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A validity and reliability study of the Attitude Scale of Computer Programming Learning (ASCOPL)

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The attitude of students towards computer programming learning is a subject which is not widely researched in the current literature. In fact, there is little generally accepted scale, which is tested and accepted in terms of reliability and validity in literature in order to measure the attitude of students towards computer programming learning. The aim of this study is to develop a valid and reliable scale. The development process consists of two phases that utilize two different sample groups. The sample group, in the first case, consists of 496 students and it consists of 262 students in the second case. In order to detect the validity of the scale, exploratory and confirmatory factor analyses, item factor total correlations, corrected correlations and item discriminations were conducted. The reliability of the scale is justified using the internal consistency level and reliability level. ASCOPL is a 5-point Likert-type scale, consisting of 20 items, grouped under three factors. The results indicate that ASCOPL is a reliable and valid scale in order to measure student attitudes towards computer programming learning.

Introduction

Programing skill requires higher level cognitive skills such as problem solving, logical-mathematical thinking, and critical thinking (Fang, 2012; Korkmaz, 2012a; Lau &Yuen, 2009; Wang, Geng, Jiang & Liu, 2012). The are several studies in the literature which demonstrate the importance of programming and the difficulties related to the teaching and learning of computer programming (Gomes & Mendes 2007; Tan, Ting & Ling, 2009; Jenkins, 2002; Katai, Juhasz & Adorjani, 2008; Korkmaz, 2012a; Korkmaz, 2013; Milne & Rowe, 2002). It can be seen from the research conducted to date that there are several different reasons behind the difficulties, among them, the lack of higher level cognitive skills, such as logical and mathematical thinking and critical thinking, the utilization of unsuitable teaching methods, the lack of computer programming teaching, and ignoring the learning styles of the students (Korkmaz, 2012a; Korkmaz, 2013; Landry, Pardue, Doran & Daigle, 2002; Lau & Yuen, 2011). Among the listed reasons are the negative perception of the students and the lack of motivation and attitude towards computer programming

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(Anastasiadou, & Karakos, 2011; Erdogan, Aydin & Kabaca, 2008; Sacks, Bellisimo & Mergendoller, 1993). It is also reported in the literature that along with the lack of motivation, there are several problems related to cognitive aspects of the learning and teaching (Hawi, 2010; Hernane, Gilney & Marcelo, 2010; Robins, Rountree & Rountree, 2003).

According to Fishbein and Ajzen (1975, cited: Lai, Wang, & Lei, 2012) the attitude towards a certain behavior is defined as positive or negative feelings of the individual towards accomplishing a behavior. There is evidence in the literature that the attitude of students towards school, course and teacher directly affect their academic success, their utilization of technology, their self-efficacy and self-confidence perception and their satisfaction (Hwang, Wu & Chen, 2012; Lai, et al., 2012; Landry et.al., 2002; Van de Gae, Grisay, Schulz & Gebhardt, 2012). Although there are few studies related specifically to the learning of computer programming skills, studies related to learning on other domains, reveal that student attitudes is one of the main factors affecting their academic success directly (Anastasiadou, & Karakos, 2011; Lockwood, 2012; Yılmaz & Kılıç-Çakmak, 2012). Based on these findings, one of the main difficulties faced in computer programming learning can be the negative attitudes of the students towards computer. The perception of the subject by the students, as confusing and meaningless, hard to learn and complicated, all seem to be factors which affect students' success adversely. Therefore, Huna Tan and associates (2009) indicate that the perception of the students that programming language learning is a difficult topic to learn, and leads students to be apathetic in their learning of programming skills.

Despite of these findings, however, there is no clear evidence demonstrating how attitude directly affects computer programming skills in terms of students' academic success. Furthermore, the authors have not encountered a valid and reliable scale in literature to measure the attitudes towards computer programming learning. In this case, it is clear that a reliable and valid scale would be a useful tool to determine the attitudes of the students towards computer programming. Therefore, the aim of this study is to establish a reliable and valid scale in order to measure the attitude towards computer programming learning.

Method

Sample

There are two study groups in this research. The first study group consists of students from the department of electrical-electronics engineering and computer engineering students in the engineering faculties of four universities in Turkey. The students are from third grade and the number of this study group consists of 469 students. In the second study group, there are 262 students from the department of computer education and instructional technology (CEIT), which is the department of the faculty of education. All students in the study groups take two five-hour courses, namely computer programming language I and II, at and fourth semester, respectively. In order to obtain a reliable and valid scale, therefore, the students in all study groups are selected among the 5th semester students. Furthermore, having two different study groups with students from different subject area such as engineering and educational department is also to ensure that the scale is reliable and valid.

In the first set of experiments, an exploratory factor analysis along with validity and reliability analyses have been carried out on the first study group, while confirmatory factor analysis has been carried out on the second study group. The distribution of the students based on their universities, subject and gender in the study groups are listed in Table 1.

