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The Relationship between the Development and Application Skills of Multiple-Choice Test of Teachers and Demonstrated Achievement in this Regard

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Abstract

This study sought to develop a Likert type scale which is valid and reliable in order to investigate the development and application skills of multiple-choice tests of teachers. The research was carried out with 386 teachers, selected randomly from primary schools and high schools in Eskisehir, Turkey in the 2010-2011 academic year. The data were collected by using a questionnaire consisting of two sections, developed by the researchers to determine the development and application skills of multiple-choice tests of teachers. The first part is related to demographic and personal information. The second part includes 72 expressions related to development and application skills of multiple-choice tests on a 5-point Likert-type scale. Data were analyzed with exploratory factor analysis and multi-factor confirmatory factor analysis by using the statistical package SPSS and LISREL. The findings of the study revealed that the scale was valid and reliable.

Keywords: Multiple-choice test; Test development; Test application; Application skills of multiple-choice test .

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1. Introduction

Today, multiple-choice tests, according to traditional examinations, are widely used because they have several advantages. In literature it's regarded that these advantages can describe following as:

- Evaluation of multiple-choice tests is objective.
- Multiple-choice tests better measure student achievement.
- It is possible to ask too many questions with multiple-choice tests.
- Multiple-choice tests measure students' level of knowledge in depth.
- Multiple-choice tests can be applied for each course.
- Multiple-choice tests are useful in determining the level of students.
- Multiple-choice tests, which can be applied to many people at the same time, are the easiest exam.
- Multiple-choice tests are evaluated rapidly.
- Multiple-choice tests are more reliable than other tests.

Considering the number of students in all teaching institutions especially for our country, multiple-choice tests are preferred because they are evaluated rapidly and can be applied to many people at the same time. Of course multiple choice tests in Turkey is not only due to the advantages above mentioned according to traditional examinations, also are preferred because of objective and reliable. Multiple-choice tests because of its advantages, not only in determining the level of the students, in other words, the evaluation of students' achievement, but also has been used widely in diagnostic and formative assessment.

Assessment in education is extremely important in terms of determining the level of learning, monitoring of learning, recognition of students, entering teaching-learning environments for the best development of students, elimination of the deficiencies in learning [1,2,3,4]. Therefore, no matter for what purpose assessment is used for; multiple-choice tests used as a measurement tool in assessment must be valid and reliable in quality that will serve for aims of education.

Teacher efficacy is an important factor directly affecting the quality of education. In the context of emerging requirements with the effect of these developments and social, political and economic developments in our country, teachers need to enhance development and application skills of multiple-choice tests. In addition, teachers should have the ability for development and application of multiple-choice tests in line with the purposes of teaching. Furthermore, teachers also should have skills in target-target behaviors in order to improve their capacity in evaluation of teaching effectiveness and to reach the level of the target behavior and in improving their skills in evaluating the success of students.

There are significant differences between a teacher who has the development and application skills of multiple-choice tests and a teacher who does not. A teacher who has the development and application skills of multiple-choice tests reaches less wrong values and improves to evaluate his teaching methods. Because he knows very well the techniques on this issue. In this regard, having the development and application skills of multiple-choice tests of teachers is inevitable. However, the level of development and application skills of multiple-choice tests

of teachers has not been known in our country. Moreover, in literature it's regarded that studies on development and application skills of multiple-choice tests of teachers are limited. There is not a scale developed in this regard. This situation is an important shortcoming.

Considering the limited number of studies on development and application skills of multiple-choice test of teachers in Turkey, this study was conducted to develop a scale for the purpose of finding out development and application skills of multiple-choice test of teachers and it is hoped that it will contribute to the existing literature on this subject. An attempt was made to answer the following questions.

- How are the development and application skills of multiple-choice tests of teachers?
- What are the achievement levels of development and application skills of multiple-choice tests of teachers?
- What is the relationship between the development and application skills of multiple-choice tests of teachers and demonstrated achievements in this regard?

It is expected to provide a data source and give direction to policies and practices about the recognition, placement and evaluation achievements of students, and to improve in-service training policy for the enhancement of development and application skills of multiple-choice tests of teachers found in this study. In this respect, it is hoped that it will contribute to the development of education programs, teacher training policies, determination of criteria for teacher training, selection and supervision of teachers, evaluation of teacher performance, provision of teaching effectiveness.

