance to determine students' learning approaches in the education process.

Studies on the determination of learning approaches date back to the 1930s. In 1933, Wrenn developed the first known scale in the literature to determine the study habits of students. Since this date, the interest in the subject has increased gradually, and numerous researchers take place in scale development studies (Locke, 1940; Brown & Holtzman, 1955; Biggs, 1987; Tait, Entwistle and Mccune, 1998; Weinstein & Palmer, 2002; Dennis, 2014). One of the most popular scales is the Approaches and Study Skills Inventory for Students (ASSIST), developed by Tait, Entwistle and Mccune (1998). ASSIST has a wide range of uses worldwide and has been translated into many languages (Diseth, 2001; Berberoğlu & Hei, 2003; Zhu, Valcke and Schellens, 2008 Gadelrab, 2011).

The first version of the scale, which is the subject of our research and was developed to determine the learning approaches of students, was developed by Entwistle, Hanley, and Hounsell (1979) at the University of Edinburgh under the original name of "Approaches to Studying Inventory" (ASI). This inventory, which was prepared to determine the individual differences in the learning approaches of students in higher education, consisted of 64 items and 16 sub-scales on a five-point Likert scale. In 1981, two short versions of the scale, 30 and 18 items, were published to facilitate the scale's use and shorten the response time (Entwistle, 1981). However, researchers did not recommend their use because both were found inadequate in the field of psychometrics. Entwistle and his colleagues 1992 reviewed ASI and "The Revised Approaches to Studying Inventory (RASI)", consisting of 15 sub-scales collected under 60 items, and five factors (deep, strategic, surface, apathetic approach and academic aptitude) were developed (Duff, 2003). In 1994, a new version of the scale was published by reducing the number of items to 38 (Entwistle & Tait, 1994). A year later, with a revision study, a new factor (Metacognitive Awareness of Studying) was added to the scale, and the number of items was increased to 44 (Entwistle & Tait, 1995).

Considering the developments occurring over time, Tait, Entwistle and Mccune published a new version of the inventory in 1998, originally titled "The Approaches and Study Skills Inventory for Students (ASSIST)," consisting of three sections (What is Learning?, Approaches to Studying, Preferences for different types of course and teaching) and 67 items. The first part is the six-item part in which the individual defines his/her learning. The second part of the scale, which is also the subject of our study, consists of 52 items rated on the five-point Likert scale and collected under three factors. The third and last part of the inventory consists of eight items and measures the learning and teaching preferences of different types of courses.

In this study, it was aimed to analyze the factor structure of the Approaches and Study Skills Inventory for Students (ASSIST) by adapting the second part of it to Turkish, which consists of a five-point Likert scale, 52 items, and three factors (deep, strategic, surface). This research sought answers to "Does the ASSIST Turkish form develop to support the factor structure which Tait, Entwistle and Mccune put forward (1998)?

METHOD/MATERIALS

The first stage of this study is translating the scale, whose original language is English, into Turkish. For this purpose, firstly, one of the authors, Noel Entwistle, was contacted via email, and the necessary permission was received regarding the adaptation of the scale. After that, three English Language Experts translated the scale into Turkish. Two Turkish Language and three Physics Education Experts examined this form in terms of meaning and grammar, and necessary corrections were made. This draft form was read by 38 students studying at the Department of Physics Teacher, and they were asked to answer the scale items by considering the physics course and to identify the items they had difficulty understanding. As a result of the implementation, some items were revised so as not to spoil the meaning. In the next stage, a linguistic equivalence study was conducted to determine the consistency between the Turkish form and the original form of the scale. For this purpose, both forms were applied to 46 students studying in the Department of English Language Teacher Education one week apart. It was determined that there was a high correlation (r=.805, p=.00) between the English-Turkish form.

In the second stage of the study, the factor structures of the scale were evaluated with CFA and EFA. In addition, the scale was subjected to discriminant analysis to determine how successful the ASSIST was in separating students' learning approaches and the discriminant functions.