Table 1. Distribution of the working group based on their university, subject and gender

University	I. Implementation					II. Implementation		
	Computer Eng.		E. E. Eng.		Total	CEIT		
	Female	Male	Female	Male		Female	Male	Total
Erciyes Un	19	42	17	14	92	-	-	-
Karabük Un	17	54	54	28	153	-	-	-
Niğde Un	0	0	23	100	123	-	-	-
Bülent Ecevit Un.	12	29	16	44	101	-	-	-
Ahi Evran Un.	-	-	-	-	-	27	25	**52**
Amasya Un.	-	-	-	-	-	52	36	**88**
Atatürk Un.	-	-	-	-	-	45	27	**72**
M.Akif Ersoy Un.	-	-	-	-	-	17	33	**50**
Total	**48**	**125**	**110**	**186**	**469**	**141**	**121**	**262**

Development process of the scale

In the first step of scale development, the literature has been reviewed in order to determine the general characteristics of the programming skills and that of attitude variables (Anastasiadou & Karakos, 2011; Aşkar & Davenport, 2009; Erdogan, et. al., 2008; Korkmaz, 2013; Korkmaz, 2012a; Korkmaz, 2012b; Lai, et al., 2012; Lockwood, 2012; Milne & Rowe 2002; Ramalingam & Wiedenbeck, 1998; Robins et al., 2003; Sacks, et al., 1993; Wang, et al., 2012; Yılmaz & Kılıç-Çakmak, 2012). Each of the identified general characteristics is considered to be an item for an attitude statement and it is put in the item pool. Furthermore, 17 students (females=8, males=9) in Mevlana University who enrolled to the Programming Language I course at fourth semester have been asked to describe their feelings, positive and negative attitudes during the learning phase of the computer programming. After investigating the written responses collected from these students, the feeling of the students are also identified as an item and put into the item pool. The resultant item pool has been investigated by three experts who are a computer engineer, an instructional technologist and a measurement-valuation expert, in order to detect overlapped items and scope validity. A linguist worked on the items to eliminate ambiguous and complex statements and then miss-worded and incorrect statement were modified.

An item pool with 25 items has been constructed based on the student opinions, reviewed of the literature, and expert's contributions. While 12 items, out of 25 items in the pool, are classified as positive statements, the rest of 13 items are classified as negative statements. A range of 5-point choices were placed for the items in order to specify the students' attitude levels expressed in the items. These choices were organized and graded as (1) "never", (2) "seldom", "(3) "sometimes", "(4) "generally" and (5) "always".

After finalizing the scale, it made available online. At this stage, an instructor in each of the departments is asked to carry out a survey for confirmatory factor analysis on the students in the engineering faculties. After completion of this phase, the implementation of the scale is carried out on the students in the educational faculties. The data collected is statically analyzed using SPSS 15.00 and LISREL 8.71 in order to carry out validity and reliability tests. The values related to the negative statements are coded inversely during loading data into programs.

Data Analysis

In order to decide whether factor analysis is liable or not, in the first place, KMO and Bartlett analyses have been conducted on the collected data in statistical framework (Korkmaz, 2012b). Having a KMO value which is greater than 0.90 is generally considered to be perfect to apply factor analysis on the dataset (Russell, 2002). Furthermore, based on the

Bartlett test values, which is known to be the identity matrix of the correlation under investigation, it is understood that the null hypothesis has been rejected at a meaningful level of 0,05 (Büyüköztürk, 2002; Eroğlu, 2008).

Based on the results, the exploratory and confirmatory factor analyses have been conducted on the data; itemizing level of the scale has been determined using principal component analysis; factor loadings have been investigated using Varimax orthogonal rotation technique. The aim of the factor analysis is to detect whether it is possible to reduce the items in a scale into a fewer number of factors (Balcı, 2009). On the other hand, the principal component analysis is a common technique, factorizing (Büyüköztürk, 2002). The items with factor loads lower than 0.30 and the items that do not have at least 0.100 difference between their loads on two factors, or in other words, the items with loads separated into two factors, should be removed (Büyüköztürk, 2002).Thus, it is accepted that having items in a scale with a factor load greater than 0,3 which explain at least 40% of the global variance, is adequate in terms of behavioral science (Büyüköztürk, 2002; Eroğlu, 2008; Kline, 1994; Scherer, Wiebe, Luther & Adams, 1988). Furthermore, it is considered to be well-accepted having a factor load of 0.5 or greater (Büyüköztürk, 2002). In the evaluation of the factor analysis, the factor loads are the primary criterion (Balcı, 2009; Gorsuch, 1983; Eroğlu, 2008). A higher factor load is an indication that the variable should belongs to the factor under consideration (Büyüköztürk, 2002). Furthermore, it is stated that the identification of the common factor variance for the patterns with multi-factor patterns is especially important. The common factor variance is defined as the variance on each of the variables caused by factors and it is identified using the result of factor analysis (Çokluk, Şekercioğlu & Büyüköztürk, 2010). There is supporting evidence that the items should be removed from the scale if its common variance is less than 0.2 (Çokluk et al., 2010).