2. Materials and Methods

2.1. Participants

This study, conducted to develop a scale for the purpose of finding out development and application skills of multiple-choice tests of teachers, is a field survey of a kind of comparative relational-research model [5]. The participants were 386 teachers, selected randomly from primary and high schools in Eskisehir, Turkey in the 2010-2011 academic year. Two hundred-five participants (53.10%) were female and the remaining one hundred and eighty-one (46.90%) were male. Two hundred- sixty five participants (68.70%) graduated from education faculty, sixty-nine participants (17.90%) graduated from faculty of arts and sciences, thirty-seven participants (9.60%) graduated from education institute, nine participants (2.30%) graduated from teachers college and six participants (1.60%) graduated from other faculties. Eighty-three participants (21.50%) were grade teachers, sixty-nine participants (17.90%) were Turkish teachers, sixty participants (15.50%) were mathematics teachers, fifty-four participants (14.00%) were science and technology teachers, fifty-six participants (14.50%) were social studies teachers, fifty-six participants (14.50%) were English teachers, and the remaining 23 (9.07%) were teachers of other subjcets. Eighty-one (21.00%) had teaching experience of 5 years or less, 140 (36.30%) had from 6 to 10 years of teaching experience, 89 (23.10%) had from 11 to 15 years, 31 (8.00%) had from 16 to 20 years, 22 (5.70%) had from 21 to 25 years and the remaining 23 (6.00%) had 26 years or more teaching experience. One hundred-four (26.90%) had taken a course about measurement and evaluation in the faculty or in-service training

about measurement and evaluation and the rest had not. One hundred-twelve participants (29.00%) believe that they had received adequate information about measurement and evaluation from educational institutions, One hundred and eighty-eight participants (48.70%) believe that they had not received adequate information about measurement and evaluation from educational institutions and fourteen (3.60%) believe that they had received adequate information about measurement and evaluation from educational institutions partly. Finally, all of the teachers in the sample participated in the study voluntarily.

2.2. Data Collection

In this study, the data were collected using a questionnaire consisting of two sections, developed by Karaca and Can to determine the development and application skills of multiple-choice tests. The first part is related to demographic and personal information, consisting of items about the schools from which they graduated, branch, their years of teaching experience, the gender, the taking of a course about measurement and evaluation in the faculty or in-service training about measurement and evaluation, the beliefs related to having enough knowledge about measurement and evaluation of teachers. The second part includes 72 expressions related to development and application skills of multiple-choice tests on a 5-point Likert-type scale consisting of 5 choices, from 1 = Strongly Disagree to 5 = Strongly Agree [6].

In this study, it is tried to develop a valid and reliable scale in order to measure development and application skills of multiple-choice tests of teachers. In the first stage of the development of the scale (the Scale of the Development and Application Skills of Multiple-Choice Test - SDASMCT), the literature on the development and application skills of multiple-choice tests was investigated. Then, the measurement instruments on the development and application skills of multiple-choice tests were reviewed. As a result of literature search, 75 written skill expressions were obtained. In this way, the prepared scale is examined by an expert in terms of language. The views of a group of teachers and specialists working in universities were taken for content validity. In line with the reported opinions, the SDASMCT has been given final form.

The SDASMCT was administered to 391 teachers in the sample group. Five questionnaires were not included in the study because they were not filled out in accordance with the instructions.

2.3. The Analysis of Data

The research data were analyzed with exploratory factor analysis and multi-factor confirmatory factor analysis using the statistical package SPSS and LISREL. Factor analysis was conducted in order to check the construct validity of the scale. Factor analysis is a statistical data reduction technique used to find latent variables or factors among observed variables. In other words, if research data contain many variables, factor analysis can be used to reduce the number of variables. With factor analysis a small number of factors can be produced which are capable of explaining the observed variance in a larger number of variables. The reduced factors can also be used for further analysis [7,8]). If the main purpose of a research is exploration, it should be used Exploratory Factor Analysis (EFA) should be used. But if the purpose of a research is to confirm, Confirmatory Factor Analysis (CFA) should be used [9,10,11]. In practice, the factor construct of the scale is determined with EFA and CFA is

applied in order to verify the determined factor construct by researchers. In this study, the factor constructs determined by using EFA were subjected to CFA.

