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Full Length Research Paper

The effect of misssing data handling methods on goodness of fit indices in confirmatory factor analysis

Alper Köse

Abant Izzet Baysal University-Turkey.

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The primary objective of this study was to examine the effect of missing data on goodness of fit statistics in confirmatory factor analysis (CFA). For this aim, four missing data handling methods; listwise deletion, full information maximum likelihood, regression imputation and expectation maximization (EM) imputation were examined in terms of sample size and proportion of missing data. It is evident from the results that when the proportions of missingness %1 or less, listwise deletion can be preferred. For more proportions of missingness, full information maximum likelihood (FIML) imputation method shows visible performance and gives closest fit indices to original fit indices. For this reason, FIML imputation method can be preferred in CFA.

Key words: Missing data, goodness of fit, confirmatory factor analysis, incomplate data, and missing value.

INTRODUCTION

Educational and psychological scientists have improved their ability to carry out quantitative analysis on large and complex data bases with the use of computers. The goal of the researcher is running the most precise analysis of the data for making acceptable and effective deductions about the population (Schafer and Garham, 2002). Generally, scientists have ignored or have underestimated some kind of research problems by reason of missing data but with the help of improved technology and computers, this problem can be handled easily. The term missing data means that some type of interested information about the phenomena is missing (Kenny, 2005). Missing data is one of the most common problems in data analysis. The problem occurs as a result of various factors. Equipment errors, reluctant respondents, researcher goofs can be given as an example for these factors. Quantity and pattern of missing data determines it's seriousness for the research (Tabachnick and Fidell, 2001).

Researches on missing data dates as far back as the 1930's. At first, a maximum likelihood method for imputation of missing data in bivariate normal distributions was suggested by Wilks (1932: cited in Cheema, 2012). Several methods such as linear regression were introduced between the 1950's and 1960's. However, absence of statistical softwares caused little progress for how to handle missing data at that time. In 1980's and 1990's, developed computer packages made handling mising

E-mail: i.alper.kose@gmail.com

data easy for resear-chers (Cheema, 2012).

It is possible to face to missing data in behavioral sciences. In all research studies, reporting necessary information for missing data should be done. Resarchers should report the extent and nature of missing data and the procedures for how to handle the missing data (Schlomer et al., 2010). Academic journals expect from the authors to take appropriate steps to properly handle missing data, but most articles do not give necessary attention to this isue (Sterner, 2011).“Small” percentages of missing values are less problematic but there is no common definition of “small amount of missing data” in the literature (Saunders et al., 2006).

Researchers should also take into consideration the pattern of missing data as well as amount and source of missing data. Occasionally, pattern of missing data can be called as missing data mechanism. It is essential to remind here that the word “mechanism” is used as a technical term. It gives point to structural association with the missing data and the observed and/or missing values of other variables in the data without emphasizing the hypothetical primary reason of these assoications (Kenny, 2005). Missing completely at random (MCAR), missing at random (MAR), and not missing at random (MNAR) are three patterns of missingness (Schlomer et al., 2010; Cheema, 2012).

Missing completely at random

Missing values do not have any relationship with any variable being examined and missing values randomly distributed throughout data. In other words, probability of missing on Y does not depend on neither X or Y (Schafer and Garham, 2002; Acock, 2005; Schlomer et al.,2010; Sterner, 2011). Mathematically this can be presented as

$$P(Y\ is\ missing|X,Y) = P(Y\ is\ missing).$$

For example, a student does not finish a test because of his or her instantaneous health problem.

Missing at random

With MAR, missing data may be related to at least one variable in the study but not to the outcome being measured (Schafer and Garham, 2002). It can be stated as

$$P(Y\ is\ missing|X,Y) = P(Y\ is\ missing|X).$$

For example, it could be difficult for an elderly person to finish the questionnaire by reason of age (a measured variable) but not because of his or her level of depression (the outcome being measured) (Saunders et al., 2006).

Missing not at random

With MNAR, the reason for missingness is related to one or more of the outcome variable or the missingness has a systematic pattern (Schafer and Garham, 2002). In mathematical base, it can be formulated as;

$$\Pr(r\backslash Y_{obs}, Y_{miss}) = \Pr\ (r\backslash Y_{miss}\ ).$$

It means that something which you have not measured as an determinative factor for the possibility that an observation is missing (Davey and Salva, 2010; Molenberghs and Kenward, 2007). For example, if the participants don’t think there is a progress from the treatment, they may give up a study on depression and not complete the final questionnaire.

Statistical results can be more affected by the pattern of missing data than the percentage of missingness. The pattern of missing data basicly based on randomness of missing values. Randomness is less problematic than nonrandomness. Because non randomness affects the generalizability of results (Tabachnick and Fidell, 2001).

All measures, less or more, contain some measurement error inevitably. Statistical analysis results and conclusions drawn from these results are affected by measurement errors. Missing data result to either measurement error or sampling error, depending on how the missing data are handled (Mackelprang, 1970). Researchers can handle missing data with the help of various methods which have different effects on estimation and and decisions made on the basis of these estimations. There are various methods which are available to handle the missing data problem. These methods can be classified as “old methods” and “new methods”. Old methods require less mathematical computations. In contrast to old methods new methods based on more complex mathematical computations. (Saunders et al., 2006).

Deletion Methods

Listwise deletion: Listwise deletion also called as a complete case analysis is the method which is the most wide spread and easiest of all to handle the missind data (Schafer and Garham, 2002; Acock, 2005; Enders, 2001; Enders, 2013). Computer program automatically discharges missing cases from the data when listwise deletion is used. This procedure reduces sample size and it causes statistical power reduction and researchers should ask the representativeness of remaining sample.

Sample size reduction brings bias problem, infliation of standart errors and reduction of significane level. (Acock, 2005; Saunders et al., 2006).

Pairwise deletion: Pairwise deletion is very similar to listwise deletion but this method discharges missing cases only in the analysis. For instance, if there are three variables as X, Y and Z and missing case is on Z variable. Correlation will use all n observations to calculate r_{XY} but only n-1 observations to calculate r_{XZ} and r_{YZ} (Cheema, 2012).

Imputation methods

Mean substitution: This is easy and fast method in which all missing cases is substituted by the mean of total sample (Saunders et al., 2006). This method has some disadvantages practically. Usage for respondents at the extremes can cause misleading results. Rich and poor persons would not want to give their incomes in a telephone survey. If mean of the population is substituted for this maissing part, it would be spurious guess (Acock, 2005). Mean substitution doesn't change variable mean but it can be used only if the missing pattern is MCAR. But it has reducing effect on variance and causes biased and deflated errors (Pigott, 2001; Tabachnick and Fidell, 2001).

Regression imputation or conditional mean imputation: Regression imputation is more complicated method and based on regression equations. Selected predictors (highest correlations) are used as independent and missing data is used as dependent variables. With the help of repeated regression equations missing values are predicted (Saunders et al., 2006; Peugh and Enders, 2004). This method's advantage is objectiveness against researcher's guess. Two disadvantages can be given for this method. First, predictions from other variables for the regression equations cause beter fit than the real score. Second, it causes reducing variance (Tabachnick and Fidell, 2001). These methods are known as the conventional methods in the literature and they produce biased estimates of parameters or their standard errors. EM and multiple imputation are new methods that have much better statistical properties (Allison, 2003).

Maximum likelihood (Ml): ML is known as modern method that utilizes information from other variables during parameter estimation procedure by incorporating information from the conditional distribution of observed variables. There are three maximum likelihood estimation algorithims; the multiple group approach, full information maximum likelihood (FIML) estimation and expectation maximization algorithim. All three algorithims assume multivariate normality (Enders, 2001).

The multi-group approach is difficult to implement and stipulates an exceptional level of expertise. For this reason this approach is not widespread among researchers but the multiple group approach can be conducted in all structural equation modeling (SEM) softwares. FIML can be seen as similar to the multiple-group method but likelihood function is calculated at the individual level, rather than the group level (Enders, 2001). Amos and Mx offer FIML. FIML was recommended as a superior method for dealing with missing data in structural equation modeling. Specifically, Enders and Bandalos (2001) pointed out that FIML estimates are unbiased and efficient under MCAR and MAR mechanisims. The third ML algorithim is expectation-maximazation algorithim. EM estimates missing data values on the likelihood under that distribution. EM is an iterative procedure and includec two steps; expectation (E) and maximization (M) for each iteration (Tabachnick and Fidell, 2001). With E step, the conditional expectation of the parameter is calculated on missing data. It is conducted by a series of regression equations (Enders, 2001). With M step the parameters by maximizing the complete data likelihood are estimated (Jing, 2012). Statistical package for the social sciences (SPSS), estimation of means and covariances (EMCOV) and NORM offer EM algorithm. Because of the accessibility for SPSS, EM algorithim was selected.

Multiple imputation: MI is an another complicated missing data handling method in which a number of imputed data sets (frequently between 5 and 10) are created and in these data sets different estimation of missing values are available. These parameter estimations for missing values are avareged to produce a single set of results (Peugh and Enders, 2004; Rose and Fraser, 2008). Researchers have been recommended maximum likelihood and multiple imputation method because of their less restrictive assumptions, strong theorethical assumptions, less biased results and greater statistical power (Enders, 2013). Enders and Bandalos (2001) stated that maximum likelihood and multiple imputation gives accurate estimations under MCAR and MAR mechanism. As missing data are frequently encountered in behavioral, psychological research much attention has been given to analyze structural equation models in the presence of missing data.

Confirmatory factor analysis

The main importance in the development and use of measurement instruments is the degree to which they do measure that which they meant to measure. That is to say sturctures are valid. Confirmatory factor analysis (CFA) is among the most important methodological approaches in order to analyze for the validity of factorial structures or within the framework of SEM (Byrne, 2001). CFA is used for evaluating and testing the hypothesized factor structure of scores obtained from various

Table 1. Summary of sample sizes used in missing data analysis.

Percentage of missing data				
0%	**1%**	**5%**	**10%**	**20%**
100	99	95	90	80
200	198	190	180	160
500	495	475	450	400
1000	990	950	900	800

measurement instruments and relations among latent constructs (for example, attitudes, traits, intelligence, clinical disorders) in counseling and education (Sun, 2005; Jackson et al., 2009). CFA generates various statistics to explain how well the competing models explained the covariation among the variables of fit the data. These statistics are called as "fit statistics" (Gillapsy, 1996). The correspondence between hypothesized latent variable models is quantified by fix indexes (Hu and Bentler, 1995).

Multiple imputation, rarely used for SEMs, is a method which is used for handling missing data but EM method is commonly used as missing data imputation and based on ML estimation. EM performs well under different conditions in simulation studies (Zhang, 2010). Regression imputation estimates missing values unbiased in the case of the data are MCAR (Tannenbaum, 2009).

Determination of relations among variables or constructs has a crucial importance in the measurement approaches. These constucts can be affected by many threats. Threats to reliability will automathically affect to construct validity. Missing data is one of the threats to internal consistency reliability (Kenny, 2005). A measure's internal consistency reliability is defined as the degree of ture score variation relative to observed-score variation:

$$\rho^2 = \frac{\sigma^2_{true}}{\sigma^2_{observed}} = 1 - \frac{\sigma^2_{error}}{\sigma^2_{observed}}$$

ρ^2 ……reliability of measure,

σ^2_{true} …..true variability,

$\sigma^2_{observed}$ …..observed variability,

σ^2_{error} …..unexplained variability in the measure.

It can be seen from the equation, as the error variance increases, reliability decreases. With respect to missing data, lost information can give rise to larger amounts of error variance. Missing data has negative effects on research results such as contribution to biased resultsand making it difficult to make valid and efficient inferences about a population, decreasing statistical power and finally cause violation statistical assumptions (Schafer and Garham, 2002; Kang et al., 2005; Kenny, 2005; Tannenbaum, 2009; Rose and Fraser, 2008). There has been considerable interest in the effect of the missing data handling methods on structural equation modeling (Enders and Bandalos 2001; Chen et al., 2012; Enders, 2001; Allison, 2003). Considering the aforementioned research, missing data handling methods have effect on goodness of fit statistics. Specifically, this study specifically asks which missing data handling method works best on goodness of fit sttistics in CFA when proportion of missing data and sample size are known?

METHODOLOGY

Data simulation

The primary source of data used for statistical anlysis performed in this study was a simulated dataset. R-studio program was used to generate data sets. Reason for using simulated data was that it is difficult to satisfy all of the assumptions under experimental conditions such as different sample sizes ranging from very small to very large with data missing at different rates in these samples. A second reason for using simulated data is that since we start with complete dataset, it is relatively straightforward to observe the effect of missing data on goodness of fit statistics by comparing results directly between complete and incomplete datasets. This allows one to objectively evaluate how much of error can be corrected by using a particular missing data method.

Four datasets (1 to 0) with 25 replications were simulated which included 10 continuous variables (Table 1). These 10 continuous variables have a multivatiate normal distribution. For ease of interpretation all variables were specified to have a mean of 0 and standard deviation of 1.

Each of these subsamples was then reduced in size by 1, 5, 10 and 20% in order to simulate datasets containing missing data. The cases were discarded randomly from each complete samples separetely in order to make sure that there were no dependencies between samples. For example, 10 cases were randomly thrown out from a sample size n=100 in order to obtain a partial sample containing 10% missing data, n=90. In order to obtain a sample with 20% missing data, 20 cases were randomly removed from the original sample of n=100 again rather than removing 10 additional cases from the n=90 sample.

Method of analysis

Missing data handling methods, listwise deletion, regression imputation, EM imputation, and FIML were applied to all samples containing missing data under CFA. The main consideration behind the choice of CFA was its widespread use among educational and psychological researchers. The data used in this study is simulated data. MCAR pattern can be produced by randomly discharding cases.