PARTICIPANTS

Participants of the study consist of 421 students studying at the Departments of Physics, Science, Chemistry, Biology and Elementary Mathematics Teacher at Dokuz Eylul University Buca Faculty of Education. The reason why these departments are preferred is that all students participating in the research have taken a physics course at the university.

FINDINGS

Data analysis was started with Exploratory Factor Analysis (EFA) to test the factor structures of the scale. It was determined by EFA that the scale consists of eight sub-dimensions. Then, Varimax axis rotation was applied to the scale to determine which items showed a high relationship with which factors. As a result, 5 items (4 items from the deep sub-scale and 1 item from the surface sub-dimension) with factor loadings below .4 and difference between factor loadings less than .1 (overlapping) were removed from the scale, KMO value was calculated as .954, and Bartlett test was calculated as (X^2 : 11865.634; p: .00).

Table 1. Items removed from the scale

Factor I	**Deep**
Item Number	
33	Ideas in course books or articles often set me off on long chains of thought of my own.
36	When I read, I examine the details carefully to see how they fit in with what's being said.
52	I sometimes get 'hooked' on academic topics and feel I would like to keep on studying them.
20	I think about what I want to get out of this course to keep my studying well focused
Factor 3	**Surface**
Item Number	
38	I gear my studying closely to just what seems to be required for assignments and exams.

The sub-dimensions of the scale and the factor loadings are seen in Table 2.

Table 2. ASSIST for three-factor structure

Factor I	**Deep**	
Item Number		Loadings
7	I go over the work I've done carefully to check the reasoning and that it makes sense.	.740
34	Before starting work on an assignment or exam question, I think first how best to tackle it.	.725
4	I usually set out to understand for myself the meaning of what we have to learn	.713
30	When I am reading I stop from time to time to reflect on what I am trying to learn from it	.707
11	I try to relate ideas I come across to those in other topics or other courses whenever possible	.689
23	Often I find myself questioning things I hear in lectures or read in books.	.682
26	I find that studying academic topics can be quite exciting at times.	.667
17	When I'm reading an article or book, I try to find out for myself exactly what the author means	.673
21	When I'm working on a new topic, I try to see in my own mind how all the ideas fit together	.664
47	When I have finished a piece of work, I check it through to see if it really meets the requirements.	.663
39	Some of the ideas I come across on the course I find really gripping.	.644
13	Regularly I find myself thinking about ideas from lectures when I'm doing other things.	.634
49	It's important for me to be able to follow the argument, or to see the reason behind things.	.622
46	I like to play around with ideas of my own even if they don't get me very far.	.607
43	Before tackling a problem or assignment, I first try to work out what lies behind it	.604
9	I look at the evidence carefully and try to reach my own conclusion about what I'm studying.	.598
Factor 2	**Strategic**	
Item Number		Loadings
10	It's important to me to feel that I'm doing as well as I really can on the courses here.	.715
5	I organise my study time carefully to make the best use of it.	.688
1	I manage to find conditions for studying which allow me to get on with my work easily.	.680
27	I'm good at following up some of the reading suggested by lecturers or tutors.	.679
41	I keep an eye open for what lecturers seem to think is important and concentrate on that.	.676
44	I generally make good use of my time during the day.	.676
50	I don't find it at all difficult to motivate myself.	.676
2	When working on an assignment, I'm keeping in mind how best to impress the marker.	.669
40	I usually plan out my week's work in advance, either on paper or in my head	.659
18	I'm pretty good at getting down to work whenever I need to.	.653
37	I put a lot of effort into studying because I'm determined to do well.	.638
15	I look carefully at tutors' comments on course work to see how to get higher marks next time.	.633
31	I work steadily through the term or semester, rather than leave it all until the last minute.	.613
28	I keep in mind who is going to mark an assignment and what they're likely to be looking for.	.607
14	I think I'm quite systematic and organised when it comes to revising for exams.	.540
24	I feel that I'm getting on well, and this helps me put more effort into the work.	.476