The scale form obtained using the exploratory factor analysis is applied to a new group which is not a part of the study group in the first application and a factor analysis has been carried out on the results. Confirmatory factor analysis is based on the evaluation of the hypotheses which are constructed on the relationship between implicit and explicit variables, i.e. on the relation between items and factors (Pohlmann, 2004). In other words, the confirmatory factor analysis is a structural equivalence model which is related to the methods for measuring the relation between hidden variable and observable measurements (Korkmaz, 2012b). Each of the factors should be explained using its relation to the observable variables (items) (Yılmaz & Çelik, 2009; Raykov & Marcoulides, 2006). The maximum likelihood method is used in the confirmatory factor analysis. It is advised to use more than one consistency value in the structural equation model (Thompson, 2000). Therefore, five consistency values are reported in this study and accordingly the values in the scale model obtained in the confirmatory factor analysis are expected to be in the range, given below, for a perfect consistency given: $\chi^2/d<3$; $0<RMSEA<0.05$; $0\leq S\text{-}RMR\leq 0.05$; $0.97\leq NNFI\leq 1$; $0.97\leq CFI\leq 1$; $0.95\leq GFI\leq 1$; $0.95\leq AGFI\leq 1$ ve $0.95\leq IFI\leq 1$. For an acceptable consistency the values are expected to be as follows: $\chi^2/d<5$; $0.06\leq RMSEA<0.08$; $0.06\leq S\text{-}RMR\leq 0.08$; $0.90\leq NNFI\leq 0.96$; $0.90\leq CFI\leq 0.96$; $0.90\leq GFI\leq 0.96$; $0.90\leq AGFI\leq 0.96$ ve $0.90\leq IFI\leq 0.96$ (Kline, 2005; Şimsek, 2007).

The discriminative power of the items left after factor analysis, is determined by the independent t-test; the item-total correlation is tested using Pearson's r-test for the validity of the scale. The correlation between the score, obtained for each items and the one of the factor, which the items belongs to, is used an indication to explain the level of contribution of the each items to the general objective of the factor (Balcı, 2009). Another possible value, in order to test the level of contribution of an item, is the corrected correlation. Having a value for the corrected correlation, that is higher than 0.2, shows that the item contributes considerably to the objective of the corresponding factors (Tavşancıl, 2010). Discriminative power of a scale is accepted as an important evidence for the validity of the scale (Büyüköztürk, 2002). A method to test the discriminative power of a scale is to monitor the differences between the top 27% and the bottom 27% of the group of items, after sorting the raw scores in descending order.

Inner-consistency coefficients and stability tests are conducted in order to determine the stability of the scale. Cronbach alpha reliability coefficients, the correlation value between the two-identical half and Sperman-Brown formula and Guttmann split-half reliability formula are used to determine the inner-consistency level of the scale. The value greater than 0.7 for the reliability coefficient is accepted to be a good indication for reliability of the scale (Büyüköztürk, 2002; Gorsuch, 1983). The stability of the scale on the other hand is determined by the correlation between the scores obtained with two applications, which have been conducted separately in an interval of six weeks. As it is indicated a reliable scale should provide reliable measurements (Balcı, 2009). Furthermore, the reliability is partially related to the stability, consistency and sensitivity of the scale. Therefore, these values are considered to be the evidence of the reliability of the scale (Hoyardaoğlu, 2000). The consistency level increases if the reliability coefficient approach to 1.00 and decrease if the coefficient approaches to 0.00 (Gorsuch, 1983). As known, the values between 0.00 – 0.30 generally indicate a low correlation, the values between 0.30 – 0.70 indicate a medium correlation and the values between 0.70 – 1.00 indicate a high correlation for correlation coefficients (Büyüköztürk, 2002).

Results

Findings regarding the validity of the scale

The structural validity, the item-total correlations, corrected correlations and item discrimination were evaluated for the validity of the attitude scale for computer programming learning (ASCOPL) and the findings are listed below.

Structural Validity

Findings regarding the exploratory factor analysis: First of all, Kaiser-Meyer-Oklin (KMO) and Bartlett tests are conducted, with KMO =0.873, and $\chi2= 4798.830$; df=595 (p=0.000) for Bartlett test value, in order to test ASCOPL structural reliability. In terms of these values, it was seen that factor analysis could be conducted on the 25-item scale.

In the first place, a principal component analysis has been conducted in order to test whether the scale is one-dimensional or not. Then the Varimax orthogonal rotation method was used according to the principal components. 5 items have been removed from the scale; four of them have an item load less than 0.3 and the other's item load is distributed over various items. The factor analysis was applied to the remaining items again. The final item pool has been investigated by a computer scientist and by a measurement and evaluation expert in order to make sure that contend validity is not deteriorated due to removing of the five items. The experts state that contend validity is not affected and after this confirmation, the rest of the analyses has been conducted.

The results of the analyses show that the 20 items in the reduced scale seem to be grouped under three factors. For the reduced scale, the KMO value is as 0.876; Bartlett values are found as $\chi2=2867.942$; df=190; $p<0.001$, respectively. The non-rotated factor loads of the 20 remaining items are found to be between 0.323 and 0.631. On the other hand, after Varimax orthogonal transformation, the loads are laid between 0.486 and 0.742. Furthermore, the factors and items in the reduced scale are found to contribute to 47.34% of the total variance. Next, the contents of the items in the factors were examined and factor names were given. There were 9 items under the factor named "willingness", 6 items under the factor named "negativity", and 5 items under the factor named "necessity". The Kaiser rule is one of the mostly used procedures to determine the number of components. According to Kaiser (1960), each observed variable contributes one unit of variance to the total variance. If the eigenvalue is greater than 1, then each principal component explains at least as much variance as 1 observed variable. According to the Kaiser Criterion examined eigenvalues, the scale is confirmed by the above-mentioned tree-factor structure.