RESULTS

Results of analytical procedures described in the methods section for the simulated data are presented in this section. In order to see the effects of missing data handling methods, goodness of fit indices were calculated separately for each original data samples first (Table 2).

Before looking at the relative performance of various

Table 2. Goodness of fit indices for each sample sizes.

	Goodness of fit statistics									
Sample Size	**X^2**	**df**	**X^2 /df**	**p**	**RMSEA**	**GFI**	**SRMR**	**CFI**	**IFI**	**AGFI**
100	27,67	32	0,86	0,685	0,000	0,95	0,062	1,00	1,00	0,91
200	32,42	29	1,11	0,302	0,024	0,97	0,047	0,98	0,98	0,94
500	27,64	35	0,79	0,807	0,000	0,99	0,026	1,00	1,00	0,98
1000	37,59	35	1,07	0,351	0,009	0,99	0,022	1,00	1,00	0,99

missing data handling methods, subsamples (n=100, 200, 500 and 1000) were then reduced in size by 1%, 5%, 10% and 20% in order to simulate datasets containing missing data. The cases were discarded randomly from each complete sample for obtaining MCAR data. As a result, 16 subsamples with incomplate cases were obtained. These subsamples were then handled with listwise method for each percentage of missing and imputed with mean, regression, and EM imputation methods. For ecah sample size and percentage of missing data, datasets were anaysed with confirmatory factor analysis and goodness of fit indices were presented with original samples' in table 3, 4, 5, and 6.

When sample size is 100, for all percentages of missing, GFIs' were presented in Table 3. The figures in Table 3 show some important results. When proportion of missing data is 1%, listwise deletion method has shown visible performance. Namely, If the proportion of missing data is 1% or smaller, missing data cases can be discarded from the dataset. Because, this proportion of missingness has no effect on GFI in confirmatory factor analysis.

When proportion of missing data is 5% or more FIML method shows beter fit indices than orther methods. Besides this, listwise deletion method works worse than orther methods beacuse CFA works well in large samples.

When sample size is 200, for all percentages of missing, GFIs' were presented in Table 4. The visible performance of EM and FIML imputation methods can be seen in all proportions of missing data. When proportion of missing data is 1%, listwise deletion method works well. Also, it is worthwhile to point here that regression imputation method produces the worst fit indices compared to other missing data handling methods. When sample size is 500, EM and FIML imputation methods are the best missing data handling methods because they produce more acceptible goodness of fit indices compared to other missing data handling methods.

Listwise deletion method works well under circumstances of 1% percentage of missing data (Table 5).

When sample size is 1000, for all percentages of missing, GFIs' were presented in Table 6. The prominent performance of FIML imputation methos can be seen in all proportions of missing data. FIML imputation method is the best missing data handling method because it produces more acceptible goodness of fit indices. When proportion of missing data is 1%, as well as FIML imputation method, listwise deletion method works well. Also, it is important to point here that regression imputation method generates the worst fit indices compared to other missing data handling methods.

DISCUSSION AND CONCLUSIONS

The primary objective of this study was to examine the effect of missing data on goodness of fit statistics in SEM. For this aim, four missing data handling methods; listwise deletion, FIML, regression imputation and EM imputation were examined with sample size and proportion of missing data. Under the small sample and low missing data conditions, statistical results imply that listwise deletion is one of the simplest and least computation-intensive methods.

Furthermore, listwise deletion method is definitely not recommended for CFA analysis, if the sample size is large and missingness proportion is high. Decreasing sample size by listwise deletion has negative effect on fit indices.

As the sample size and proportion of missing data increases, FIML imputation methods works best in all sample sizes and missing data proportions. This finding was in line with Enders and Bandalos 2001. Regression impu-tation methods were not good choices as missing data handling method in the frame of results of this study. These results confirmed the findings of earlier researches of Zhang (2010) and Tanenbaum (2009). Statistical software packages for SEM use maximum likelihood method and FIML for the estimation of model parameters. EM algorithm is a general method for doing ML and FIML estimation with missing data. Simulation studies have shown that it tends to perform well under various conditions (Zhang, 2010; Enders and Bandalos (2001) 2001). When the missing data handling method is regression imputation and the data are MCAR, the resulting estimates will be relatively unbiased in large

Table 3. GFIs' for each percentage of missing (n=100)

Sample Size	MR	Method	X^2	Df	X^2/df	p	RMSEA	SRMR	CFI	GFI	AGFI
100	1%	Original	27,67	32	0,86	0,685	0,000	0,062	1,00	0,95	0,91
		LWD	27,76	32	0,87	0,680	0,000	0,062	1,00	0,95	0,91
		FIML	28,89	32	0,90	0,624	0,000	0,063	1,00	0,94	0,91
		RI	28,98	32	0,91	0,624	0,000	0,063	1,00	0,94	0,91
		EMI	28,89	32	0,90	0,624	0,000	0,063	1,00	0,94	0,91
	5%	Original	27,67	32	0,86	0,685	0,000	0,062	1,00	0,95	0,91
		LWD	26,81	32	0,84	0,727	0,000	0,063	1,00	0,95	0,91
		FIML	27,92	32	0,87	0,670	0,000	0,067	1,00	0,94	0,91
		RI	26,74	32	0,84	0,729	0,000	0,062	1,00	0,95	0,91
		EMI	31,92	32	1,00	0,470	0,000	0,067	0,99	0,94	0,90
	10%	Original	27,67	32	0,86	0,685	0,000	0,062	1,00	0,95	0,91
		LWD	23,84	32	0,75	0,850	0,000	0,056	1,00	0,95	0,92
		FIML	26,68	32	0,83	0,732	0,000	0,061	1,00	0,95	0,91
		RI	28,66	32	0,90	0,636	0,000	0,062	1,00	0,95	0,91
		EMI	26,69	32	0,83	0,732	0,000	0,061	1,00	0,95	0,91
	20%	Original	27,67	32	0,86	0,685	0,000	0,062	1,00	0,95	0,91
		LWD	25,16	32	0,79	0,799	0,000	0,067	1,00	0,94	0,90
		FIML	27,86	32	0,87	0,701	0,000	0,060	1,00	0,95	0,91
		RI	29,55	32	0,92	0,590	0,000	0,063	1,00	0,94	0,90
		EMI	28,25	32	0,88	0,656	0,000	0,063	1,00	0,95	0,91

Table 4. GFIs' for each percentage of missing (n=200)

Sample Size	MR	Method	X^2	df	X^2/df	p	RMSEA	SRMR	CFI	GFI	AGFI
200	1%	Original	32,42	29	1,12	0,302	0,024	0,047	0,98	0,97	0,94
		LWD	33,02	29	1,14	0,300	0,027	0,048	0,97	0,97	0,94
		FIML	33,75	29	1,16	0,298	0,028	0,047	0,97	0,97	0,94
		RI	34,41	29	1,19	0,224	0,031	0,048	0,96	0,97	0,94
		EMI	35,75	29	1,13	0,288	0,025	0,047	0,97	0,97	0,94
	5%	Original	32,42	29	1,12	0,302	0,024	0,047	0,98	0,97	0,94
		LWD	31,11	29	1,07	0,36	0,02	0,047	0,98	0,97	0,94
		FIML	33,12	29	1,14	0,299	0,025	0,048	0,97	0,97	0,94
		RI	33,91	29	1,17	0,242	0,029	0,048	0,97	0,97	0,94
		EMI	30,56	29	1,05	0,386	0,016	0,046	0,98	0,97	0,94
	10%	Original	32,42	29	1,12	0,302	0,024	0,047	0,98	0,97	0,94
		LWD	36,61	29	1,26	0,156	0,036	0,05	0,95	0,96	0,93
		FIML	33,79	29	1,16	0,279	0,027	0,05	0,96	0,97	0,93
		RI	36,07	29	1,24	0,171	0,035	0,05	0,96	0,97	0,93
		EMI	32,33	29	1,11	0,227	0,027	0,052	0,97	0,96	0,93
	20%	Original	32,42	29	1,12	0,302	0,024	0,047	0,98	0,97	0,94
		LWD	34,97	29	1,21	0,205	0,038	0,048	0,97	0,97	0,94
		FIML	33,83	29	1,16	0,285	0,03	0,049	0,96	0,97	0,94
		RI	37,68	29	1,3	0,129	0,039	0,052	0,94	0,96	0,93
		EMI	33,05	29	1,14	0,275	0,029	0,051	0,97	0,96	0,93

Table 5. GFIs for each percentage of missing (n=500)

Sample Size	MR	Method	X^2	df	X^2/df	p	RMSEA	SRMR	CFI	GFI	AGFI
500	1%	Original	27,67	35	0,79	0,807	0,000	0,026	1,00	0,99	0,98
		LWD	28,00	35	0,80	0,566	0,008	0,022	1,00	0,99	0,99
		FIML	26,95	35	0,77	0,350	0,009	0,022	1,00	0,99	0,99
		RI	26,77	35	0,76	0,320	0,010	0,022	1,00	0,99	0,99
		EMI	26,92	35	0,77	0,366	0,008	0,022	1,00	0,99	0,99
	5%	Original	27,67	32	0,86	0,807	0,000	0,026	1,00	0,99	0,98
		LWD	29,89	32	0,93	0,713	0,000	0,028	1,00	0,99	0,98
		FIML	26,89	32	0,84	0,835	0,000	0,026	1,00	0,99	0,98
		RI	31,39	32	0,98	0,643	0,000	0,029	1,00	0,99	0,98
		EMI	26,89	32	0,84	0,835	0,000	0,026	1,00	0,99	0,98
	10%	Original	27,67	32	0,86	0,807	0,000	0,026	1,00	0,99	0,98
		LWD	31,43	32	0,98	0,641	0,000	0,029	1,00	0,99	0,98
		FIML	28,82	32	0,90	0,759	0,000	0,027	1,00	0,99	0,98
		RI	39,94	32	1,25	0,259	0,017	0,032	0,99	0,98	0,98
		EMI	28,88	32	0,90	0,758	0,000	0,027	1,00	0,99	0,98
	20%	Original	27,67	32	0,86	0,807	0,000	0,026	1,00	0,99	0,98
		LWD	26,49	32	0,83	0,849	0,000	0,029	1,00	0,99	0,98
		FIML	28,69	32	0,89	0,821	0,000	0,027	1,00	0,99	0,98
		RI	37,20	32	1,16	0,367	0,011	0,031	0,99	0,99	0,98
		EMI	28,93	32	0,90	0,755	0,000	0,027	1,00	0,99	0,98

Table 6. GFIs' for each percentage of missing (n=1000)

Sample Size	MR	Method	X^2	df	X^2/df	p	RMSEA	SRMR	CFI	GFI	AGFI
1000	1%	Original	37,59	35	1,07	0,351	0,009	0,020	1,00	0,99	0,99
		LWD	35,18	35	1,05	0,453	0,008	0,020	1,00	0,99	0,99
		FIML	32,18	35	0,92	0,604	0,000	0,020	1,00	0,99	0,99
		RI	51,08	35	1,46	0,038	0,021	0,030	0,99	0,99	0,98
		EMI	32,42	35	0,92	0,502	0,007	0,020	1,00	0,99	0,99
	5%	Original	37,59	35	1,07	0,351	0,009	0,020	1,00	0,99	0,99
		LWD	41,80	35	1,19	0,199	0,014	0,020	0,99	0,99	0,99
		FIML	37,20	35	1,06	0,368	0,008	0,020	0,99	1,00	1,00
		RI	43,79	35	1,25	0,146	0,016	0,020	0,99	0,99	0,99
		EMI	38,15	35	1,09	0,380	0,008	0,020	1,00	0,99	0,99
	10%	Original	37,59	35	1,07	0,351	0,009	0,020	1,00	0,99	0,99
		LWD	40,32	35	1,15	0,246	0,013	0,020	1,00	0,99	0,99
		FIML	38,94	35	1,11	0,296	0,011	0,020	1,00	0,99	0,99
		RI	50,68	35	1,45	0,042	0,021	0,030	1,00	0,99	0,98
		EMI	42,83	35	1,22	0,170	0,015	0,020	0,99	0,99	0,99
	20%	Original	37,59	35	1,07	0,351	0,009	0,020	1,00	0,99	0,99
		LWD	55,08	35	1,57	0,048	0,022	0,030	0,99	0,99	0,98
		FIML	35,18	35	1,05	0,304	0,000	0,020	1,00	0,99	0,99
		RI	33,26	35	0,95	0,553	0,000	0,020	1,00	0,99	0,99
		EMI	34,42	35	0,98	0,502	0,007	0,020	1,00	0,99	0,99

samples though not fully efficient (Tannenbaum, 2009).

The American psychological association (APA) task force on statistical inference (1999) was against the application of "traditional" methods, like listwise and pairwise

deletion. These methods were among the the worst methods available for practical applications. Highly recommended and preferred missing data handling methods are EM imputation and multiple imputation (Schafer and Graham, 2002). With the frame of the literature and the results of this study, some recommendations can be made;

1. During the data collection, researchers should be careful to minimize missing values.
2. Every researcher should examine the patterns of missing values.
3. Reasons for and the amount of missing data in research should be reported as well as how to handle missingness.
4. FIML imputation method shows visible performance and gives the closest fit indices to original fit indices. For this reason, FIML imputation method can be preferred in CFA.
5. Missing cases can be extracted from the data set if missing data percentage is 1% or less.
6. This study can be replicated under larger sample sizes and proportions of missing data.
7. The effects of other missing data handling methods, like multiple imputation and full information maximum likelihood on goodness of fit indices in CFA should be examined.