Reliability coefficients were calculated by applying Cronbach α for each subscale, determined as a result of varimax rotation and for the whole scale.

The SDASMCT is a reflective scale. The latent conceptual structures in the background are discovered by means of reflective scales. The indicators (items) are affected by latent factors in these scales. The latent factors are independent variables and they define external structures. The indicators are dependent variables and they define internal structures. It is suggested that the reflective scales are analyzed with softwares tested structural equation models such as LISREL, AMOS EQS [12]. In this study, the LISREL statistical program was used in data analysis, because the SDASMCT is a reflective scale.

An external criterion was applied to evaluate the extent that determines levels of development and application skills of multiple-choice tests of teachers of SDASMCT and determine the consistency of responses to the skill statements in SDASMCT [13,14]). This measure is an achievement test, developed by Karaca and Can.

Achievement test is developed for evaluating demonstrated achievements in terms of recall, comprehension and application knowledge about development and application of multiple-choice tests of teachers. This test was applied to 391 teachers in the sample group for validity and reliability analyses with SDASMCT

In developing the achievement test, basic steps in the process of development and application of multiple-choice tests have been followed. Accordingly, the content of achievement test was determined primarily. In determining the content of achievement test, the skill statements in SDASMCT was taken into consideration. After the content of the achievement test was determined, it was determined the number and type of question in the achievement test. Multiple-choice test is preferred for achievement test because it is objective, easily answered, rapidly evaluated and can be applied to many people at the same time. Fifty questions with five-choice related to development and application skills of multiple-choice tests were prepared [15]. After application, distribution of achievement test scores was investigated. Scoring was done by giving "1" points to the right answers and "0" points to the wrong answers.Item analyses of the achievement test consisting of fifty questions that were applied to a sample group and distribution of answers on each item was found out. Also, degree of difficulty (p) and discriminative power (r_j) of each item were calculated. In order to determine the criterion validity, the correlation between SDASMCT scores and achievement test scores of 386 teachers was calculated by Pearson Product Moment Correlation Coefficient.

2.4. Procedure

The SDASMCT was applied to the teachers at the participating province within a two-week period in the autumn term of the 2010-2011 academic year. The purpose of the study was explained to the teachers and they were asked to read the instructions. The teachers completed the questionnaires independently in approximately 45 minutes.

3. Results

In the factor analysis, the items with a factor load value higher than .45 are considered (Büyüköztürk, 2002) [8]. Having higher variance rates after factor analysis results in a stronger factor structure of the scale [16]; [17]. In social sciences, the variance rates changing in the range of 40 % and 60 % are accepted as sufficient [18]. According to these criteria, any item extracting from the scale was not required. Seventy-two items to which Principal Components Analysis was applied were collected under fourteen factors whose eigenvalues are higher than 1.00. A rotation process was performed using the varimax technique to find the items having high relations with the factors and to interpret the items easily [8]. After rotation, items 4, 5, 6, 7, 11, 15, 16, 17, 18, 20, 21, 22, 26, 27, 28, 31, 33, 34, 40, 41, 42, 43, 44, 45, 58, 59, 60 and 69, having low factor load value were extracted from the scale and 44 items remained. Also it is observed that remaining forty-four items are collected under eight factors whose eigenvalues are higher than 1.00 and the 44 items come under the first factor and first factor load values vary between .53 and .72. The variance of items in the scale is between .51 and .77. This finding shows that SDASMCT consists of the items having high relations and this scale measures the structure, defined as the development and application skills of multiple-choice tests. The cumulative variance explained by eight factors is 65.72 %. The variance first factor explains is 42. 42 %, for the second factor it is 4.63 %, for the third factor, 4.14 %, for the fourth factor 3.34 %, for the fifth factor, 3.20 %, for the sixth factor, 2.95 %, seventh factor, 2.58 % and eighth factor, 2.47 %, respectively. These findings show that the factor construct of SDASMCT is strong. The overall reliability coefficient was .97. The reliability coefficient of the first factor was .92, for the second factor it was .91, for the third factor, .87, for the fourth factor, . 90, for the fifth factor, .81, for the sixth factor, . 78, for the seventh factor, .81, and for the eighth factor, .78. These values prove that the scale is reliable. Factors are named for the meanings which the items include. The distribution of the remaining 44 items in the scale according to factors is shown in Table 1.