Table 2 illustrates the results obtained on the reduced scale with 20 items; it shows item loads, factor eigenvalues and the amount of the contribution of the items to the total variance

Table 2. Factor analysis results of the reduced scale as per factors

Items			**Common factor variances**	**F1**	**F2**	**F3**
Willingness	I1	Given the chance, I would like to participate in computer programming courses in different departments in my free time.	0.514	0.715		
	I2	Writing a computer program is funny for me.	0.591	0.712		
	I3	I want to be a member of a club for computer programming.	0.472	0.662		
	I4	Computer programming courses are at the head of the courses that I enjoy the most.	0.631	0.642		
	I5	I thing that less time for lesson about programming skills.	0.394	0.620		
	I6	I feel very comfortable in computer programming courses.	0.526	0.560		
	I7	I'm sure I can learn to computer programming.	0.323	0.512		
	I8	I am sure I'm able to put on high-level programming products.	0.350	0.506		
	I9	I think I can write long and complex programs.	0.433	0.486		
Negativity	I10	I am afraid of computer programming courses,	0.505		0.700	
	I11	I'm not good in computer programming.	0.542		0.691	
	I12	Computer programming is very difficult to me.	0.459		0.632	
	I13	In my spare time, writing a computer program does not deal with inside.	0.398		0.614	
	I14	Programming courses has always been my worst courses.	0.399		0.594	
	I15	I can handle many issues. But it cannot keep a good job with programming.	0.497		0.567	
Necessity	I16	Programming will be important to my business life.	0.581			0.742
	I17	After graduating from school, I do not think use the programming skills.	0.534			0.717
	I18	Taking Programming course is a waste time for me.	0.525			0.661
	I19	It doesn't matter for my future to be successful in programming	0.410			0.594
	I20	My teachers think that advanced programming would be a waste of time for me.	0.384			0.580
			Eigenvalue	5.75	2.10	1.610
			Explained variance	17.554	16.094	13.687

The "willingness" factor consists of 9 items as seen in Table 2 and their factor loads varies from 0.715 to 0.486. The eigenvalue of this factor within the scale is 5.75, and its contribution to general variance is 17.554%. The "negativity" factor, on the other hand, contains 6 items. The factor loads of these items are within a range of 0.700 and 0.567. The eigenvalue of the factor is found to be 2.10 and the factor explains 16.094% of the variance. The last factor, the "necessity" has 5 items. The factor load of the items is ranging from 0.742 to 0.580. The eigenvalue of the factor is 1.610 and, the contribution of the factor to total variance is measured as 13.687%.

Findings regarding confirmatory factor analysis: After an expletory analysis it has been proved that the scale consists of three factors. Another confirmatory factor analysis has been carried out on the new data. The data covers a group of sample which contains 262 students, which is not used in the previous experiments.

As the result of the confirmatory factor analysis conducted using the maximum likelihood method without any limitations, the worth of fit values was found to be: $\chi^2_{(sd=167,\ N=226)}$= 636,68, p<.001, RMSEA= 0,075, S-RMR= 0,063, GFI= 0,90, AGFI= 0,91, CFI= 0,96, NNFI= 0,96 ve IFI= 0,96. According to these values, it can be claimed that all consistency goodness values are acceptable, in another words, the attained model shows that the factors are validated by data. The factorial model of the scale and the t values regarding the factor-item relationship are illustrated in Figure 1.

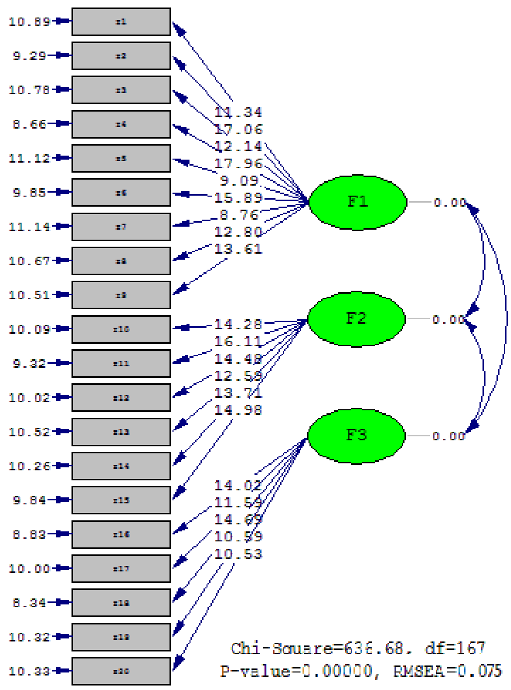

Figure 1. First level confirmatory factor analysis correlation diagram of the scale (t values)

A second level confirmatory factor analysis has been carried out in order to show that three factors obtained by the first level confirmatory factor analysis of the scale can be combined together to represent an "attitude" variable as an upper level concept. The model under consideration are based on the relationship between hidden variables, which obtained from the first level confirmative factor analysis. Also, the variances, which are explained by the second level attitude variable on the first level variables, are taken into consideration. The second level factor model has been tested by adding the second level attitude variable to the first level confirmative structure, which has already been tested by using the three hidden and 20 indicator variables. The correlation diagram of the second level confirmatory factor analysis of the scale and its t-values are given in Figure 2.