There are some limitations of this study. First of all, this study was comducted with simulated data and missing data pattern was assumed as MCAR. Other missing data patterns MAR and NMAR should be investigated.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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Developing interest in art scale and determining the relation between personality type of teacher candidates and their interest in art

Taşkesen, Orhan

Erzincan University, Faculty of Education, Department of Fine Arts Education, Erzincan/ Turkey.

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The goal of this study is to develop a scale that measures individuals' interest in art and to test if there is a relation between this scale and personality types. For this aim, in the first stage of the study, a scale that can measure university students' interest in art is developed. Draft scale, which is made of 25 items, is conducted on 171 university students (98 female, 73 male) in 2013 to 2014 academic year. The scale is made of 2 sub-scales (Emotion-Perception and Behaviour) and there are 10 items in each sub-scale. At the end of the reliability analysis of the scale, Cronbach alpha coefficient is found to be .84. After the factor analysis of the interest in art scale which is made of 20 items, a structure made of 2 factors, whose eigenvalue is over 4.00 and explains 41% of the total variance, occurred. At the end of the confirmatory factor analysis, which is made for confirming this structure, fit index values are determined to be RMSEA= .052, GFI= .90, CFI= .90, AGFI= .89, NFI= .89, NNFI= .90 and SRMR= .048. In the second stage of the study, data obtained by the scale developed by Bacanlı, İlhan and Aslan is used. In order to determine the relation between university students' personality types and their interest in art, the prediction levels of responsibility, amiableness, being open to experience, extroversion, emotional instability and neuroticism are researched. It is found that, the variables of extroversion and being open to experience are significant predictors of interest in art.

Key words: Interest in art, personality, extroversion.

INTRODUCTION

Today's human being spare more time for cultural and artistic activities. The increasing interest, necessity and desire for awareness about cultural and artistic events can be interpreted as the attempt to escape from the stress of daily life and the state of consciously or unconsciously taking shelter in art. In fact, the topic of 'healthy and balanced education is only possible with increasing interest in different disciplines' was discussed long time ago. For instance, in the report of the Ministry of National Education, Higher Advisory Committee (MEBİ 1991), it is mentioned that; modern individual who has the goal of having healthy, balanced and satisfied life needs stimulating and using the abilities and potentials, It is stated that, "Science, technique and art", which are the products of this effort, refer to the three basic activities of human being. According to the report, these spheres of

E-mail: orhantaskesen@erzincan.edu.tr. Tel: +90 446 224 00 89

activities are the places for creation and development which are the bases of biologic social and cultural structures. It is the duty of our educational institutes to meet the increasing education demand in different fields of biology, technique and art. Mercin (2006) states that although general education has an important place in preparing individuals for future, formal education is the most significant and efficient institution, especially with its obligation of being planned. Although the place of our formal education institutes in this process is indisputable, in order to lighten the burden of these significant institutions, it is necessary to have space and place for individuals to reinforce and practice what they learn in daily life and to enable them realize their interest and desires. In this context, art education is the most important instrument which will make significant contributions to other disciplines. As mentioned before, education through art, which is the discipline in which creativity is ensured the best, has such a wide field of application and efficiency that, it cannot be reduced to schools as education institutions. "When art education is taken into consideration from this perspective, it can be said that, this education shouldn't be limited to talented students, everybody should take art education; as art education helps spiritual satisfaction of individual besides revealing creativity, and in that sense, it is an inseparable part of general education" (Mercin and Alakuş, 2007:19). Özsoy (2003) emphasizes that art education will continue to be one of the most important education field from preschool until university level, with its feature of being a part of formal training, an assistance in recreation and as a hobby, which can continue for life time. "Life long art education shouldn't be limited to formal education; it should be supported with museums, books, periodicals and every kind of audiovisual communication tools." (Alakuş, 2002: 154).

Besides creative, educational and ability-developing features of education through art, there are some researches stating that it is effective in personality development. "It is known that, feelings that are aroused by art in us have positive effect on emotions, conscious and perception level and they enable healthy personality development besides developing effective interpersonal relations" (Erel, 2012). Ersoy (2002:38, 42) emphasizes this feature of art education and states that when an individual who has an aesthetical attitude, reads novel, listens to music, watches a movie or theatre and looks at a painting, completely focuses on what he/she does, thinks of nothing else at that moment and only feels the existence of that work of art; the one that is interested in art can be more intelligent, tactful and richer in terms of spirituality. Hick (2004) emphasizes this feature of art by saying that "Art is a dynamic process in which an individual can express oneself in different styles about what happens around him in the society he lives".

In the literature of psychology, art and personality discussions occur in different forms such as researching the thing that forms artistic personality, determining if there is a relation between artistic personality and mental illness, the effect of an artist's personality on his style, similarities between art and personality. Although many art-lovers feel being transformed as a result of an interaction with art, this change is rare, unique, unpredictable and difficult to measure. The interest in art and the potential transformers of its consumers still continues today (Djikic et al., 2009: 24). The structure of art, whose effect on individuals is difficult to measure, has pushed many researchers towards researching this issue.

Most of the art and personality researches have been taken into consideration abroad, but there are few researches about the issue in Turkey. The definition of personality is "Personality is a concept that includes a person's interest, attitude, abilities, physical appearance and his adaptation to environment" (Per and Beyoğlu, 2011:247). In their studies, Bacanlı et al. (2009: 262) stated that, studies about personality can be collected as five factors which are confirmed by many international studies. These are extroversion, emotional stability/ neuroticism, amiableness, responsibility and being open to experience/culture. Studies that question the relation between art and personality types generally focus on personality and creativity (Rump, 1982, Perinne and Brodersen, 2005), personality and art performance or preferences (Chamorro-Premuzic et al., 2009, Giannini et al., 2013, Dreger and Moffett, 1975, Furnham and Bunyam, 1988, Rosenbluh, at al., 1972, McManus, and Furnham, 2006). For instance in the research of Zonash and Naqvi(2011), which is directly related with this issue, they attempted to explain learning styles and personality traits among mathematics, architecture and fine arts students. In their study titled "Extroversion Personality Traits and Awareness of Works of Art", Alkan et al. (2007:317) sought for an answer to the question "Is there a relation between extroversion personality trait of students and awareness of the works of art?" and they found that art awareness and extroversion can affect art awareness. Per and Beyoğlu (2010) made a research on the personality traits of students in fine arts, verbal and numerical departments, and found that there are similarities among the students in verbal and numerical departments while there are significant differences between students in fine arts department and students in other departments. Furham and Chamorro-Premuzic (2003: 705) made a study titled "Personality, intelligence and art" and tested the relations between participants' personality, intelligence, art experience (interest in art, activities and knowledge) and attitude towards art. On the other hand, Furham and Bachtiar (2008: 613) carried out a study titled "Personality and intelligence as predictors of creativity"; they conducted the Big Five NEO-FFI (Costa and McCrae, 1992) as a personality measure, the Wonderlic Personnel Test (Wonderlic, 1992) as an intelligence measure, and four measures of creativity. Furnham and Crump, in their study (2013), discovered

that art students out scored science students in coziness, sensibility, openness to change, awareness and GMA scores (verbal). In the light of the findings above, it can be said that, art students are more emotional and they are more open to different experiences. Also, this study shows that art students use their intelligence more effectively and they have a better perception of abstract concepts. Studies regarding creativity and personality traits (personally being artistic, analytical, social, realistic and entrepreneur) examined the relationship between different types of personality and arts and found a positive association between creativity and openness to experiences (Kaufman et al., 2013, King et al.., 1996).

When the researches in the literature are analyzed in details, it can be seen that these researches generally focus on comparing individuals who take art education and students in other departments. On the other hand, as most of the researches on personality and art interest are made in America and Europe, it is obvious that there is a necessity of doing such researches in Turkey. So, the goal of this research is to develop an art interest scale for determining individuals who study in different fields but have art interest, and to compare personality traits according to individuals' art interest. For this aim, the answers to the below mentioned questions are searched:

1- Is it possible to develop a valid and reliable scale that measures the Interest in Art in Turkish culture?
2- How much do the personality traits such as extroversion, emotional stability/neuroticism, amiableness, responsibility and being open to experience, predict interest in art on the basis of five factor personality theory?

METHOD

This study is a general survey study, aiming at developing a scale and practicing it. Survey studies are a research approach whose goal is to describe a past or present situation, event, individual, society or object within its conditions and as the way it is (Karasar, 2002). For this purpose, in the 1st stage of this study, a scale that can measure students' interest in art was developed. In the 2nd stage of the study data obtained by the scale that was developed by Bacanlı et al (2009) was used and the prediction level of university students' personality types on art interest was researched.

Study group

The sample group of the research is made of a total of 171 university students; these students are 98 female (57%), 73 male students (43%) studying at the department of Painting Teaching (n=29), Psychological Counseling and Guidance (n=24), Mathematics teaching (n=33), department of Physical Education teaching (n=38), Music Education teaching (n=23) and department of Turkish teaching (n=24) in Education Faculty, Erzincan University.

Developing of Interest in Art Scale

Preparing of Scale Items

During the process of developing the scale, literature review was done in terms of periodicals, books and similar scales and based on this review, items about the necessity of taking art education were written down and an item pool was created. On the other hand, two (2) lecturers from Erzincan University, Education Faculty, Department of Psychological Counseling and Guidance made contributions to forming the item pool. There were 34 items in the first item pool. As a result of the first evaluation, including processes such as removing similar items in order to ensure content validity, reviewing statements, items were decreased to 24. In order to test the understandability of this 24 items form, it was conducted on 50 students in Erzincan University, Education Faculty. During application, feedbacks about the items that were determined to be difficult to understand were noted, necessary changes were done and the scale was finalized.

For content validity based on expert opinion, the prepared 24 items scale form was presented to 4 lecturers in Erzincan University, Education Faculty, Department of Educational Sciences. After experts made an analysis on the issue, they evaluated the understand ability of each item and items' corresponding to the need of taking art education. In addition to these, experts were required to give information about the items that should be removed from the scale, and items that should be added. In accordance with the suggestions of experts, some small changes were done and necessary arrangements were carried out. According to the expert views, after making necessary reorganizations, this new form of the scale was used for validity and reliability studies. Cronbach alpha coefficient was calculated for determining internal consistency of the scale made of 24 items, and this calculation is presented in Table 1.

When Table 1 is analyzed, it can be seen that the scale's corrected item-total correlation of 10th and 17th items is very low and in these items' section of "Cronbach Alpha coefficient if the item is removed", Cronbach alpha coefficient value increases. Based on this finding, these two items were removed from the scale; cronbach Alpha value was calculated again and presented in Table 2.

When Table 2 is analyzed, it can be seen that Interest in Art scale's 23rd item corrected Item-Total correlation was very low, so in these item section of "Cronbach Alpha coefficient if the item is deleted", Cronbach alpha coefficient value increases. Based on this finding, these item were deleted from the scale and scale's cronbach Alpha value was analyzed again. The result is presented in Table 3.

When Table 3 is analyzed, it can be seen that a total of 3 items were removed from the scale during reliability studies. At the end of this, it was determined that corrected Item-Total score correlation of the other items in the scale were as expected. In reliability studies of the scale, it was found that cronbach alpha coefficient was .87. At the end of these studies, items whose representation ability were low, were removed from the scale and validity studies of the scale form including 21 items, were carried out.

Validity studies of interest in art scale

Structural validity was used in the validity studies of Interest in Art Scale. For structural validity, in order to determine scale's factor structure and sub-scales, explanatory and confirmatory factor analyses were carried out.

Structural Validity of Interest in Art Scale

Explanatory factor analysis was made in order to analyze the factor structure of Interest in Art scale. Principal components technique and varimax rotation were used and factor number were analyzed; it was seen that items were grouped in 2 factors. The rotation was used in order to ensure independence, to be meaningful and clear

Table 1. Cronbach alpha coefficient of Interest in Art Scale.

Item No	Scale mean if the item is deleted	Scale variance if item is deleted	Corrected Item-Total correlation	Scale's Cronbach alpha coefficient if item is deleted
Art1	77,8063	201,163	,738	,848
Art2	77,5563	221,745	,349	,862
Art3	77,7000	219,633	,342	,862
Art4	78,1813	215,294	,405	,860
Art5	77,4813	217,547	,369	,861
Art6	78,4750	212,716	,471	,858
Art7	77,8625	211,629	,496	,857
Art8	77,2563	212,733	,500	,857
Art9	77,9000	216,644	,355	,862
Art10	**79,1438**	**230,526**	**,045**	**,871**
Art11	78,7250	218,553	,389	,861
Art12	77,1813	222,225	,297	,863
Art13	78,2625	207,239	,609	,853
Art14	77,5563	215,053	,471	,858
Art15	77,5625	216,160	,437	,859
Art16	77,2813	208,505	,651	,852
Art17	77,7875	231,665	,003	,873
Art18	77,3688	211,391	,576	,855
Art19	77,5625	214,160	,452	,859
Art20	77,4125	208,068	,671	,852
Art21	77,3563	220,218	,351	,862
Art22	77,6000	215,814	,457	,859
Art23	77,8188	223,156	,221	,866
Art24	77,7563	210,035	,589	,854

Table 2. Alpha coefficient of Interest in art scale (2nd application).