Table 1: The distribution of items in SDASMCT according to factors

Factors	Items
1. Factor: Interpretation and application of statistical procedures	63, 64, 65, 66, 67, 68, 70, 71, 72
2. Factor: Knowing the features of multiple-choice tests and test preparation for these features.	51, 52, 53, 54, 55, 56, 57
3. Factor: Knowing what needs to be done prior to exam application	19, 35, 36, 37, 38, 39
4. Factor: Interpretation features of multiple-choice tests	46, 47, 48, 49, 50
5. Factor: Question preparation appropriate instructional goals	9, 10, 12, 13, 14
6. Factor: Question writing appropriate multiple-choice test preparation rules	29, 30, 32, 61, 62
7. Factor: Knowing the basic concepts, stages and classifications of multiple-choice tests	1, 2, 3, 8
8. Factor: Editing of question choices	23, 24, 25

As it can be seen in Table 1, According to the results of EFA, there are eight latent variables in SDASMCT. There are nine indicators of one of these latent variables, seven indicators of one, six indicators of one, five indicators

of three, four indicators of one and three indicators of one . The result of EFA, after the distribution of the remaining 44 items in the scale according to factors is determined, the multi-factor CFA was applied in order to test whether the dimensions of SDASMCT is significant in .05 significance level statistically. The results of the multi-factor CFA are shown in Table 2.

Table 2: The results of the multi-factor CFA

Variables		Relation coefficient	t-values	R^2
Interpretation and application of statistical procedures	M63	.71	15.32	.49
	M64	.74	17.32	.58
	M65	.76	18.02	.61
	M66	.71	18.31	.63
	M67	.69	17.42	.59
	M68	.67	16.02	.52
	M70	.62	16.75	.55
	M71	.68	16.67	.55
	M72	.70	16.32	.53
Knowing the features of multiple-choice tests and test preparation for these features.	M51	.66	16.63	.55
	M52	.73	19.12	.67
	M53	.74	19.49	.68
	M54	.75	18.34	.63
	M55	.70	17.01	.57
	M56	.69	17.19	.58
	M57	.59	14.45	45

Knowing what needs to be done prior to exam application	M19	.51	13.10	.40
	M35	.58	14.56	.47
	M36	.62	14.84	.48
	M37	.60	14.87	.48
	M38	.72	17.98	.63
	M39	.65	17.06	.59
Interpretation features of multiple-choice tests	M46	.69	17.76	.61
	M47	.71	19.38	.68
	M48	.70	18.45	.64
	M49	.71	17.98	.62
	M50	.69	17.52	.60
Question preparation appropriate instructional goals	M9	.54	12.52	.38
	M10	.55	12.40	.37
	M12	.68	14.76	.49
	M13	.64	15.40	.52
	M14	.68	15.12	.51
Question writing appropriate multiple-choice test preparation rules	M29	.70	17.82	.62
	M30	.67	17.09	.58
	M32	.62	15.14	.49
	M61	.64	15.40	.50
	M62	.69	15.77	.52
Knowing the basic concepts, stages and classifications of multiple-choice tests	M1	.62	17.16	.60
	M2	.62	18.25	.66
	M3	.64	15.35	.51