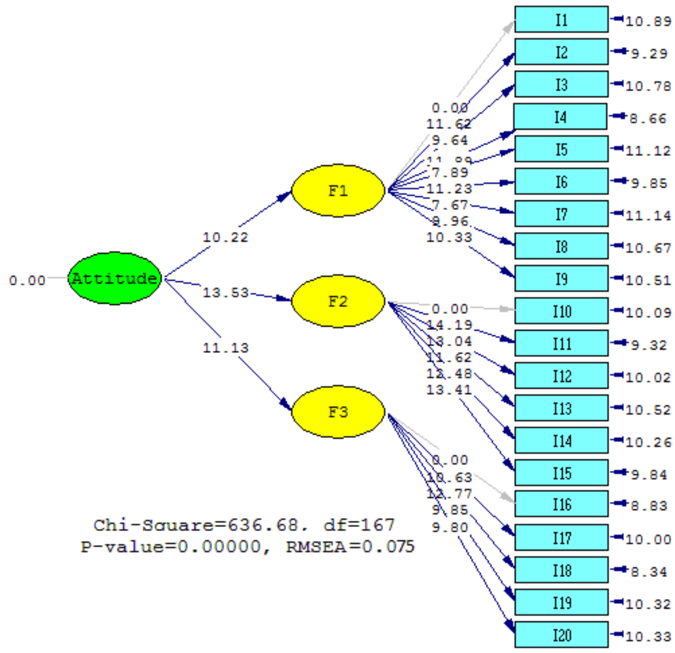

Figure 2. Second level confirmatory factor analysis correlation diagram of the scale (t values)

The factor loads between the first level hidden variables (Willingness, Negativity and Necessity) in the model and Attitude, the upper level (second level) variable, (λx), t values, measurement errors (δ) and the (R2) the rate of explaining the second level variables on the first level variables are given in Table 3.

Tablo 3. λx , δ, t and R^2 values of the second level confirmatory factor analysis on super concept – sub concept relation.

Second level variable	First level variable	λx	δ	t	R2
Attitude	F1: Willingness	0.84	0.22	10.22	0.76
	F2: Negativity	0.97	0.018	13.53	0.98
	F3: Necessity	0.82	0.38	11.13	0.64

Based on the path coefficients and t-values, it is found that the highest correlation is between the "Attitude" and "Negativity". Also the correlation between "Attitude" and the 3 dimensions are found to be meaningful and positive ($p<0.05$). When investigating the explained variances on the first level variables by the second level variable, "Attitude", it is found that the "Negativity" variable is explained by a value of ($R^2=0.98$), following the "Willingness" ($R^2=0.76$) and "Necessity" ($R^2=0.64$).

Item factor total and corrected correlations

In this section, the correlations between the scores obtained from each item and the scores obtained from the factors with the item total correlation and corrected item correlation method were calculated and each item's level of serving the general purpose was tested. The item-factor correlation values and corrected correlation values for each item are presented in Table 4.

Table 4. Item-factor scores correlation analysis

Items Factor Total Correlation						Items Corrected Correlation					
F1		**F2**		**F3**		**F1**		**F2**			
I.	r	I.	R	I.	r	I.	r	I.	r	I.	r
I1	0.643(**)	I10	0.686(**)	I6	0.742(**)	I1	0.517	I10	0.510	I6	,562
I2	0.749(**)	I11	0.736(**)	I7	0.738(**)	I2	0.659	I11	0.590	I7	,540
I3	0.663(**)	I12	0.701(**)	I18	0.728(**)	I3	0.539	I12	0.539	I18	,548
I4	0.729(**)	I13	0.626(**)	I19	0.689(**)	I4	0.631	I13	0.433	I19	,486
I5	0.596(**)	I14	0.670(**)	I20	0.621(**)	I5	0.455	I14	0.503	I20	,414
I6	0.637(**)	I15	0.688(**)			I6	0.516	I15	0.531		
I7	0.540(**)					I7	0.415				
I8	0.604(**)					I8	0.447				
I9	0.639(**)					I9	0.525				

N=469; **=p<0. 001

As seen from the Table 4, the item test correlation varies from 0.540 to 0.749 for the first factor; from 0.626 to 0.736 for the second factor; from 0.621 to 0.742 for the third factor. Each item is meaningful for the factors in general and have a positive correlation (p<0,001). Also, as seen in the table 4, the corrected correlation coefficient, between each one of the items in the scale and the factor that the item belongs to, varies from 0.415 to 0.659 for the first factor; from 0.433 to 0.590 for the second factor; from 0.414 to 0.742 for the third factor. It can be stated that, based on the findings, each one of the items contributes to the factor to which it belongs.

Item discrimination

The discrimination power of each item in the scale has been calculated. First of all, the raw score obtained for each item has been sorted in descending order. Then, the upper and the bottom groups of items, which formed by the lowest 27% and by the highest 27%, both of which included 127 students were determined. The independent group t-test value is calculated based on the total scores in the groups. t-values regarding the discrimination power and the findings related to the level of meaningfulness are listed in Table 5.

Table 5. Item discrimination powers.