Item No	Scale mean if the item is deleted	Scale variance if item is deleted	Corrected Item-Total correlation	Scale's Cronbach alpha coefficient if item is deleted
Art2	71,5688	207,039	,349	,867
Art3	71,7125	205,640	,324	,868
Art4	72,1938	200,761	,407	,865
Art5	71,4938	203,119	,365	,866
Art6	72,4875	198,264	,472	,863
Art7	71,8750	196,940	,505	,862
Art8	71,2688	198,072	,508	,862
Art9	71,9125	201,992	,358	,867
Art11	72,7375	204,472	,373	,866
Art12	71,8000	216,664	,316	,879
Art13	72,2750	193,496	,596	,858
Art14	71,5688	200,360	,478	,863
Art15	71,5750	201,856	,431	,864
Art16	71,2938	194,008	,659	,857
Art18	71,3813	196,942	,580	,860
Art19	71,5750	199,655	,454	,864
Art20	71,4250	193,944	,668	,857
Art21	71,3688	205,329	,359	,866
Art22	71,6125	200,830	,472	,863
Art23	**71,8313**	**209,286**	**,198**	**,872**
Art24	71,7688	195,374	,600	,859

Table 3. Cronbach Alpha coefficient of Interest in Art Scale (3rd application).

Item No	Scale mean if the item is deleted	Scale variance if item is deleted	Corrected Item-Total correlation	Scale's Cronbach alpha coefficient if item is deleted
Art1	65,1801	175,361	,771	,866
Art2	64,9441	196,528	,327	,881
Art3	65,0745	194,269	,330	,881
Art4	65,5528	188,386	,442	,878
Art5	64,8571	191,511	,380	,880
Art6	65,8447	187,232	,471	,877
Art7	65,2484	185,625	,518	,876
Art8	64,6398	186,869	,518	,876
Art9	65,2733	190,950	,356	,881
Art10	66,1056	193,283	,377	,880
Art11	71,8000	216,664	,316	,879
Art12	65,6398	182,857	,592	,873
Art13	64,9317	189,264	,480	,877
Art14	64,9379	190,259	,448	,878
Art15	64,6646	182,837	,672	,871
Art16	64,7453	185,903	,584	,874
Art17	64,9565	189,429	,431	,879
Art18	64,7950	183,064	,673	,871
Art19	64,7391	194,557	,349	,881
Art20	65,0000	190,287	,452	,878
Art21	65,1366	184,706	,596	,873

Table 4. Variance Explanation ratios of the Items and Factors in the Interest in Art Scale.

Principal Components	Initial Eigenvalues			Extraction Sums of Squared Loadings			Extraction Sums of Squared Loadings after Varimax Rotation		
S/N	Total	% of the explained variance	Cumulative %	Total	% of the explained variance	Cumulative %	Total	% of the explained variance	Total
1	6,509	30,995	30,995	6,509	30,995	30,995	4,515	21,502	21,502
2	2,304	10,970	41,965	2,304	10,970	41,965	4,297	20,463	41,965

increase conceptual meaningfulness, factor structure, on which varimax rotation was conducted, was analyzed. Findings of the analysis are presented in Table 4.

As can be seen in Table 4, after the factor analysis on 21 items of Interest in Art Scale, a 2 factor structure was obtained, whose eigenvalue, which explains 41 of total variance was over 4.00. Another method that was used in order to determine factor number is ScreePlot test. After ScreePlot test, it was seen that, the sudden change in the graphic curve's slope, occurred in the 2nd factor.

This data supports the 2 factors structure of data. In Figure 1, the result of ScreePlot test is presented.in factor analysis, .40 or higher factor loads are acceptable (Kline, 2005). After Varimaxrotation method, distributions of items in 2 factors are presented in Table 5.

When Table 5 is analyzed, it can be seen that item 11 in 2nd factor was low and affected this factor negatively. In order to delete this effect, 11th item was deleted from the scale and factor analysis was repeated. Results are presented in Table 6.

When Table 6 is analyzed, it can be seen that after removing 11th item in 2nd factor, factor loads of the items in the scale became acceptable. Components which formed the 2 factors structure of Interest in Art Scale, including 20 items, were analyzed and these names were suggested for them: 1st Factor is made of ten items including 1, 3, 5, 6, 9, 11, 13, 14, 16 and 17. This factor can be called Emotion and Reasoning Dimension. The 2nd factor is made of 10 items including 2, 4, 7, 8, 10, 12, 15, 18, 19 and 20. This factor can be called Behavior Dimension.

Confirmatory factor analysis

After forming and creating the 2 factors structure including 20 items on theoretical basis, results of Explanatory Factor Analysis was taken into consideration and the model of the scale was tested with Confirmatory Factor Analysis. Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit Index (CFI), Normed Fit Index (NFI), Non-Normed Fit Index (NNFI), Root-Mean-Square Error of Approximation (RMSEA) and Standardized Root-Mean-Square Residual (S-RMR), obtained at the end of Confirmatory

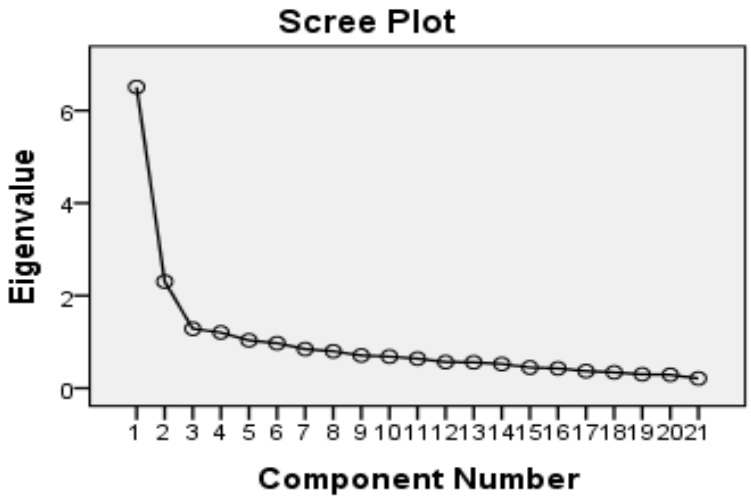

Figure 1. ScreePlot test result of Interest in Art Scale.

Table 5.Matrix of Factor loads after Varimax Rotation method.

Item no	Factor load	Factor load
art1	,821	-,195
art 18	,736	-,090
art 15	,735	-,218
art 12	,661	-,014
art 21	,656	,138
art 16	,654	,228
art 8	,590	,059
art 7	,576	,518
art 13	,542	,196
art14	,533	-,405
art 6	,527	-,069
art4	,520	,128
art20	,502	,430
art17	,498	-,289
art5	,442	-,418
art10	,429	,126
art3	,393	-,364
art19	,403	,628
art2	,385	,514
art9	,434	500
art11	,244	-,280

Factor Analysis, were analyzed and it was determined that Chi-Square value was at an acceptable level (χ^2 =570.29, N=171, sd= 168, χ^2 / Sd ratio=3.39, p=0.00). It was found that Fit Index values were RMSEA= .052, GFI= .90, CFI= .90, AGFI= .89, NFI= .89, NNFI= .90 and SRMR= .048. In fit indexes, for GFI, CFI, AGFI, NFI, NNFI: > .90 was taken as the criterion while for RMSEA and S-RMR: < .05 was taken as the criterion (Hu and Bentler, 1999; Sümer, 2000). Based on these fit indexes, it was found that, there was coherence between the model and observed data and the suggested model is reasonably coherent. Path diagram and factor loads of the model are presented in Figure 2. On the other hand, relations between sub scales of Interest in Art Scale and the relations between sub scales and total scores were analyzed by calculating the Paerson Product Moment Correlation Coefficient and results are presented in Table 7.

When Table 6 is analyzed, it can be seen that there is a positive correlation between .56 and .90 between sub scales of the Interest in Art Scale and sub scales and total score.

According to the Confirmatory Factor Analysis result in Figure 2, item factor loads varied between .38 and .79. On the other hand, it was seen that, Error Variance values of the items was between .38 and .86. At the end of CFA (confirmatory factor analysis), the scale with 2 dimensions and 20 items, was shaped. Based on these data, we can say that all of the items in the model are coherent with the model.

Interest in art scale item analysis

In order to test the item discrimination of Interest in Art Scale, 27% sub-super group comparison was made. It was seen that, t values about the differences between the scores of items in 27% subgroup and super group ranged between 3.96 (p<.01) and 18.33 (p<.01). These findings are presented in Table 8.

When Table 8 is analyzed, it can be seen that t values of every item in Interest in Art scale and total scores was found to be meaningful at p< .01 significance level. These findings show that items and subscales of Interest in Art Scale discriminates the ones whose attitude about Art Interest is high and the ones whose attitude is low.

When Table 9 is analyzed, it can be seen that, internal consistency and test-retest reliability coefficients of total score and subscale scores are meaningful and high. It can also be seen that, the lowest coefficient in internal consistency is .81 while the lowest correlation in test-retest is .65. These findings can be interpreted as an indicator of reliability.

Evaluation of interest in art scale scores

The scale is a likert type scale including 20 items that are developed in order to evaluate individuals' interest in art. Individuals

Table 6. Matrix of Factor loads after Varimax Rotation Method (II. Application).

Item No	1 Factor load	2 Factor load
1-Whenever I see a poster related art I check it out	,740	,411
14- I think that art is necessary for individual development.	,710	,331
9- I don't like reading book promotions of newspaper supplements.	,666	,058
13- I don't like following artistic events on internet. (R)	,646	,086
5- I am not interested in painting exhibitions (R)	,612	,000
17- I have positive thoughts about artistic activities.	,594	,447
16- I don't like buying music albums (R)	,567	,114
3- I don't like talking about art with my friends (R)	,512	,021
11- I believe that I should spare some money for artistic activities.	,480	,435
6- I read information about the musician inside music albums.	,468	,287
7- I take the informing about instruments in concerts into consideration.	,062	,762
18- I take the informing about music in concerts into consideration.	,138	,739
2- I read culture and art pages of newspapers.	,094	,660
19- I like making researches about artists and their works on internet.	,086	,653
15- I watch carefully when there is news on TV about art.	,303	,627
20- I go to exhibitions with a friend who can have knowledge and experience.	,386	,541
12- When I see a beautiful photograph, I want to obtain information about it.	,253	,528
8- I think that individuals who deal with art are more creative.	,391	,448
4- I am interested in a branch of art unprofessionally.	,282	,445
10- We talk and make discussions about art events in my family.	,227	,382

Table 7. Correlation among Sub Scales (N=171).

		art	Emotion-Reasoning
Art	Pearson Correlation		
	Sig. (2-tailed)		
	N	171	
Emotion-Reasoning	Pearson Correlation	,903**	
	Sig. (2-tailed)	0	
	N	171	171
Behavior	Pearson Correlation	,861**	,567**
	Sig. (2-tailed)	0	0
	N	171	171

** p< .01

are required to show how much each item in the scale fits them by scoring the scale between 1 and 5. Answers to the items are ranked as: 5= I Definitely Agree, 4= I agree, 3=I am indecisive, 2= I don't agree and 1= I definitely don't agree. The scale is made of 2 subscales and there are 10 items in each subscale. 5 items in the scale are reverse scored. The lowest score is 20 while the highest score is 100 in the scale. Getting low point from the scale means that the individual has no interest in art; getting high point means that the individual is interested in art. The scale can be conducted both on groups and individuals; standard answering time of the scale is 30 minutes.

FINDINGS

In the second stage of the study, the answer to the question of "How much do the personality traits such as Extroversion, Emotional stability/Neuroticism, Amiableness, Responsibility and Being open to Experience, predict interest in art, on the basis of five factor personality theory?" was searched. In this context, regression analysis of the data obtained from the study group was carried out. Analysis results are presented below. ANOVA test results of the regression model about the question of Extroversion, Emotional stability/ Neuroticism, Amiableness, responsibility and being open to experience, predict an individual's interest in art, are presented in Table 10.

Results of the ANOVA test, which tested the meaningfulness of the regression model established on the prediction power of responsibility, amiableness, being

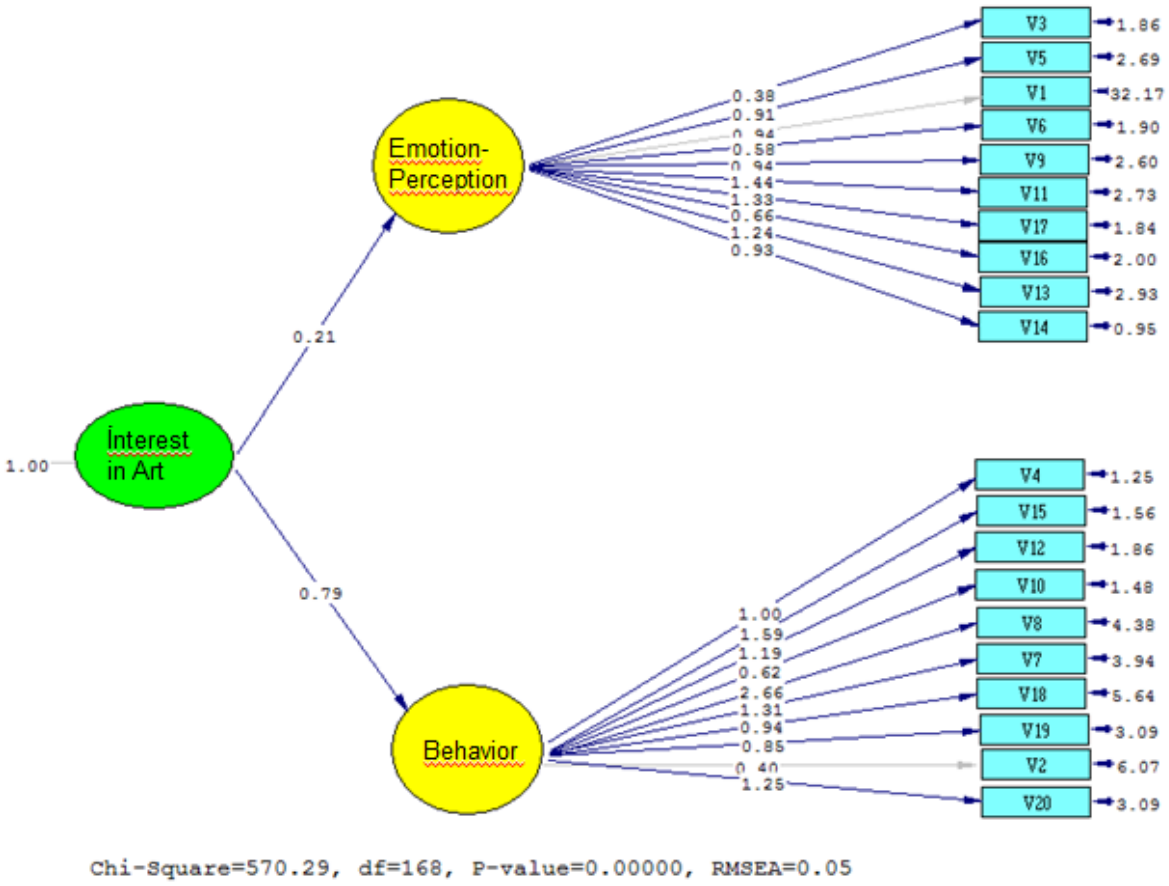

Figure 2. Path diagram and Factor loads of Interest in Art Scale.