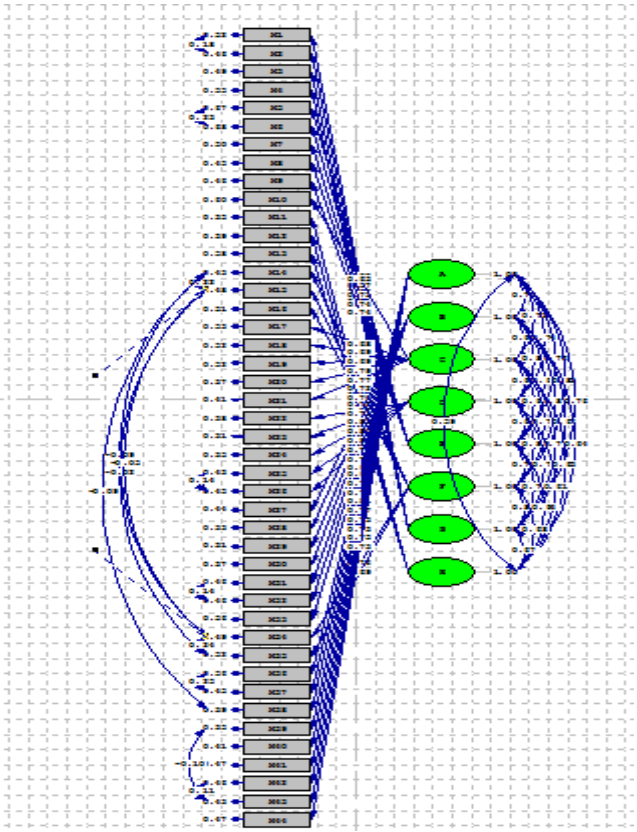
	M8	.51	12.86	.39
Editing of question choices	M23	.77	17.44	.65
	M24	.73	16.60	.60
	M25	.66	13.32	.43

According to the results of multi-factor CFA, the level of significance of t-values of the observed variables were controlled primarily. If t-value is greater than 1.96, it is significant in .05 significance level; If t-value is greater than 2.56, it is significant in .01 significance statistically [10]. According to the results of CFA, t-values are greater than 2.56. Accordingly, t-values associated with the latent variables explain the observed variables are significant in .01 significance. After it was determined that t-values were significant according to the results of CFA, the error variances of variables were also examined. The error variance of variables were low level and were varied .32 to .63. Based on these findings, it was decided to take part in all of the indicators defined in the model. Then, the appropriateness of the model was discussed taking into account the eligibility criteria.

Primarily, p-value has been tested in terms of the appropriateness of the model. Although insignificant p-value is not a desirable situation, it is significant depending on the size of the sample in CFA. Therefore, it is evaluated through alternative fit indexes. The first of these fit indexes is chi-square (χ^2) statistics. However, the chi-square statistic alone is not considered. Therefore, it is evaluated by calculating with degree of freedom (df). If χ^2 / df ratio is smaller than three, the level of fit is excellent and if it is smaller than five, the level of fit is acceptable. Accordingly, it can be said that the fit value of χ^2 / df ratio (2318.36 / 874= 2.65) is excellent.

Root Mean Square Error of Approximation (RMSEA) was examined, it was obtained .066-level fit index. If RMSEA value is equal to .05 or is smaller than .05, the level of fit is excellent; if it is smaller than .08, the level of fit is acceptable. If RMSEA value is greater than .10, the level of fit is unacceptable. Accordingly, it can be said that the fit index is acceptable. Goodness of Fit Index (GFI) was examined, it is seen that the value of GFI is .79. GFI takes values ranging from 0-1. If GFI is above .95, the level of fit is excellent; it is between .90-.94, the level of fit is acceptable [9]; [19]. Thus, although GFI is low, it is close to an acceptable level.Standardized Root Mean Square Residual (RMR) was examined, it is seen that the value of this index was .052. IF RMR and standardized RMR are below .05, the level of fit is excellent; it is below .08, the level of fit is good; it is below .10, the level of fit is acceptable. Thus, RMR is at a good level. Non-Normed Fit Index (NNFI) and Comparative Fit Index (CFI) were examined, it is seen that the value of NNFI was .85, the value of CFI was .86. If NNFI and CFI are above .95, the level of fit is excellent; if it is above .90, the level of fit is acceptable [20]. Accordingly, it can be said that NNFI is a low level, but CFI is an acceptable level.Finally, the modification proposals were examined according to the results of multi-factor CFA and 63 modifications were suggested. After the

modifications proposals were examined, it was determined that modifications would provide a significant contribution to the χ^2. Indeed, as a result of modification, χ^2 value decreased from 2318.36 to 1800.21.