Continuation of Table 2. ASSIST for three-factor structure

Factor 3		
Item Number	**Surface**	Loadings
6	I find I have to concentrate on just memorising a good deal of what I have to learn.	.753
3	Often I find myself wondering whether the work I am doing here is really worthwhile.	.738
12	I tend to read very little beyond what is actually required to pass.	.721
19	Much of what I'm studying makes little sense: it's like unrelated bits and pieces.	.715
48	Often I lie awake worrying about work I think I won't be able to do.	.692
8	Often I feel I'm drowning in the sheer amount of material we're having to cope with.	.680
35	I often seem to panic if I get behind with my work.	.658
51	I like to be told precisely what to do in essays or other assignments.	.657
29	When I look back, I sometimes wonder why I ever decided to come here.	.653
45	I often have trouble in making sense of the things I have to remember	.653
42	I'm not really interested in this course, but I have to take it for other reasons.	.652
16	There's not much of the work here that I find interesting or relevant	.644
32	I'm not really sure what's important in lectures, so I try to get down all I can.	.640
25	I concentrate on learning just those bits of information I have to know to pass.	.614
22	I often worry about whether I'll ever be able to cope with the work properly	.603

As a result of EFA, it is seen that the "Strategic Learning" sub-dimension of the scale consists of 16 items with factor loadings ranging from .715 to .476, the "Deep Learning" sub-dimension consists of 16 items with factor loadings ranging from .740 to .598 and the "Surface Learning" sub-dimension consists of 15 items with factor loadings between .753-.603.

Table 3 presents the percentage of total explained variance of the 3 sub-dimensions in the scale.

Table 3. ASSIST sub-dimensions

Factors	Number of Items	Variance Percentage	Total Variance Percentage
Strategic	16	18.748	18.748
Deep	16	17.601	36.349
Surface	15	15.636	**51.985**

As a result, it is seen that the scale, consisting of 47 items, is grouped under 3 factors which explain 51.9% of the total variance, and the items in the sub-dimensions and the original form overlap exactly. Cronbach's α reliability coefficients determined for the ASSIST 3-factor structure are presented in Table 4.

Table 4. ASSIST reliability study results

ASSIST and Factors	Number of items	Number items for original version	Cronbach's Alpha	Cronbach's Alpha for original version
Deep	16	20	.84	.87
Strategic	16	16	.83	.91
Surface	15	16	.82	.71
ASSIST	47	52	.82	.87

For the test-retest reliability study, ASSIST was applied twice to 31 students studying at Dokuz Eylül University Science Education Department two weeks apart. Test-retest reliability coefficients of the scale are presented in Table 5.