Table 8. T values of the differences between the scores of items in 27% subgroup and super groups, determined according to the total scores of Interest in Art Scale.

Factor	Item No	t	Factor	Item No	t
Emotion and Reasoning	1	18,33	Behavior	2	3,96
	3	5,38		4	6,99
	5	5,77		7	9,73
	6	7,05		8	8,80
	9	6,23		10	5,40
	11	8,91		12	6,89
	13	6,89		15	9,68
	14	12,18		18	5,13
	16	6,09		19	6,02
	17	11,44		20	9,62

open to experience, extroversion, emotional instability/ neuroticism, which are the subscales of personality scale based on the attributions developed according to five factor personality theory, are presented in Table 10. According to the test results, it can be said that, the model is generally meaningful ($F_{5\text{-}171}$: 10,962; $p < .001$). Regression equality (mathematical model) about the prediction of Interest in Art according to regression analysis, is presented below.

Art Interest= 38.441 + Being open to Experience.197 + Extroversion .229

When Table 11 is analyzed, it can be seen that being open to experience and extroversion have significant

Table 9. Internal Consistency and Test-Retest Reliability Coefficient of Interest in Art Scale (N: 50).

Interest in Art Scale	Internal Consistency N=171	Test-Retest Test N=171
Total Scale Score	.84**	.70*
Emotion Reasoning (ER)	.82**	.68*
Behavior	.81**	.65*

**p< .01

Table 10. One Way ANOVA Test Results of the Regression model about Art Interest and Personality Type.

	Sum of squares	df	Total square	F
Regression	8596,301007	5	1719,260	10,962*
Residual	23054,757816	166	156,835	
Total	31651,058824	171		

*p< .001

Table 11. Regression Analysis results about the Personality Types of Individuals who have high Interest in Art.

Independent Variables	B	Standard Error	β	t	p
Constant	38,441	7,726		4,976	,000*
Responsibility	-,068	,071	-,079	-,958	,34
Amiableness	,156	,092	,151	1,693	,093
Being open to Experience	,197	,098	,194	2	,047*
Extroversion	,229	,076	,279	3,013	,003*
E. Neuroticism	-,097	,055	-,128	-1,763	,80
R = .521 R^2= .272					
F (3,16) = .962 p=.05					

*p< .001

relation with individuals' interest in Art (R= .52, R^2= .27, p<.001). Being open to experience and extroversion together explain 27% of total variance of interest in Art Scale. Relative significance order of predictive variables in Art Interest, according to the standardized regression co-efficient (β) is Extroversion and Being open to Experience. When t test results about the meaning-fulness of regression coefficients are analyzed, it can be seen that, variables of extroversion and being open to experience are meaningful predictors of Art Interest.

DISCUSSION

The research is made of two sections. The first section is developing of Interest in Art Scale.The second section is evaluating the prediction power of the scores of responsibility, amiableness, being open to experience, extroversion and emotional instability and neuroticism, which are the subscales of personality scale based on the attributions developed according to five factor per-sonality theory.

It was seen that, ANOVA test, which tested the meaningfulness of the regression model established on the prediction power of responsibility, amiableness, being open to experience, extroversion, emotional instability/ neuroticism, which are the subscales of personality scale based on the attributions developed according to five factor personality theory, was meaningful. According to the regression analysis, it was determined that the variables of Extroversion and Being open to Experience significantly predicted Art Interest. Furham and Chamorro-Premuzic (2003: 705) made a study titled "Personality, intelligence and art" and they tested the relations between personality, intelligence, art experience (interest in art, activities and knowledge) and attitudes towards art. In the

research, it was found that the relation between being open to experience and art experience was meaningful while the relation between being open to experience and attitude towards art was not meaningful. It is known that having different experiences and being open to these experiences develop an individual's creative side (Feist, 1998). In this context, if we say that art is the expression of an individual's creative tendencies, the study by Furham et al. (2003) shows that individuals' being open to experience is a personality trait that is necessary for showing, expressing artistic side. It is known that there is a positive relation between expressing oneself and having extroversion personality trait (Allida and Vyhmeister, 2004). So, an individual's expressing oneself correctly, clearly and straightly is connected with being extrovert. In the study by Furham and Bachtiar (2008: 613), it was found that extroversion was the predictor of creativity, but intelligence didn't predict the scores of creativity. This finding obtained by Furham and Bachtiar is in parallel with our research. Creativity's relation with extroversion means that there is an indirect relation between creativity and art. The finding about intelligence is also in parallel with the present literature. Based on the study of Furham and Bachtiar (2008), it can be said that creativity has features independent from intelligence and it varies according to the personality traits of individuals. Other researches about the issue show that there is a relation between personality traits and thoughts, emotions and behaviors about art (Kaufman et al., 2013, Zonash and Naqvi, 2011, Alkan et al., 2007). Another significant study that shows the effect of art on personality traits was made by Djikic et al. who conducted a research on 166 university students. In this study, Djikic et al. used the story of "The Lady with the Dog" by Anton Chekhov. They formed two groups of participants as experiment and control; members of the experiment group read the story. After that, tests that evaluated personality structures and the intensity of emotions, that had been conducted at the beginning of the process were conducted again. At the end of the tests, it was determined that, compared to the Control, the group that had read the artistic and fictional story (the story by Chekhov) had more changes in basic personality traits (extroversion, emotional balance, being open to new ideas, responsibility and adaptability features). On the other hand, it was seen that people who had read Chekhov's story, went through more emotional changes. These results show that art affect personality in terms of the features of extroversion and being open to new experiences. These personality traits of individuals are the ones that support social harmony and development. In this context, it can be said that, giving place to activities that develop individuals' artistic sides in order to ensure that individuals are more creative and outgoing, will make positive and significant contributions to one's life completely in a positive way. This study attempted to reveal the relationships between arts and personality by analyzing the quantitative data obtained from interval scales. However it's not merely possible to reduce the personality of an individual into a context related to data obtained that way. Therefore, it is thought that further studies with mixed model design, with the help of interval scales and semi-structured interview forms developed for this study can and will be very beneficial in gaining a clearer and deeper understanding of the subject in Turkey as a country which has a communitarian culture.

Results and suggestions

Interest in art scale, which was developed for this study, can be considered as a valid and reliable tool in measuring individuals' levels of interest in arts within the context of their thoughts and behaviors. Also, in the second part of the study, a relationship between individuals' levels of interest in art and their types of personality in the context of big five factors of personality. Openness to experience and extroversion are the predictors of level of interest in art. From this aspect, the scale developed can be considered as a useful tool in detecting the individuals who were interested in art. At the same time it is possible to form an opinion about type of relationship between individuals and art by evaluating their personality traits. Screening methods can be used to select students for high schools of fine arts and departments of fine arts in universities by considering these traits. Thus, it will be easier to direct individuals with undiscovered potentials towards this field more effectively.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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Full Length Research Paper

Analyzing the classroom teachers' levels of creating a constructivist learning environments in terms of various variables: A Mersin case

Lütfi Üredi

Mersin University Educational Faculty, 33169 Mersin, Turkey.

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In this research, it was aimed to analyze the classroom teachers' level of creating a constructivist learning environment in terms of various variables. For that purpose, relational screening model was used in the research. Classroom teachers' level of creating a constructivist learning environment was determined using the "constructivist learning environment inventory" developed by Tenenbaum et al., (2001), and adapted into Turkish by Fer and Cırık (2006); "teachers' variables information form" was used in order to determine demographical features of classroom teachers. Cronbach alpha internal consistency coefficients related to dimensions of constructivist learning environment inventory varied between .89 and .94. The measurement instruments were performed to total 504 classroom teachers carrying on their duties in 32 elementary education schools affiliated to Mersin province Akdeniz, Yenişehir, Toroslar and Mezitli central districts. The research results revealed that there was a significant difference at p<.01 level of significance between classroom teachers' ages, professional seniority and their level of creating a constructivist learning environment. No significant difference was found between classroom teachers' gender and their level of creating a constructivist learning environment. Moreover, the research also proved that the teachers with high professional seniority perceived the learning environment as more constructivist rather than the teachers with lower seniority.

Key words: Classroom teacher, constructivism, various variables, learning environment.

INTRODUCTION

In rapidly changing world, transition from industrial society to information society has gained speed through the developing technology. With this point of view, the educational system has also renovated itself, and made reforms related to meeting the needs of new human model. Turkey adapted a curriculum based upon the constructivist approach through a radical change actualized in programs at elementary education level in 2005 to 2006 academic year. Constructivism is an epistemology, and theory of learning and making meaning (Applebee,

E-mail: lutfiuredi@gmail.com Tel: +90 324 341 28 15/1729.

1993; Richardson, 1997; Abdal Haqq, 1998; Sewell, 2002). According to this theory which explained the nature of knowledge and how people learn, people create new meanings through the interactions formed among the ideas, events and activities they have encountered or experiences before. The knowledge is acquired through participation rather than repetition or memorizing. The learning activities in this approach are organized depending the activities such as active participation, analyzing, problem solving and cooperation with others (Abdal Haqq, 1998). Hackmann (2004) defined the constructivism as a process in which the learners create their own reality, or interpret the meaning depending upon their own experiences and perceptions, and accordingly a process when the individuals use their knowledge to interpret their previous experiences, mental structure, and the meaning of objects and events. For that reason, the constructivist approach purges the ideas on knowledge from only being some processes developing out of students, and puts the learner at the center of learning. The knowledge is a product structured by anyone as result of interactions though their surrounding (Bhatnagar, 1997). According to Snyder et al. (1992 Akt: Turgut, 2001), the knowledge in constructivism has "a created, discovered, and experienced structure." According to Applebee (1993), the knowledge in constructivism has a feature that cannot be defined absolutely, but structured through the social activities.

In a constructivist learning environment, teachers are the ones who establish a dialogue with learners and help them to constructs their own knowledge. According to this feature, teachers know the learners in terms of their various characteristics, and place within the center of learning. The teacher whose main role is to create an environment that will facilitate learning in terms of learners is an important factor of the constructivist approach. A constructivist teacher should direct the process of teaching-learning, should be a guide to students, prepare an efficient learning environment, and have a strong field knowledge (Alesandrini and Larson, 2002; Brooks and Brooks, 1993; Güneş and Asan, 2000; Jadallah, 2000; Şimşek, 2004; Tobin, 1993). Because the student is in the center of learning in a constructivist learning environment, interest and needs of a student is the first degree determinative of the factors within the environment. The learning activities in this approach are organized on the basis of activities such as the active participation of student, analyzing, problem solving and cooperation with others. According to this approach, learning is the process of creating an understanding related to the world. In learning environment, the knowledge is produced through the social interactions and specific to individual (Fox, 2001). This viewpoint related to knowledge and learning necessitates a democratic classroom appearance. Besides democratic process in a classroom environment provides learners the opportunity of being active and free, it also provides teachers to have the chance of being more productive.

The features such as presenting the multi-dimensional explanations of reality, providing the formation of information, emphasizing that the duties should be in a meaningful sense, supporting the ideational reflection upon expressions, supporting the formation of information through content and context, and forming information in cooperation through social interactions are the leading to create a constructivist learning environment (Tezci and Gürol, 2001). Beside these features, the studies that have been carried out also reveal the characteristics of a constructivist learning environment. Hand et al. (1997) investigated creating a classroom environment based upon the constructivist approach, and how learners perceived the features of a classroom environment prepared in accordance with the constructivist learning approach. As result of the study, it was determined that the learners had chance to use their ideas and knowledge freely, got aware of their changing role and responsibilities in a classroom, their self-confidence and desire for participating into the learning process increased. Tenenbaum et al. (2001) mentioned the basic features of a constructivist learning environment as arguments, discussions and debates, conceptual conflicts and dilemmas, sharing ideas with others, materials and resources targeted towards solutions, motivation toward reflections and concept investigation, meeting learners' needs, and making meaning, real life examples.

The researchers have emphasized that the factor determining the features of a constructivist learning environment is the interest and needs of students, and their individual characteristics. The researches that have been carried out related to the constructivist learning environment have revealed that the constructivist program has positive effects upon the academic success of learners (Lord, 1999; Maypole and Davies, 2001), their thinking skills (Tynjala, 1998), and problem solving skills (Wolff, 1994). Similarly, there have also been studies in our country related to the positive effects of the constructivist learning environment upon the academic success of students (Bukova-Güzel, 2007; Gültepe et al., 2008), their creativity (Tezci and Gürol, 2002), student and teacher views (Altun and Büyükduman, 2007; Tanrıseven and Üredi, 2009).