F1		**F2**		**F3**	
I.	**T**	**I.**	**t**	**I.**	**t**
I1	9.810	I10	12.561	I6	10.735
I2	16.943	I11	14.412	I7	10.062
I3	11.983	I12	12.388	I18	13.068
I4	16.532	I13	11.045	I19	10.066
I5	11.579	I14	10.659	I20	8.234
I6	12.100	I15	13.542		
I7	10.732	**F1**	26.270	**F3**	17.070
I8	12.481	**F2**	22.712	**Total**	39.408
I9	13.920		df:242; p< 0.001		

In Table 5, it is seen that the values of the independent pattern t-test, regarding 20 items in the scale, factors and total score, range from 8.234 to 16.943. The t-value for the scale, on the other hand, is found to be 39.408. Each of the difference level is meaningful (p<0.001). Based on these findings, it can be stated that the discrimination power of the scale and that of each of the items are high.

Findings regarding the reliability of the scale

In order to determine the reliability of the scale the internal-consistency and stability analyses have been performed. The procedures and findings are elaborated in the following sections.

Internal consistency level

For the stability of the scale as a whole and on the factor level, Cronbach alpha reliability coefficients, the correlation value between the two-identical half and Sperman-Brown formula and Guttmann split-half reliability formula are used. The reliability test results on the factors and on the whole scale are summarized in the Table 6.

Table 6. Reliability analysis results considering the whole of the scale and its factors.

Factors	Number of items	Two congruent halves correlation	Sperman Brown	Guttmann Split-Half	Cronbach's Alpha
F1	9	0.635	0.777	0.752	0.824
F2	6	0.662	0.797	0.795	0.772
F3	5	0.554	0.713	0.669	0.749
Total	20	0.526	0.690	0.688	0.866

As seen from the Table 6, the scale which consists of 3 factors and 20 items has a value of 0.526 for the correlation value between the two-identical half. For the scale, the Sperman Brown reliability coefficient is 0.690; Guttmann Split-Half value is 0.688; Cronbach's Alpha reliability coefficient is 0.866. On the other hand, for the factors, the Sperman Brown reliability coefficient is found to be between 0.713 and 0.777; Guttmann Split-Half value is found to be between 0.669 and 0.795; Cronbach's Alpha reliability coefficient is found to be between 0.749 and 0.824. Based on these findings, it can be concluded that the scale as a whole and the factors can be used for a consistent measurement.

Stability Level

The stability level of the scale was calculated using the test-retest method. The 20-item final form of the scale was re-applied to 41 students, to whom the scale had been applied, after six weeks. These 41 students were voluntary senior students at the same institution and department of computer education and instructional technology. There are many barriers to reach many more students for retesting. However, these 41 students at Ahi Evran University could be reached easily. In any case, it can be said that 41 participants are enough for parametric analyses. The correlations between the obtained scores after each application were examined, both in terms of the general scale and each item in the scale. Therefore, both the general scales and each item's ability to make stable measurements were tested and the findings are summarized in Table 7.

Table 7. Test-retest results of the items of the scale.

Items Factor Total Correlation					
F1		**F2**		**F3**	
I.	R	I.	R	I.	r
I1	0.596(**)	I10	0.711 (**)	I6	0.411(*)
I2	0.601(**)	I11	0.724(**)	I7	0.641(**)
I3	0.550(**)	I12	0.664 (**)	I18	0.478(*)
I4	0.465(*)	I13	0.597(**)	I19	0.641(**)
I5	0.579(**)	I14	0.708(**)	I20	0.695(**)
I6	0.611(**)	I15	0.467(*)		
I7	0.647(**)				
I8	0.487(*)	**F1**	0.611(**)	**F3**	0.654(**)
I9	0.541(**)	**F2**	0.671(**)	**FT**	0.732(**)

N=41; *=p<00.05; **=p<0. 001

The correlation coefficients for each item in the scale, obtained by the test-retest methods, are found to be in the range of 0.411 and 0.724. It is found that the relations are meaning and positive. The correlation coefficients for the factors, on the other hand, are found to range from 0.611 and 0.671. The correlation regarding total score is 0.732 and all the relations are meaningful and positive. The findings indicate that the scale is able to conduct reliable measurements.

Discussion

In this study, a scale was developed in order to determine the attitude of students towards computer programming learning. ASCOPL is a 5-point Likert-type scale, consisting of 20 items, which can be grouped under three factors. The factors are labeled based on their general characteristics of items in the factor and on the convention in the literature. Attitude indicates the tendency of the individuals towards rejection or acceptance; it's positive or negative feelings towards the events, phenomenon, objects and thoughts (Gay & Airasian, 2000). In a similar way, it is the positive or negative feelings of the individuals towards realization of a behavior according to Fishbein ve Ajzen (1975, cited: Lai, et al., 2012). The attitude, according to Robbins (1994), is the expression of the feelings of an individual on an object. Therefore, given these circumstances, it can be said that the general structure of an attitude possesses a two-pool indication between positive-ness and negative-ness. Under this convention, due to similar characteristics which are observable for the items under the factors, the factor which embraces the nine positive items is labeled as "Willingness", and the factor which consists of six negative items is labeled as "Negativity". As the rest of positive items have a common theme of necessity regarding computer programming learning, the factor which embraces these items is labeled as "Necessity".