Table 5. ASSIST test-retest reliability coefficients

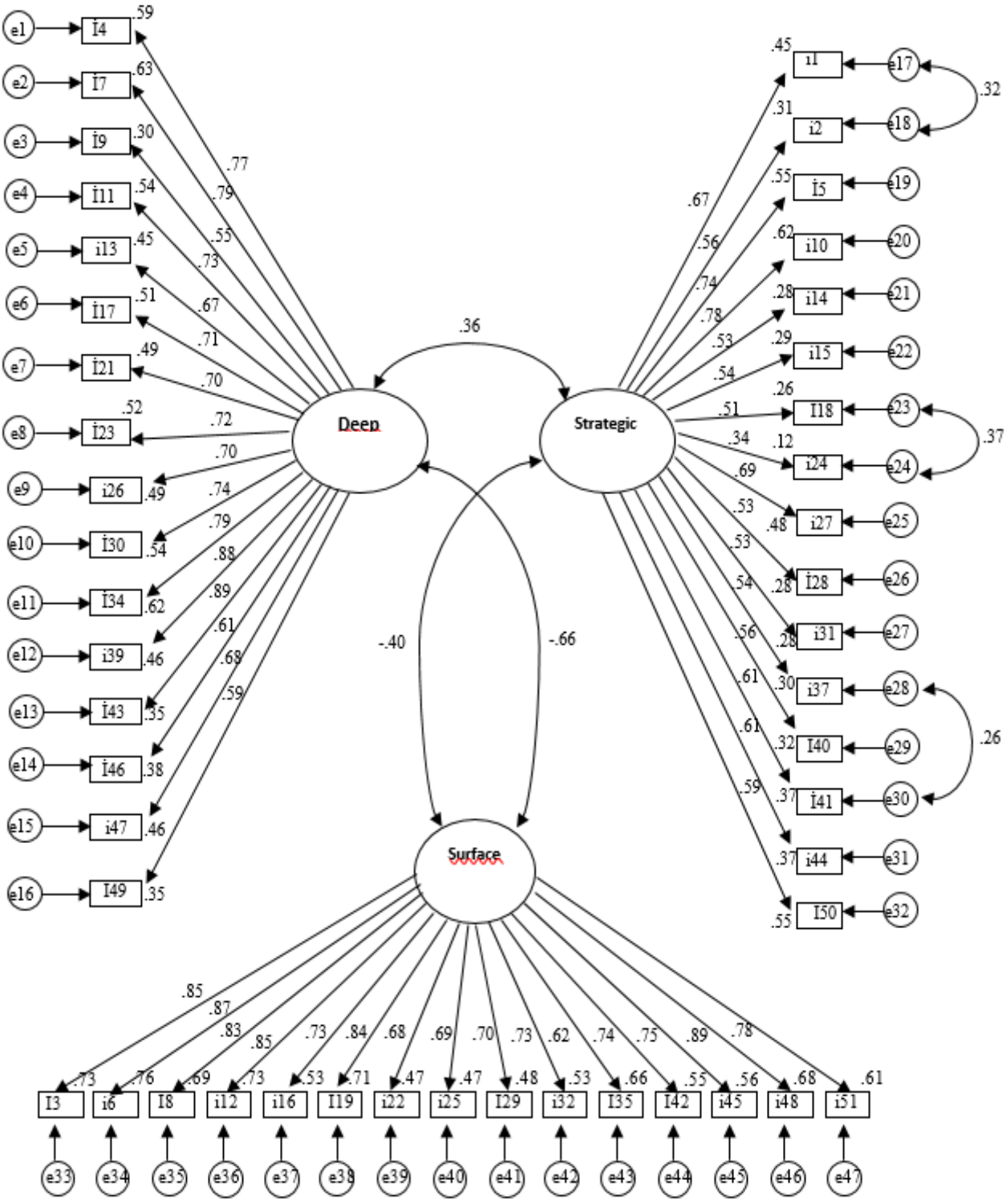
ASSIST and Factors	Application	M	df	r
Deep	1. Application	55.161	6.148	.700
	2.Application	54.064	8.872	
Strategic	1. Application	69.645	10.855	.917
	2.Application	71.774	11.146	
Surface	1. Application	42.483	7.154	.716
	2.Application	42.837	7.470	
ASSIST	1. Application	184.677	15.843	.813
	2.Application	185.870	19.236	

Results show that the 47-item scale is highly reliable.

Later, the scale was subjected to Confirmatory Factor Analysis in order to test the compatibility of the three-factor structure of the ASSIST, determined by EFA.

CFA is being applied to test whether the scales, which were previously discovered and combined under fewer factors, are similar to the sample in which the research was conducted (Byrne, 2010).

Figure 1. Confirmatory Factor Analysis for the three-factor structure.



In Figure 1, latent variables (deep, strategic, and surface) are expressed as a circle, and observable variables (items in the scale) are expressed as squares. Also, in the diagram, there is a measurement error caused by randomness depending on each observed variable. Values on the one-way arrows show the path coefficient of an observed variable on the latent variable, and values on the two-way arrows show the correlation between the latent variables. Accordingly, a positive and significant relationship (r = .36, p <.05) between deep learning and strategic learning, a negative and significant relationship (r = -.40, p <.05) between deep learning and surface learning, a negative and significant relationship (r = -.66, p <.05) between strategic learning and surface learning were found. The two-way arrow between the two error terms also indicates that there is variance between the variables. In order to decide whether the model has been verified, Fit Indices should be examined. MI (Modification Indicies) suggests modifications associated with the model to the investigator by looking at the covariance between observed and latent variables. These modifications are created on the basis of error terms and indicate the chi-square value that was not originally predicted but will be acquired in the model by making the corresponding edit. According to the results; the values, obtained when the error terms 23 and 24, 17 and 18, 28, and 30 are associated with each other, are presented in Table 6.