Starting to practice elementary education programs based upon the constructivist approach in 2005 to 2006 in Tukey has brought about many problems that should be overcome. The leading of these problems was teachers' level of presenting behaviors appropriate for the constructivist learning environment. In our country, overcoming the problems relevant to application of a curriculum based upon the constructivist approach necessitates researches that will be carried out upon

various variables related to teachers. From this point of view, we analyzed the classroom teachers' level of creating a constructivist learning environment in terms of various variables, in this study. In the research, it was aimed to determine the classroom teachers' level of creating a constructivist learning environment in terms of various variables (gender of teachers, ages and their professional seniority). In accordance with this purpose, answers to those sub-problems were sought:

1. What are the classroom teachers' levels of creating a constructivist learning environment?
2. Does classroom teachers' level of creating a constructivist learning environment differ according to their gender, ages and their professional seniority?

METHODOLOGY

Research model

The research was carried out in relational screening model, and it was a descriptive study. Classroom teachers' level of creating a constructivist learning environment was described; and moreover, teachers' level of creating a constructivist learning environment was analyzed in terms of various variables.

Population and sample

The research population included primary school teachers carrying on their duties in all official primary schools in central districts (Mezitli, Yenişehir, Akdeniz, and Toroslar) of Mersin province in 2012 to 2013 academic year. The research sample included 32 primary schools chosen randomly in schools that have different socio-economic levels (high, mid, low). And the sample included totally 504 primary school teachers including 277 female and 227 male teachers working in these schools. In the research, 22% of teachers included into the sample worked in schools located on a surrounding with high socio-economic level, 49.0% worked on a surrounding with mid socio-economic level, and 28.8% worked on a surrounding with a low socio-economic level. The personal data related to primary school teachers were analyzed, their frequency and percentage table was created and presented in Table 1.

Data Collection

In the research, "teachers' variables information form" developed by the researcher in order to collect information of various variables related to teachers included into the study group. In "teachers' variables information form," questions related to gender of teachers, ages and the period of their professional seniority were asked.

In the research, "constructivist learning environment questionnaire (CLEQ)" developed by Tenenbaum et al., (2001) and adapted into Turkish by Fer and Cırık (2006) was used to determine the primary school teachers' level of creating a constructivist learning environment. The evaluation instrument included 30 items and 7 sub-factors describing the appearance of a constructivist learning environment. These sub-factors were arguments, discussions, debates (5 items , α= .90), conceptual conflicts and dilemmas (3 items, α= .94), sharing ideas with others (4 items, α= .90), materials and resources targeted toward solutions (3 items α= .90), motivation towards reflections and concept investigation (6 items, α= .89), meeting learners' needs (5 items, α= .89), and making meaning, real life examples (4 items, α= .90). The scale was a 5-point Likert type evaluation instrument. The grades determined from one to five varied between "never" and "always." Cronbach Alpha internal consistency coefficients related to the dimensions of the evaluation instrument varied between .89 and .94.

Data Analysis

In the research, frequency (f) and percentage (%) distribution tables were created to describe the primary school teachers' level of forming a constructivist learning environment. Whether primary school teachers' level of creating a constructivist learning environment showed a significant difference or not according to the gender and type of school (the variables creating chaos) was determined using unrelated group t-test. Whether it showed a significant difference according to age, the grade they train, the professional seniority, and type ıf school graduated finally (the variables creating chaos) was determined using one way variance analysis (ANOVA). Turkey test was performed to determine among which variables (age and professional seniority) the difference of creating a constructivist learning environment exists. In whole statistical analysis, 0,05 level of significance was accepted as the criteria. The data obtained from the research was analyzed using the standing for statistical package for the social sciences (SPSS) Windows 17.0 statistical package program.

FINDINGS

In the first sub-problem of the research, classroom teachers' level of creating a constructivist learning environment was determined. Factor total scores obtained from the answers given by classroom teachers to the constructivist learning environment inventory were categorized as low, medium and high. The data obtained from the answers given by classroom teachers to "constructivist learning environment inventory" were analyzed; frequency and percentage table was created and the results were presented in Table 2. When Table 2 was analyzed, majority of primary school teachers in total (f=347, %68,8) were noticed to create the constructivist learning environment at medium level. Whereas 15.1% of primary school teachers created the constructivist learning environment at low level, 16.1% created at high level.

In the second sub-problem of the research, it was analyzed whether classroom teachers' level of creating a constructivist learning environment differed significantly according to gender. In order to find an answer to this sub-problem, and to determine whether level of creating a constructivist learning environment differed according to gender, unrelated group t-test analysis was performed. The t-test results related to whether teachers' level of creating a constructivist learning environment differed according to gender or not were presented in Table 3.

Table 1. Frequency and percentage distribution table related to the study group:

Variables	Participants	f	%
Gender	Female	277	55,0
	Male	227	45,0
Age	21-25 years old	5	1,0
	26-30 years old	61	12,1
	31-35 years old	84	16,7
	36-40 years old	84	16,7
	41-45 years old	126	25,0
	46 years old and over	144	28,6
Seniority	1-5 years	36	7,1
	6-10 years	76	15,1
	11-15 years	100	19,8
	16-20 years	82	16,3
	21-25 years	103	20,4
	26 years and over	107	21,2

Table 2. Frequency and Percentage Distribution Table related to primary school teachers' level of creating a constructivist learning environment.

Constructivist learning environment	Low		Medium		high	
	f	%	f	%	f	%
Arguments, discussions, debates	96	19,0	312	61,9	96	19,0
Conceptual conflicts and dilemmas	127	25,2	248	49,2	129	25,6
Sharing ideas with others	90	17,9	272	54,0	142	28,2
Materials and resources targeted toward solutions	49	9,7	361	71,6	94	18,7
Motivation toward reflections and concept investigation	95	18,8	289	57,3	120	23,8
Meeting learners' needs	104	20,6	150	29,8	250	49,6
Making meaning, real life examples	90	17,9	305	60,5	109	21,6
Total	76	15,1	347	68,8	81	16,1

When Table 3 was analyzed, it was noticed that female and male teachers' constructivist learning environment questionnaire score averages were similar to each other. As result of the unrelated t-test, there was no statistically significant difference ($p>.05$) within the context of constructivist learning environment's general and sub-factors.

Moreover, in the second sub-problem of the research, it was analyzed whether classroom teachers' level of creating a constructivist learning environment differed significantly according to their ages and their professional seniority. In order to find an answer to this sub-problem, and to determine whether level of creating a constructivist learning environment differed according to their ages and their professional seniority, one-way variance Analysis (ANOVA) was performed. After ANOVA analysis, Tukey test was performed in order to determine among what variables (their ages and their professional seniority) there were differences in terms of classroom teachers' level of creating a constructivist learning environment. ANOVA analysis results related to whether teachers' level of creating a constructivist learning environment differed according to age was presented in Table 4.

When Table 4 was analyzed, significant differences at $p<.01$ level of significance were noticed between primary school teachers' level of creating a constructivist learning environment according to their ages. This difference was also observed in all other sub-dimensions of constructivist learning environment questionnaire apart from the

Table 3. Unrelated Group t-test results according to the difference of primary school teachers' creating a constructivist learning environment from gender.

CLEQ	GENDER	N	$\bar{x}$	SD	Sh	Sd	t	p
Arguments, discussions, debates	Male	227	19,6875	3,3006	,2223	502	-3,496	.251
	Female	277	19,2655	3,3400	,1722			
Conceptual conflicts and dilemmas	Male	227	7,7266	2,8415	,2363	502	-6,276	.242
	Female	277	8,0708	2,5428	,1625			
Sharing ideas with others	Male	227	16,6641	2,5294	,2374	502	-4,627	.551
	Female	277	16,4956	2,5669	,1801			
Materials and resources targeted toward solutions	Male	227	12,0703	1,9968	,1908	502	-4,941	.141
	Female	277	11,7434	2,0035	,2135			
Motivation toward reflections and concept investigation	Male	227	22,9766	3,7405	,1861	502	-3,054	.953
	Female	277	22,9513	3,9308	,1892			
Meeting learners' needs	Male	227	18,7734	2,9248	,1731	502	-6,178	.131
	Female	277	18,2257	3,4522	,1226			
Making meaning, real life examples	Male	227	16,8438	6,0853	,1491	502	-5,013	.126
	Female	277	15,9735	2,6058	,1127			
TOTAL	Male	227	113,2159	19,7692	,6682	502	-1,503	.133
	Female	277	114,9747	21,0853	,5179			

sub-dimensions of conceptual conflicts and dilemmas, sharing ideas with others, making meaning and real life examples. Tukey test results performed related to determine which ages the level of creating a constructivist learning environment showed difference according to ages showed parallelism in scale dimensions. According to these results, it can be said that the primary school teachers between 26 to 30 years old created a constructivist classroom environment at a higher level than the primary school teachers between 31 to 35 years old. According to the research result, the primary school teachers between 26 to 30 years old can be said to have higher level of creating a constructivist learning environment rather than the teachers at 31 to 35, 41 to 45, and 46 years old and over primary school teachers in terms of arguments, discussions and debates, material and resources targeted toward solutions, motivation toward reflections and concept investigation, and meeting learners' needs. Moreover, according to research result, the primary school teachers between 21 to 25 years old can also be said to have higher level of creating a constructivist learning environment rather than the teachers at 31 to 35, 41 to 45 and 46 years old and over primary school teachers in terms of material and resources targeted toward solutions, motivation toward reflections and concept investigation, and meeting learners' needs..

When Table 5 was analyzed, significant difference at $p<.01$ level of significance were noticed between the primary school teachers' level of forming a constructivist learning environment according to their professional seniority. This difference was noticed collaterally in all sub-dimensions of the constructivist learning environment questionnaire apart from the sub-dimensions of conceptual conflicts and dilemmas, sharing ideas with others, and motivation towards reflections and concept investigation. Tukey test results showed parallelism with the scale sub-dimensions. According to this result, score averages of the teachers having 26 years and over professional seniority and the score averages of the teachers having 11 to 15 years professional seniority revealed statistically significant difference in terms of total questionnaire, arguments, discussions and debates, materials and resources targeted toward solutions, meeting learners' needs, and making meaning, real life examples. This difference was found in favor of the teachers having 26 years and over professional seniority.

Table 4. One Way Variance Analysis and Tukey Test Results related to whether primary school teachers' level of creating a constructivist learning environment differs according to their ages.

CLEQ	Seniority	N	X	SD	F	p	Significant Difference
Arguments, discussions, debates	21-25 ages	5	17,4320	7,23187			
	26-30 ages	61	18,3889	4,46241			
	31-35 ages	84	19,5417	5,47872			
	36-40 ages	84	16,9684	4,11911	5,096**	,001	26-30>41-45 ages
	41-45 ages	126	15,2447	4,44639			
	46 ages and over	144	16,2624	4,23343			
	Total	504	17,5980	4,53644			
Conceptual conflicts and dilemmas	21-25 ages	5	7,8120	1,64837			
	26-30 ages	61	8,1879	2,45143			
	31-35 ages	84	7,8826	2,90968			
	36-40 ages	84	7,9784	2,78213	,453	,781	-
	41-45 ages	126	8,7843	2,49706			
	46 ages and over	144	7,8541	2,56871			
	Total	504	7,9950	2,38360			
Sharing ideas with others	21-25 ages	5	13,8520	2,83647			
	26-30 ages	61	12,1667	3,27957			
	31-35 ages	84	11,8333	3,25631			
	36-40 ages	84	11,9789	2,89821	,958	,474	-
	41-45 ages	126	12,4219	2,98521			
	46 ages and over	144	11,7521	2,89214			
	Total	504	12,2506	2,90294			
Materials and resources targeted toward solutions	21-25 ages	5	14,5038	3,75235			
	26-30 ages	61	13,8746	4,63211			
	31-35 ages	84	12,5857	4,02236			
	36-40 ages	84	13,5389	3,78542	2,453*	,039	21-25>46 and over ages
	41-45 ages	126	15,2345	4,85328			
	46 ages and over	144	12,6254	4,32104			
	Total	504	13,9564	3,85254			
Motivation toward reflections and concept investigation	21-25 ages	5	17,5346	7,43125			
	26-30 ages	61	19,6245	5,59871			
	31-35 ages	84	15,8417	4,56243			
	36-40 ages	84	16,9988	4,31912	4,257**	,001	26-30>31-35 ages
	41-45 ages	126	18,2849	4,47631			
	46 ages and over	144	17,3512	5,12141			
	Total	504	17,5980	4,53644			
Meeting learners' needs	21-25 ages	5	14,3937	3,89562			
	26-30 ages	61	13,5985	4,57901			
	31-35 ages	84	13,6871	4,02563			
	36-40 ages	84	13,3692	3,52761	2,748*	,033	21-25>46 ages and over
	41-45 ages	126	15,0354	4,84768			
	46 ages and over	144	13,0021	3,75614			
	Total	504	13,8561	3,87094			

Table 4. Contd.