Chi-Square=1800.38, df=861, P-value=0.00000

Figure 1: after the modification, obtained road scheme

After modification, χ^2 / df (1800.32 / 861) ratio was found to be 2.09. This ratio is below 3. Therefore it can be said that the level of fit is excellent. RMSEA was examined in a road scheme, its value was .053. This index is smaller than .08. Therefore, it can be said that the level of fit is acceptable for RMSEA. After modification, fit indexes were examined, it was seen that values of NNFI (.90) and CFI (.91) were .90 and above .90; the value of standardized RMR (.047); was below .08; the value of GFI was .82. These values show that the level of fit is acceptable. As mentioned before, in order to determine the consistency of responses to the statements in SDASMCT, achievement test as an external criterion was applied. According to the result of item analyses of the achievement test, items that are below .15 of the degree of item difficulty and below .20 of the discriminative power were omitted. These items were 6., 13., 25., 27.-33., 35.., 36., 39., 41.-44. 46., 47. ve 49 [21]. Items whose discriminative power is between .20 and 29 were corrected. The (p) values and (r_j) values of each item in the achievement test are shown below in Table 3.

Table 3: Difficulty and discriminative power of the achievement test items

Item no	Item difficulty index	Discriminative power index
1	.64	.41
2	.40	.43
3	.62	.38
4	.49	.34
5	.40	.42
7	.49	.31
8	.38	.51
9	.44	.55
10	.47	.44
11	.51	.43
12	.37	.43
14	.61	.44
15	.30	.25
16	.31	.30
17	.44	.39
18	.37	.26
19	.39	.40
20	.29	.27
21	.29	.36
22	.39	.30
23	.44	.28
24	.24	.24
26	.25	.26
34	.35	.22
37	.33	.21
38	.35	.24
40	.32	.30
45	.37	.28
48	.35	.31
50	.33	.21

As it can be seen in Table 3, the discriminative power of the achievement test Items varies between .15 and .64; the degree of difficulty is between .21-.55. Also, KR-20 reliability of achievement test is found out to be .80.

Pearson Product Moment Correlation Coefficient calculated in order to determine the relationship between the development and application skills of multiple-choice tests and demonstrated achievements in this regard of teachers is .20 ($p < .00$). This correlation coefficient is significant at .01 level. This finding shows that There is a

significant relationship between the development and application skills of multiple-choice tests and demonstrated achievements in this regard of teachers. Also, these values prove that the SDASMCT ise reliable.

4. Conclusion

In this study, it is tried to develop a valid and reliable scale in order to measure the development and application skills of multiple-choice tests of teachers. In the first stage of the development of the scale the literature on the development and application skills of multiple-choice tests was examined. Then, the measurement instruments on the development and application skills of multiple-choice tests of teachers were reviewed.

The prepared scale was examined by a specialist in terms of language. The views of a group of teachers and specialists working in universities were taken for content validity. In line with the reported opinions, SDASMCT has been given its final form.

The results of AFA showed that the reliability coefficient of SDASMCT, the factor construct of which was strong, was high at the same time. On the other hand, results of the multifactor DFA revealed that the eight-factor structure of SDASMCT consisting of 44 items was verified as a model; and that the model was convenient to explain the relationship between development and application skills of multiple-choice test of teachers and interpretation and application of statistical procedures, knowing the features of multiple-choice test and test preparation for these features, knowing what needs to be done prior to exam application, interpretation features of multiple-choice tests, question preparation appropriate instructional goals, question writing appropriate multiple-choice test preparation rules, knowing the basic concepts, stages and classifications of multiple-choice tests and editing of question choices.Again the significance of the relationship between SDASMCT scores and scores of achievement test, applied as an external criterion proves that SDACSMCT is a valid instrument.

The findings obtained from this study show that the scale is valid and reliable for the data obtained from the sample group. When repeating the reliability and validity studies and comparing the analysis it was realized that having similar features in a form including all teachers from different branches of study would also be useful for determining the structural validity. In this regard, a number of studies should be conducted by using the 'Scale of the Development and Application Skills of Multiple-Choice Test' and the findings obtained should be compared with the findings from this research.

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