Table 6. Goodness of fit results of the three-factor model

Scale	χ^2	df	χ^2/df	RMSEA	CFI	GFI	NFI
ASSIST	2024.70	1028	1.96	.072	.82	.78	.88

Chi-Square Compatibility Test tests the hypothesis whether the model developed and the model emerging in the covariance structure of the observation variables are different. The ratio of chi-square to degrees of freedom less than 3 gives the result that the general fit of the model is acceptable. In our data set, this value is seen as 1.96. Root Mean Square Error of Approximation (RMSEA) is the square root of the average of predicted errors and takes values between 0-1. Giving values close to zero indicates that there is a minimum error between observed and generated matrices. Values of 0.05 and smaller indicate perfect fit, and values up to 0.08 indicate acceptable fit. The RMSEA value of .072 in our data set indicates acceptable fit. Comparative Fit Index (CFI) compares the covariance matrix estimated by the model with the covariance matrix of the H_0 hypothesis model and takes values ranging from 0-1. As it approaches 1, it indicates that the goodness of fit increases. This value was found as .82 in our data set. The Goodness of Fit Index (GFI) shows the amount of covariance between observed variables calculated by the default model and takes values between 0-1. Exceeding 0.90 means an excellent model indicator. The GFI was calculated as .78 in our data set. Normed Fit Index (NFI) is calculated by dividing the chi-square value of the tested model by the chi-square value of the independent model (Ullman, 2001) and takes values between 0-1. Values above 0.90 indicate acceptable fit. This value was found as .88 in our data set.

These results indicate that the three-factor model is fit adequately with the data set.

In the next stage, the scale was subjected to discriminant analysis to determine how successful the ASSIST was in separating groups, and to determine discriminant functions.

Discriminant Analysis is a method used to calculate the functions that serve to determine group profile discriminant functions, and thus to predict with a minimal error which group the newly observed units should be assigned to.

Discriminant Analysis is examined in two different groups, linear and square, according to whether the covariance matrices of the groups are equal or not. Linear Discriminant Analysis assumes that the covariance matrices of all groups are similar, whereas Quadratic Discriminant Analysis does not use the assumption that the covariance matrices of the groups are similar.

For this reason, Box's Test of Equality of Covariance Matrices was performed first and at the end of the test, Box's was determined as M = 91.842, F = 7.46, df1 = 12, df2 = 71555.91, and p = .000. Since Box's M test (p <.05) indicated that group covariance matrices are not similar, Quadratic Discriminant Analysis was used for the data. The data obtained as a result of the analysis are presented in Tables 7 and 8:

Table 7. Wilks' Lambda test results

Fonction	Wilks' Lambda	χ^2	df	p
1-2	.117	439.213	6	.00*
2	.387	194.818	2	.00*

p<.05*

Wilks' Lambda is a statistical analysis that tests whether the means of the groups are different from each other. As a result of the analysis, it was determined that the groups were separated significantly from each other. Accordingly, a student assigned to one of the three groups (deep, strategic, and surface) in the scale can be considered to be significantly separated from the other groups, and thus learning approaches can be determined.

The Discriminant Functions determined as a result of the analysis are as below:

Table 8. The Discriminant functions

	Groups		
	1. Group (Y_1)	2. Group (Y_2)	3. Group (Y_3)
Surface (X_1)	.959	.515	.523
Strategic (X_2)	.812	1.376	.951
Deep (X_3)	.635	.680	1.038
Constant	-62.201	-74.878	-69.982

Discriminant functions create a real prediction model that can be used to classify new observations. Accordingly, discriminant functions for the groups were determined as follows: the 1st group surface learner (Y1), the 2nd group strategic learner (Y2), and the 3rd group deep learner (Y3).