Item total correlations and corrected correlations were calculated and it was found that each item and each factor in the scale significantly served the purpose of measuring the feature that was expected to be measured with the general scale. In addition, the item discrimination powers were investigated by examining the t values regarding the difference between the highest 27% and the lowest 27% groups and it was determined that both the general scale and each item in the scale had high discrimination power, in other words each item was discriminatory at the expected level. The internal stability coefficients are calculated using Cronbach alpha reliability coefficients, the correlation value between the two-identical half and Sperman-Brown formula and Guttmann split-half reliability formula. Based on the findings using these values it is determined that the scale is suitable for reliable measurements. Test-retest method is used to check the time-invariance level of the scale, on the data which collected after six weeks from the first experiments. Test-retest method is applied for each one of the items and as well as for each sub-factors in the scale. It is proven that the items and the factors in the scale is time-invariance and hence provide stabile measurements.

As a result, it can be said that the ASCOPL is a valid and reliable scale that can be used in the determination of students' attitude towards computer programming learning. There is little reliable and stable scale in the literature for this purpose. Therefore, the scale will provide a substantial contribution to the literature. However, validity and reliability studies of the assessment instrument are restricted only to 496 students of Engineering and 262 students of Computer and Instructional Technologies Teacher Education. It can be suggested that validity and reliability studies should be repeated in order for the scale to be used in different stages of education.

References

Anastasiadou, S.D. & Karakos, A.S. (2011). The beliefs of electrical and computer engineering students' regarding computer programming. *The International Journal of Technology, Knowledge and Society*, 7(1): 37-51.

Aşkar, P., Davenport, D. (2009). An investigation of factors related to self-efficacy for java programming among engineering students. *The Turkish Online Journal of Educational Technology*, 8(1): 26-32.

Balcı, A. (2009). *Sosyal bilimlerde araştırma: Yöntem, teknik ve ilkeler [Research in social science: Methods, techniques and principles]*. Ankara: PegemA Pub.

Büyüköztürk, Ş. (2002). *Sosyal bilimler için veri analizi el kitabı [Data analysis for social sciences hand book]*. Ankara: PegemA Pub.

Çokluk, Ö., Şekercioğlu, G., & Büyüköztürk, Ş. (2010). *Sosyal bilimler için çok değişkenli istatistik: Spss ve Lisrel uygulamaları [Multivariable statistics for social sciences: Spss and Lisrel applications]*. Ankara: PegemA pub.

Erdogan, Y., Aydin, E. & Kabaca, Y.T. (2008). Exploring the Psychological Predictors of Programming Achievement. *Journal of Instructional Psychology,* 35(3): 264-270. Eric No: EJ813334.

Eroğlu, A. (2008). *Faktör analizi [Factor analyses]*. In: Kalaycı, Ş. (ed), SPSS Uygulamalı Çok Değişkenli İstatistik Teknikleri [Statistics Techniques with Multi Variable in SPSS Applications], Ankara: Asil Pub: 321-331.

Fang, X. (2012). Application of the participatory method to the computer fundamentals course, Affective Computing and Intelligent Interaction. *Advances in Intelligent and Soft Computing*, 137: 185-189.

Gay, L.R. & Airasian, P. (2000). *Educational Research*. New Jersey: Upper Saddle River.

Gomes, A., Mendes, A., J.(2007). Learning to program-difficulties and solutions. International Conference on Engineering Education, ICEE. Available at: http://ineer.org/Events/ICEE2007/papers/411.pdf

Gorsuch, R. L. (1983). *Factor analysis*. Hillsdale: Lawrence Erlbaum Associates.

Hawi, N. (2010). Causal attributions of success and failure made by undergraduate students in an introductory-level computer programming course. *Computers & Education,* 54: 1127–1136. doi:10.1016/j.compedu.2009.10.020

Hernane, B.P., Gilney F.Z & Marcelo A., M.(2010). Learning computer programming: Implementing a fractal in a Turing machine, *Computers & Education.* 55(2):767-776. doi: 10.1016/j.compedu.2010.03.009.

Hovardaoğlu, S, (2000). *Davranış bilimleri için araştırma teknikleri [Research techniques for behavioral science]*. Ankara: Ve-Ga Pub.

Hwang, G., Wu, P. & Chen, C. (2012). An online game approach for improving students' learning performance in web-based problem-solving activities. *Computers & Education,* 59: 1246–1256. doi:10.1016/j.compedu.2012.05.009.

Jenkins, T. (2002). *On the difficulty of learning to program*. in Proc. of the 3 rd Annu. LTSN_ICS Conf., Loughborough University, United Kingdom, pp. 53-58. Available at: http://www.psy.gla.ac.uk/~steve/localed/jenkins.html

Kaiser, H. F. (1960). *The application of electronic computers to factor analysis*. Educational and Psychological Measurement, 20, 141-151.

Katai, Z., Juhasz, K., & Adorjani, A. K. (2008). On the role of senses in education. Computers & Education, 51(4), 1707–1717. doi:10.1016/j.compedu.2008.05.002.

Kline, P. (1994). *An easy guide to factor analysis*. London and New York: Routledge.

Kline, R.B. (2005). *Principles and practice of structural equation modeling*, 2nd ed, New York: Guilford Press.

Korkmaz, Ö. (2012a). The Impact of Critical Thinking and Logical-Mathematical Intelligence on Algorithmic Design Skills. *Journal of Educational Computing Research,* 46(2):173-193. DOI: 10.2190/EC.46.2.d.