Making meaning, real life examples	21-25 ages	5	12,1874	4,22351			
	26-30 ages	61	11,9334	3,75123			
	31-35 ages	84	10,4621	3,33214			
	36-40 ages	84	11,6312	2,89521	,864*	,549	-
	41-45 ages	126	11,7956	3,12456			
	46 ages and over	144	11,9561	3,45685			
	Total	504	11,9866	3,13773			
Total	21-25 ages	5	114,200	26,30969			
	26-30 ages	61	116,409	16,51199			
	31-35 ages	84	107,821	22,01049	3,085**	,001	26-30>31-35 ages
	36-40 ages	84	109,773	22,26746			
	41-45 ages	126	116,571	18,98733			
	46 ages and over	144	114,854	20,49321			
	Total	504	113,732	20,52893			

N=504 * p<.05 ** p<.01

Table 5. One Way Variance Analysis and Tukey Test Results related to whether primary school teachers' level of creating a constructivist learning environment differs according to their professional seniority

CLEQ	Seniority	N	X	SD	F	p	Significant Difference
Arguments, discussions, debates	1-5 years	36	18,9592	3,1041			
	6-10 years	76	17,9020	3,0694			
	11-15 years	100	17,7149	3,4624			
	16-20 years	82	20,6510	3,5914	5,495**	,001	26 and over >11-15 years
	21-25 years	103	21,2360	2,4548			
	26 years and over	107	20,5484	2,6912			
	Total	504	19,4361	3,4513			
Conceptual conflicts and dilemmas	1-5 years	36	8,1884	2,4351			
	6-10 years	76	7,9350	2,3535			
	11-15 years	100	7,9366	2,5621			
	16-20 years	82	7,8022	3,1192	,395	,786	-
	21-25 years	103	7,4210	3,2482			
	26 years and over	107	8,0010	2,9419			
	Total	504	7,9642	2,6578			
Sharing ideas with others	1-5 years	36	12,5600	2,85297			
	6-10 years	76	12,3502	2,88128			
	11-15 years	100	12,1857	3,28644			
	16-20 years	82	11,9383	3,03704	,836	,453	-
	21-25 years	103	11,9749	2,89712			
	26 years and over	107	12,3289	2,78872			
	Total	504	12,2646	2,90294			
Materials and resources targeted toward solutions	1-5 years	36	16,2397	2,6821			
	6-10 years	76	15,6843	2,3685			
	11-15 years	100	15,5844	2,9367			
	16-20 years	82	17,9240	2,3975	9,193*	,037	26 and over >11-15 years
	21-25 years	103	16,7640	2,1653			
	26 years and over	107	17,7656	2,1081			
	Total	504	16,5565	2,5511			

Table 5. Contd.

Motivation toward reflections and concept investigation	1-5 years	36	9,1888	2,4948	,784	,652	-
	6-10 years	76	8,9100	2,3456			
	11-15 years	100	8,8286	2,5578			
	16-20 years	82	8,6000	3,0199			
	21-25 years	103	8,5000	3,2542			
	26 years and over	107	9,0000	2,9487			
	Total	504	8,9482	2,6473			
Meeting learners' needs	1-5 years	36	17,3352	2,5531	4,629**	,001	26 and over >11-15 years
	6-10 years	76	17,3454	3,0563			
	11-15 years	100	16,5890	3,5676			
	16-20 years	82	17,7756	3,2168			
	21-25 years	103	19,6118	2,5789			
	26 years and over	107	18,8628	2,4624			
	Total	504	18,4857	3,2847			
Making meaning, real life examples	1-5 years	36	15,4527	2,3462	7,745*	,028	26 and over >11-15 years
	6-10 years	76	15,2602	2,2308			
	11-15 years	100	14,9466	3,5096			
	16-20 years	82	17,4668	2,1623			
	21-25 years	103	16,3450	2,4654			
	26 years and over	107	17,1200	2,9231			
	Total	504	16,3898	4,2331			
Total	1-5 years	36	120,527	17,2915	3,525**	,001	26 and over >11-15 years
	6-10 years	76	111,320	19,3849			
	11-15 years	100	109,263	22,2287			
	16-20 years	82	112,719	21,3317			
	21-25 years	103	115,048	21,7406			
	26 years and over	107	116,383	18,7866			
	Total	504	113,732	20,5289			

N=504 *p<.05 ** p<.01

When the research findings were analyzed, the result emerged generally was that the primary school teachers having higher professional seniority created a more constructivist learning environment rather than the ones having lower professional seniority.

DISCUSSION AND CONCLUSION

According to the result revealed by the research, majority of primary school teachers were noticed to create a constructivist learning environment at medium level. Theoretically, there have been studies revealing that the curriculums are appropriate to the principles and standards of the constructivist approach (Sert, 2008). In a study carried out by Tanrıseven and Üredi (2009), majority of teachers were determined to create a constructivist learning environment at medium level. Besides, a research carried out by Sert (2008) obtained the result that teachers met the requirements of a constructivist curriculum at medium level. Furthermore, the studies depending upon the researchers' observation have indicated different findings. In a research conducted by Ünal and Akpınar (2006) upon this, it was determined that although teachers had ideas related to the importance of a constructivist learning environment, they could not present constructivist behaviors within the classroom environment. On the other hand, in a research carried out by Howard et el. (2000) upon the pre-service teachers, it was specified that the practices based upon the

constructivist approach caused a change from the objectivist epistemology towards a constructivist epistemology. In their research Kim et al. (1998) obtained the result that a teaching process based upon constructivism had a positive effect upon pre-service teachers' planning their teaching strategies depending upon constructivism. However, teachers need to have experiences depending upon constructivist practices not only during the pre-service period but also during their in-service trainings.

Majority of primary school teachers' creating a constructivist learning environment at medium level makes us consider that they encounter to some problems in practice. The conducted researches have indicated that the problems such as inadequate resources, crowded classrooms, the way of evaluations' being not clear, inadequacy of in-service training, and physical substructure deficiencies exist in creating a constructivist learning environment (Gözütok et al, 2005; Sert, 2008; Yapıcı and Leblebiciler, 2007).

In the research, it was noticed that constructivist learning environment questionnaire of female and male teachers showed similarities to each other. It was determined that there was no statistically significant difference within the context of constructivist learning environment's general and factors according to the genders of primary school teachers. It was noticed that there were significant differences between the primary school teachers' level of creating a constructivist learning environment according to their ages. Related to what ages the level of creating a constructivist learning environment differed, it can be said that the primary school teachers between 26 to 30 years old formed a constructivist learning environment at a higher level than the primary school teachers between 31 to 35 years old.

Significant differences were noticed between the primary school teachers' level of creating a constructivist learning environment according to their professional seniority. Professional seniority reveals itself as an important variable in teaching practices. In their study, Işıkoğlu et al. (2009) specified that the teachers with higher professional seniority had student centered teaching belief at a higher level. Similarly, Ünal and Akpınar (2006) the teachers having lower professional seniority created a more traditional learning environment. In their study, Tanrıseven et al. (2010) determined that there was a significant difference according to the views of primary school supervisors between the professional seniority and creating a constructivist learning environment. In the research, statistically significant difference was determined between the score averages of the teachers having 26 years and over professional seniority, and score averages of teachers with 11 to 15 years professional seniority in total of the scale. This difference was found in favor of the teachers having 26 years and over professional seniority.

Although there have been studies determining a relationship between the age and seniority of teachers and their emotional exhaustion and professional desensitization (Cemaloğlu and Erdemoğlu, 2007), the result obtained from the research group showed parallelism with this findings. Moreover, in his study Tanrıöğen (2000) specified a significant difference in favor of the teachers having 6-10 years professional seniority between the attitudes of teachers having 1-5 years and 11 years and over seniority towards change and the attitudes of teachers having 6-10 years seniority towards change. According to this result, the teachers having high professional seniority have more positive attitude towards practicing and actualizing the new ideas. Accordingly, the relationships between the professional seniority of teachers and the teaching practices can differ according to the characteristics of the sample group.

Increasing the primary school teachers' level of creating a constructivist learning environment can be possible through adapting the period of raising teachers using the student-centered learning as base. In their research Kim et al. (1998) obtained the result that a teaching process based upon constructivism had a positive effect upon pre-service teachers' planning their teaching strategies depending upon constructivism. However, teachers need to have experiences depending upon constructivist practices not only during the pre-service period but also during their in-service trainings. Consequently, reflection of a constructivist learning environment not only to the perception of teachers but also to their practices seems possible through a constructivist teacher training system beside overcoming the problems revealed in researches. For that reason, the quality of the constructivist approach is considered to increase through the reflection of both in-service trainings and teacher training programs creating the key point. Organization of in-service trainings that will be provided to meet these needs of primary school teachers in accordance with the constructivist approach can be offered as a suggestion to increase the level of creating a constructivist learning environment.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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Mathematics teacher candidates' skills of using multiple representations for division of fractions

Abdullah Çağrı Biber

Department of Mathematics Education Kastamonu University, Kastamonu, Turkey.

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The aim of this study is to reveal teacher candidates' preference regarding uses of verbal, symbolic, number line, and/or model representations of fraction divisions, and to investigate their skill of transferring from one representation type to the others. Case study was used as the research method in this study. The case that is examined within the scope of the study involves the performances of students in transiting between different representations of the fraction division. The study group consisted a total of 71 mathematics teacher candidates who were students in a university in Turkey. Among the results of the study were that the comparison of the performances of the pre-service teachers in transitions between representations reveals that the pre-service teachers were quite successful in expressing a fraction whose verbal or numeric (symbolic) expression was provided through other types of representation, but they were very unsuccessful in representing the fractions that were provided via models or on number lines through other types of representation.

Key words: Multiple representations, division of fractions, mathematics teacher candidates.

INTRODUCTION

The representations that one uses when solving mathematical problems provide us with a gateway to understanding his/her thinking (NCTM, 2000). Utilizing multiple representations during problem solving provides opportunities for the students to engage with the problem from the different aspects and to investigate deeply (Driscoll, 1999; McGowan and Tall, 2001). This is, in turn, beneficiary for robust understanding of the concepts. One theory of learning in mathematics is the multiple representations can be utilized to help students develop deeper, more flexible understanding of the concepts and processes (Even, 1998; Hiebert and Carpenter, 1992; Keller and Hirsch 1998; Piez and Voxman, 1997).

NCTM (2000) put a great emphasis on representations so that it was included in the process standards along with problem solving, reasoning and proof, communication and connection. According to NCTM, "When students gain access to mathematical representations and the ideas they express and when they can create representations to capture mathematical concepts or

E-mail: acbiber@kastamonu.edu.tr Tel: 0366-212-2314

relationships, they acquire a set of tools that significantly expand their capacity to model and interpret physical, social and mathematical phenomena." (p.4).

The concept of representation is among the psychological terms used in the field of mathematics education to explain important phenomenon about children's thinking. Speiser and Walter (2000), who, in agreement with Davis (1984), base their assertion on the previous work of Minsky (1975) and others, when they claim that mathematical knowledge is cognitively represented symbolically, often in the form of representations that are referred to as frames. When students think about a mathematical situation, they must first build a representation, which is usually done in the form of a mental representation.

Literature shows that teaching requires improving students' skill of transiting between different representations to support conceptual learning (NCTM, 2000; Kendal, 2002; Goerdt, 2007). Being stated as the language of mathematics, representing, in general, is a modeling process of abstract concepts and symbols in a concrete way inside the real world (Kaput, 1998). By means of representations, students can learn mathematics from different aspects (Choike, 2000). Multiple representations also prepare students for advanced mathematics (Schultz and Waters, 2000). Moreover, they also provide students with different problem solving strategies and support conceptual learning (Keller and Hirsch, 1998).

Learning environments that utilize multiple representations contribute students' conceptual understandings of mathematical identities (Dufour-Janvier et al., 1987; Porzio, 1999). Among mathematical concepts, fractions are the ones that allow teachers to use multiple representations. Starting from the elementary schools, students confront with fractions that interact with natural numbers, integers and rational numbers. The difficulties that many students have experienced in the concepts of fractions and fraction operations have been well documented (Aksu, 1997; Başgün and Ersoy, 2000; Davis et al., 1991; Davis et al., 1993; Gürbüz and Birgin, 2008; İpek et al., 2005; Kamii and Clark, 1995; Mack, 1995; Pesen, 2008, Richards and Cobb, 1983; Steffe et al., 1988; Yang et al., 2008; Tzur, 1999).

Research indicates that division is the most complex one among all fraction operations. In a study conducted with teachers and students, Ma (1999) indicated that only 43% of the United States teachers were able to perform the computation successfully and only one out of twenty-three teachers was able to give a correct representation for a problem involving division of fractions. In their study, Watson et al. (1993) examined how four fraction problems were solved by children from kindergarten to grade ten to analyze the work of children's use of images, reality and experience. They found a developmental progression in the iconic reasoning, the ability to reason involving images and drawings, was developed in building ideas about fractions. Lamon (2001) attributes some of the difficulties students have with fractions to their limited ability to extend the meaning of a fraction to various interpretations. She states that a fraction, such as 3/4, can be interpreted as 1) a part/whole comparison 2) an operator 3) a ratio or rate 4) a quotient or 5) a mea-sure. She suggests that students should be involved in a variety of activities that will enable them to experience the meaning of fraction in a wide range of ways by means of multiple representations.

In a study conducted with the fifth grade students, Şiap and Duru (2004) indicated that students had difficulty in ordering, operating and transferring different representations of fraction. Orhun (2007) also found that fourth graders had issues with classifying, ordering, adding, multiplying and representing fractions. The study also indicated that students could not interpret the fractions that were given in visually (through modeling).

In order to balance conceptual knowledge and algorithmic knowledge, it is important for both students and teachers to transfer among the different representations of the fractions and to operate on these representations (Baki, 2006). Some studies indicated teachers' weaknesses on integrating multiple representations inside their teaching environments (Stein et al., 1990; Even, 1998; Hitt, 1998; Çelik and Baki, 2007). When taken into account that uses of multiple representations are included and emphasized in the mathematics teaching program in Turkey (MEB, 2009; MEB, 2013), teachers (of now and in future) are to know and able to use these representations. Within this regard, literature provides a lack of studies that investigates mathematics teachers' and teacher candidates' uses of multiple representations, especially in fractions. Based on the explanations and literature given above, the aim of this study was (1) to reveal teacher candidates' preference regarding uses of verbal, symbolic, number line, and/or model representations of fraction divisions and (2) to investigate their skill of transferring from one representation type to the others.