1. Group: Y_1=-62.201 + .959X_1 + .812X_2 + 0.635X_3 (Surface)

2. Group: Y_2=-74.878 + .515X_1 + 1.376X_2 + .680X_3 (Strategic)

3. Group: Y_3=-69.982 + .523X_1 + .951X_2 + 1.038X_3 (Deep)

DISCUSSION

In this study, the 2nd part of the ASSIST inventory developed by Tait, Entwistle and Mccune (1998), consisting of a five-point Likert scale, three factors, and 52 items, was adapted to Turkish, and validity and confidence studies were conducted. At the end of the study, it was determined that, with EFA, our data set could be classified under three factors. This situation supports the 3-factor structure that Tait, Entwistle and Mccune (1998) proposed.

The first of the determining factors (deep) consists of sixteen items. These items are the same as the sixteen items in the group called deep approach by Tait, Entwistle and Mccune (1998). The second factor (strategic); contains 16 of the 20 items in the group named as a strategic approach by Tait, Entwistle and Mccune (1998). Four items with factor loadings below .4 and the difference between factor loadings less than .1 (overlapping) were removed from the scale. On the other hand, the third factor (surface) contains 15 of the 16 items in the group, initially named a surface approach of the scale. In this group, an item with a factor loading below 0.4 was removed from the scale at the end of EFA.

CFA, adapted to the scale, showed that the three-factor model adequately fits with the data set. As a result, the three-factor structure required the removal of 5 items from the scale consisting of 52 items. Although five items removed from the scale increased unexplained variance, it made it easier to use because it shortened the response time.

With discriminant analysis applied to our data set, it was determined that a student assigned to one of the three groups (deep, strategic, and surface) in the scale could be considered to be significantly separated from the other groups. Thus, students' learning approaches could be specified successfully.

When the relevant literature is examined, it is seen that similar results are found in two different studies. ASSIST was adapted to Turkish by Senemoğlu (2011) and Coşkun, Özeke, Budakoğlu, Tutan, Nazlı, and Aksoy (2017). In her study, Senemoğlu (2011) applied the original form of ASSIST, Turkish and English, to the students of the Turkish and American faculty of education. As a result, the three main dimensional structure of the scale was confirmed by removing one item from the deep and strategic learning dimension and two items from the surface learning dimension for the Turkish form. Coşkun, Özeke, Budakoğlu, Tutan, Nazlı, and Aksoy (2017) worked with medical school students in their research and stated that three main dimensional structure was preserved by removing a total of 8 items from the Turkish form of the scale. In the last case, there are 44 items in total, including 14 items in the deep learning dimension, 20 in the strategic learning dimension, and ten in the surface learning dimension.

When the studies conducted abroad on this subject are examined, it is seen that ASSIST has been translated into many languages (Diseth, 2001; Berberoğlu & Hei, 2003; Zhu, Valcke and Schellens, 2008 Gadelrab, 2011). Although a measurement tool can show different structures when applied to different cultures, studies nevertheless show that the ASSIST three-dimension structure is confirmed in almost every culture at the higher education level.

However, there are few studies examining physics learning approaches in our country and abroad (Prosser and Millar, 1989; Prosser, Walker and Millar, 1996; Nguyen, 1998 Dickie, 2003; Selçuk, Çalışkan and Erol, 2007 Çelik, 2013). It is believed that this situation increases the importance of the study. While the science of physics enables us to understand the universe we live in, it also enables us to produce technology by imitating nature. In addition, as the natural sciences develop, the theories and techniques of physics and research methods are more needed (İnan, 1988). From this point of view, the importance of physics education is indisputable, and the basis of research on this subject is how students learn physics (Chiou, Lee ve Tsai, 2013). With the ASSIST Turkish form developed, it is thought that determining the physics learning approaches of the students studying at higher education level in our country will answer the question of how they learn physics.