Korkmaz, Ö. (2012b). A validity and reliability study of the online cooperative learning attitude scale (oclas). *Computers & Education*, 59(4):1162-1169. Doi: 10.1016/j.compedu.2012.05.021

Korkmaz, Ö. (2013). Students' Difficulties in and Opinions about Designing Algorithms According to Different Instructional Applications. *Energy Education Science and Technology Part B: Social and Educational Studies* , 5(1).209-218.

Lai, C., Wang, Q. & Lei, J. (2012). What factors predict undergraduate students' use of technology for learning? A case from Hong Kong. *Computers & Education*, 59(2): 569–579. oi:10.1016/j.compedu.2012.03.006.

Landry, J.P., Pardue, J.H., Doran, M.V. & Daigle, R.J. (2002). Encouraging Students to Adopt Software Engineering Methodologies: The Inf luence of Structured Group Labs on Beliefs and Attitudes. *Journal of Engineering Education,* 91(1):103-108. Doi: 10.1002/j.2168-9830.2002.tb00678.x

Lau, W.W.F. & Yuen, A.H.K. (2009) Exploring the effects of gender and learning styles on computer programming performance: implications for programming pedagogy. *British Journal of Educational Technology*, Vol. 40, No. 4, pp.696–712. doi:10.1111/j.1467-8535.2008.00847.x

Lau, W.W.F., Yuen, A.H.K. (2011). Modelling programming performance: Beyond the influence of learner characteristics. *Computers & Education,* 57: 1202–1213. doi:10.1016/j.compedu.2011.01.002

Lockwood, M. (2012). Attitudes to Reading in English Primary Schools. *English in Education*, 46(3):228-246. DOI: 10.1111/j.1754-8845.2012.01132.x

Milne, I. & Rowe, G. (2002). Difficulties in Learning and Teaching Programming—Views of Students and Tutors. *Education and Information Technologies*, 2002, 7(1): 55-66. Doi: 10.1023/A:1015362608943

Pohlmann, J.T. (2004). Use and Interpretation of Factor Analysis in the Journal of Educational Research: 1992-2002. *The Journal of Educational Research*, 98(1), 14-23. Eric No: EJ698628.

Ramalingam, V. & Wiedenbeck, S. (1998) Development and validation of scores on a computer programming self-efficacy scale and group analyses of novice programmer self-efficacy. *Journal of Educational Computing Research*, 19(4): 367-381.

Raykov, T., & Marcoulides, G.A. (2006). *A first course structural equation modeling*. New Jersey: Lawrence Erlbaum Assocation Inc. Publishers, pp 4.

Robbins, S.P. (1994*). Örgütsel Davranışın Temelleri [Organisational Behavior]* (Translate.: Sevgi Ayşe Öztürk) Eskişehir ETAM Pub.

Robins, A., Rountree, J. & Rountree, N.(2003). Learning and Teaching Programming: A Review and Discussion. *Computer Science Education*, 13(2): 137–172. Doi:10.1076/csed.13.2.137.14200.

Russell, D. W. (2002). In search of underlying dimensions:the use (and abuse) of factor analysis. *Personality and Social Psychology Bulletin*, 28, 1629–1646.

Sacks, C., Bellisimo, Y. & Mergendoller, J (1993) Attitudes toward computers and computer use: the issue of gender. *Journal of Research on Computing in Education,* 26: 257-269.

Scherer, R.F., Wiebe, F.A., Luther, D. C. & Adams J. S. (1988). Dimensionality of coping: Factor stability using the ways of coping questionnaire, *Psychological Reports* 62(3), 763-770. PubMed PMID: 3406294.

Şimşek, Ö.F. (2007). *Yapısal eşitlik modellemesine giriş [Introduction to structural equation modeling]*. Ankara: Ekinoks Pub., 18-71.

Tan, P., Ting, C., Ling, S. (2009). Learning Difficulties in Programming Courses: Undergraduates' Perspective and Perception. *International Conference on Computer Technology and Development*,42-46. doi:10.1109/ICCTD.2009.188

Tavşancıl E. (2010). *Tutumların ölçülmesi ve spss ile veri analizi [Measurement of attitudes, and data analysis with SPSS*], 4th ed. Ankara: Nobel Pub., 93-124.

Thompson, B. (2000). *Ten commandments of structural equation modeling*. In Grimm, L. G., Yarnold, P. R. (Eds.), Reading and understanding more multivariate statistics (pp. 261–284). Washington, DC:American Psychological Association.

Van de Gae, E., Grisay, A., Schulz, W. & Gebhardt, E. (2012).The Reference Group Effect An Explanation of the Paradoxical Relationship Between Academic Achievement and Self-Confidence Across Countries. *Journal Of Cross-Cultural Psychology*, 43(8): 1205-1228 doi: 10.1177/0022022111428083.

Wang, Y., Li, H., Feng, Y., Jiang, Y., & Liu, Y. (2012). Assessment of programming language learning based on peer code review model: Implementation and experience report. *Computers & Education*, 59: 412–422. doi:10.1016/j.compedu.2012.01.007.

Yılmaz, R. & Kılıç-Çakmak, E. (2012). Educational interface agents as social models to influence learner achievement, attitude and retention of learning. *Computers & Education*, 59(2): 828–838. doi: 10.1016/j.compedu.2012.03.020

Yılmaz, V., & Çelik, E. (2009). *Lirsel ile yapısal eşitlik modellemesi I [Structural equation modeling with Lisrel]*. Ankara: PegemA pub, pp 53.