The research was conducted on teacher candidates. It is thought that determining the learning approaches of teacher candidates in the pre-service period with a reliable measurement tool and performing studies that direct them to deep learning approaches will be highly effective in their students' approaches to learning in their professional lives. Student learning approaches are influenced by variables such as the learning-teaching environment, teaching methods and techniques used, and teachers' teaching approaches (Trigwell & Prosser, 2004). There is no doubt that, for students to achieve meaningful learning by adopting deep learning approaches, the most critical task belongs to the teachers (Çoban & Ergin, 2008). When teachers prepare interactive and creative learning environments that require learners to be active, it is observed that students' motivation increases, and they get away from undesirable situations such as memorizing or competing with each other (Honkimaki, Tynjala and Valkonen, 2007). Students are more inclined to adopt a deep learning approach in such learning environments. Relevant literature shows that assessment methods are also effective in students' learning approaches (Çelik, 2013; Gijbels & Dochy, 2006; Scouller, 1998). Assessment methods that do not require cognitive thinking reveal the surface approach in students, while problem-based assessment methods that require high-level cognitive thinking support the deep approach (Byrne, Flood and Willis, 2002). In this context, it is believed that teachers who have adopted a deep learning approach will also positively affect their academic success by directing their students to deep learning in both learning-teaching and evaluation processes. When the literature was reviewed, it was determined that there is a significant positive relationship between deep learning and academic success in many related studies (Çelik, 2013; Selçuk, Çalışkan and Erol, 2007; Senemoğlu, Berliner, Yıldız, Doğan, Savaş and Çelik, 2007; Bernardo, 2003 and Ellez and Sezgin, 2002).

CONCLUSION AND RECOMMENDATIONS

It is seen that the Turkish form of ASSIST is a valuable measurement tool for students in higher education. Findings obtained from teacher candidates' data are essential in revealing which outputs the scale gives at the higher education level. However, our research findings are limited to data collected from teacher candidates studying Physics, Science, Chemistry, Biology and Elementary Mathematics Teacher Departments at Dokuz Eylül University. All the students who participated in the study took a physics course at the university, and they answered the Turkish form of the scale considering the physics course. In advanced studies, more detailed research can be planned for courses with larger sample groups and students in different departments. In this way, with the help of the developed ASSIST Turkish form, it will be possible to determine how students ' learning approaches change according to the different courses (quantitative and verbal).

In their study on determining the learning approaches of students studying at three different universities in our country, Çoban and Ergin (2008) concluded that the students of the three universities have a similar level but significantly surface learning tendency. At the same time, it is thought that this situation is due to the widespread use of rote learning and teaching in higher education. In this context, by determining the physics learning approaches of students studying at the higher education level with a reliable measurement tool, more detailed studies can be planned, which are thought to contribute to the review and development of physics teaching programs and methods being applied today.

It has been revealed in many studies that the teaching approaches used by teachers in their professional life are highly effective in the learning approaches of students (Meyer & Muller, 1990; Entwistle, 1990; Ramsden & Entwistle, 1981; Richardson, 2003; Kember, 2004; Segers, Gijbels and Thurlings, 2008 and Pimparyon, Caleer, Pemba and Roff, 2009). It is known that the students of teachers who focus on transferring knowledge tend towards the surface approach, while those who organise learning-oriented classroom activities prefer the deep approach more (Çelik, 2013; Trigwell, Prosser and Waterhouse, 1999). By their nature, faculties of education are expected to train teachers who can think critically, know the research, be sceptical about previous results, conduct logical results, perform meaningful learning, and adopt deep learning. In this context, with the help of ASSIST Turkish form, studies can be planned in which the learning approaches of the teacher candidates in our country will be determined and compared from the point of view of different universities.

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The first author played an active role in writing the conceptual framework, data collection and discussion conclusions of the research, and the second author played an active role in analysis process.

Ethics Committee Approval Information

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