METHODOLOGY OF RESEARCH

Case study was used as the research method in this study. The case that is examined within the scope of the study involves the performances of students in transiting between different representations of the fraction division.

Study group

The study group consisted of a total of 71 mathematics teacher candidates who were students in the department of elementary

Table 1. Distribution of question peers.

Question peers	Transition	
	From	To
WN/WN, WN/F, F/WN, F/F	Symbol	Verbal Model Number Line
WN/WN, WN/F, F/WN, F/F	Verbal	Symbol Model Number Line
WN/WN, WN/F, F/WN, F/F	Model	Symbol Verbal Number Line
WN/WN, WN/F, F/WN, F/F	Number Line	Verbal Symbol Model

WN. Whole number question, F: fraction question

mathematics education at a university in Turkey, and nobody in this group had teaching experience previously. A criterion-based purposive sampling strategy was applied in forming of the study group. The percentage of the female participants was more than double of the one of the males (70 versus 30%, respectively). The criteria for selection were for all students to be in the fourth-grade and to have successfully completed the courses relating mathematics education, such as Mathematics Teaching Methods I and II.

Data collection tool

In line with the aims, this study used a multiple representations of fraction division test (MRFDT) in the concept of fraction division. MRFDT consisted of 64 questions (16 sets each with four questions), which require from teacher candidates to represent the given form of the question in other forms. In addition, data concerning which methods pre-service teachers preferred or did not prefer in demonstrating division in fractions through different representations were collected by a separate question.

For each representation type (symbolic, verbal, model, number line), students were to addressed four question requiring dividing (1) two whole numbers, (2) a whole number by another fraction, (3) a fraction by a whole number, and (4) a fraction by another fraction. MRFDT prepared by the researchers, checked and approved by an external expert who studies in the field of mathematics education, in terms of its understandability and practicability. A pilot application of the achievement test conducted with 32 students, and its understandability was found sufficient. All of the questions are open-ended, and their features are given in Table 1.

The data were collected with an exam-quality application in a single-session process of 180 minutes, and teacher candidates tried to answer the whole question set. One set of questions, which were directed towards students on the subject of rotational motion, are given in Table 2. These questions required from teacher candidates to represent symbolic form of fraction division by using area models. The operations included dividing two whole numbers (Q1), a whole number by another fraction (Q2), a fraction by a whole number (Q3), and a fraction by another fraction (Q4).

As is seen in Figure 1, since Question 3C required students to use their conceptual information regarding the given condition, it was considered a conceptual question. Since Question 3A required students to make algorithmic calculations and reach a numerical value, it was accepted as an algorithmic question. Since Question 3G required students to express the given values on a graphic and draw the graphic, it was assessed as a graphical question.

Data analysis

The data that were obtained were initially examined in terms of the success and (correct answers) and failure (wrong and no answers) states of students. During this process, the whole analysis was conducted by the researcher in company with an external expert, who holds a doctoral degree in the field of mathematics education. The most occurred mistakes during the transitions were also provided.

Findings of research

The analysis of the answers to the question “Which methodology do you prefer to use while showing the dividing in fractions with different representations (verbal, symbol, number line and by using model) and which methodology do not you think to use?” were given in Table 3. The mostly preferred type is symbolic show (by half of the candidate teachers) for the dividing in fractions. Verbal expression and number line showing methods are individually representing 18% of the candidates. Model showing in dividing fractions represent 14% of the candidates and has the lowest percentage distribution in this category.

The least preferred methodology in dividing fractions showing is the showing on number line (by most of the candidates). The model showing method is stated by 27% of the candidates. The symbolic and statement showings have the least percentage among the showings which are preferred by the candidates representing the27% of the candidates, as supporting the data in most preferred methodologies.

Table 4 shows the success of pre-service teachers in expressing division in fractions, which was provided verbally, through other types of representation. The examination of general averages demonstrated that although the pre-service teachers were quite successful in transition from verbal expression to symbolic representation (98%), more than half of the pre-service teachers were unsuccessful in representations via number lines and models (that is, gave wrong answers or no answers). In addition, the pre-service teachers had a difficulty in dividing a fractional number by a natural number. The pre-service teachers were found to be quite successful in division of a natural number by a natural number (example, 1:5) during transition from textual representation to other types of representation, but to have lower rates of success in operations involving the division of natural numbers by fractions [example, 1:(2/5)] or the division of fractions by fractions [(1/5): (3/10)].

Table 5 includes findings about the transition of the pre-service teachers from symbolic representation including numbers to other types of representation in division in fractions. As it is seen in the

Table 1. Sample questions, which were directed towards students on the same subject.

	Transition from	Division requiring
Q1: Use model to illustrate $1 \div 2$.	Symbol to Model	WN/WN
Q2: Use model to illustrate $4 \div \frac{1}{2}$.		WN/F
Q3: Use model to illustrate $\frac{2}{3} \div 3$.		F/WN
Q4: Use model to illustrate $\frac{3}{5} \div \frac{1}{5}$.		F/F

Table 2. Percentage distribution of teacher candidates' preferences of fraction representations.

	Verbal	Number line	Symbol	Model
Most preferred	18	18	50	14
Least Preferred	9	55	9	27

table 5, although the pre-service teachers were quite successful in expressing numerically provided division in fractions through other types of representation and in transition to textual representation (verbal expression) of fractions (88%), they were quite unsuccessful in transition to representation via models (%32) and numbers (%43). In demonstrating fractions by other representations, the pre-service teachers were more unsuccessful in cases where a natural number was divided by a natural number, a fraction was divided by a natural number, and a fraction was divided by a fraction. These two cases indicate that the pre-service teachers have difficulty in representing division in fractions via models and number lines.

Table 6 presents findings about the performance displayed by the pre-service teachers in transition from representation via number lines to other types of representation. As it is seen in the table 6, although more than half of the pre-service teachers succeeded in transition from representation via number lines to symbolic representation and textual representation, they had lower success in representation via models. The number of the successful pre-service teachers decreased more in the representation of division of a natural number by a fraction. Even though the pre-service teachers showed an important success in transition from representing the division of a natural number by another natural number through a number line to representing such operation through other types of representation, they were unsuccessful in other question types (number:fraction and fraction:fraction in particular). Moreover, the overall performance of the pre-service teachers in transition from representation via number lines to other types of representation was found to be lower than their performance in transition from textual representation and symbolic (numerical) representation to other types of representation.

Table 7, provides findings about the performance of the pre-service teachers in transition from representation via models to other types of representation. According to the table 7, the pre-service teachers had difficulty especially in representation via number lines in transition from representation via models to other types of representation. While 87% of the pre-service teachers succeeded in transition from representation of division of a natural number by a natural number via models to other types of representation, this ratio fell to 63% in division of a fractional number by a natural number, to 33% in division of a natural number by a fractional number, and to 13% in division of a fractional number by a fractional number. The fact that more than half of the pre-service teachers (51%) did not give any answer to transition from representation via models to other types of representation in questions including the division of fractional numbers by fractional numbers indicates the problems encountered by the pre-service teachers in this matter. Furthermore, the overall performance of the pre-service teachers on this subject is similar to their performance in transition from representation via number lines to other types of representation. However, the performance of the pre-service teachers in both cases is lower than their performance in transition from textual representation and symbolic (numerical) representation to other types of representation.

Table 8, indicates the difficulties which the pre-service teachers encountered most frequently in transition from one type of representation to another. Almost half of the pre-service teachers (n=24) calculated the result of fractional operation in the first place, and then fell into the error of marking such calculated value on the number line. In addition, 16 pre-service teachers showed only such final value calculated by them on the number line. Another frequently encountered representation error involved using a model instead of each number value in the fractional expression and giving the separately calculated final value via a model.

RESULTS AND IMPLICATIONS

This study investigated the preferences of pre-service teachers for using multiple representations such as verbal representation, symbolic representation, number line representation and model representation in division in fractions and their competences for using such representations and transiting between such representations. Based on the findings of the study, the results and implications of the study are provided here.

The pre-service teachers were quite successful in expressing division in fractions whose verbal or symbolic (numeric) expressions were provided through symbolic (numeric) or verbal representations. However, the pre-service teachers were found to be very unsuccessful in representing a fraction whose verbal or symbolic

Table 4. Transition from textual representation to other types of representation.

	WN/WN			WN/F			F/WN			F/F			Overall		
	T	F	NA	T	F	NA	T	F	NA	T	F	NA	T	F	NA
Symbol	100	0	0	94	6	0	100	0	0	100	0	0	98	2	0
Model	83	17	0	44	39	17	22	33	45	33	50	17	45	35	20
Number Line	61	39	0	50	39	11	28	22	50	50	33	17	47	33	20
Overall	81	19	0	63	28	9	50	18	32	61	28	11			

*T:True, F:False, NA: No answer

Table 5. Transition from symbolic (numerical) representation to other types of representation**.**

	WN/WN			WN/F			F/WN			F/F			Overall		
	T	F	NA	T	F		T	F	NA	T	F	NA	T	F	NA
Verbal	100	0	0	94	0	6	94	0	6	67	0	33	88	0	11
Model	66	16	17	28	33	39	17	44	39	17	39	44	32	33	34
Number line	83	6	11	33	39	28	28	28	44	28	22	50	43	23	33
Overall	83	7	9	51	24	24	46	24	29	37	20	42			

*T:True, F:False, NA: No answer

Table 6. Transition from representation via number lines to other types of representation.

	WN/WN			WN/F			F/WN			F/F			Overall		
	T	F	NA	T	F		T	F	NA	T	F	NA	T	F	NA
Symbol	89	11	0	44	50	5	61	28	11	33	67	0	56	39	4
Verbal	89	11	0	44	45	11	61	28	11	28	61	11	55	36	8
Model	72	17	6	22	67	11	39	44	17	22	67	11	38	48	11
Overall	83	13	2	36	54	9	53	33	13	27	65	7			

*T:True, F:False, NA: No answer

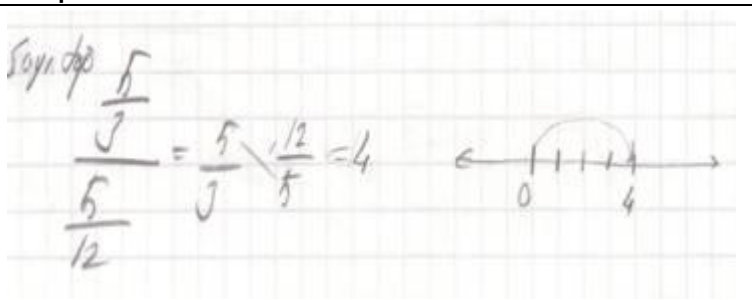
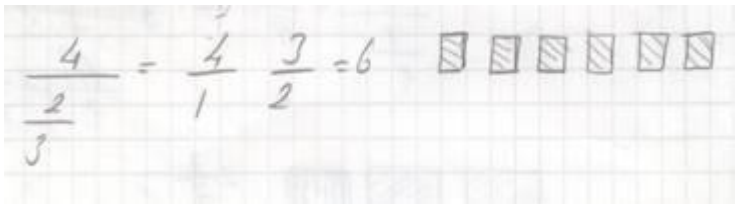
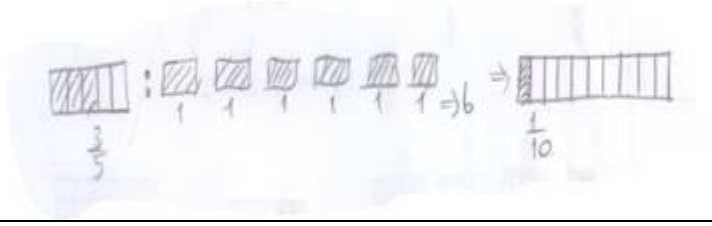
Table 7. Transition from representation via models to other types of representation.

	WN/WN			WN/F			F/WN			F/F			Overall		
	T	F	NA	T	F	NA	T	F	NA	T	F	NA	T	F	NA
Symbol	89	11	0	38	56	6	72	28	0	17	39	44	54	33	12
Verbal	94	6	0	39	44	17	67	33	0	17	33	50	54	29	12
Number line	78	11	11	22	50	28	50	39	11	6	33	61	39	33	27
Overall	87	9	3	33	50	17	63	33	3	13	35	51			

*T:True, F:False, NA: No answer

(numeric) expression was provided through models or number lines. Higher success of the pre-service teachers in symbolic representations may be attributed to the fact that traditional teaching methods are used in the learning environments of the pre-service teachers, and algebraic (symbolic) representation is the most suitable type of representation for this method and is featured more in this method. As a matter of fact, Mack (1995) and

Table 8. Most frequent errors and examples about them.

Error type	n	Sample answer
Only showing the final value	24 (number line)	
	16 (model)	
Modeling each step of the operational algorithm	N=22 (model)	

Moseley (2005) obtained findings supporting the above-mentioned idea.

The pre-service teachers were able to express a fractional division operation provided through models or represented on a number line by using verbal and numeric (symbolic) representations. This result conflicts with the finding of Billings and Klanderman (2000) that pre-service teachers had difficulty in turning graphical problems into verbal expressions. However, the pre-service teachers were found to be very unsuccessful especially in the expressions involving (number:fraction) and (fraction:fraction) while using models or representing via a number line. Thus, it can be said that although the pre-service teachers had good operational skills, they failed to achieve an absolute understanding of the conceptual meaning of division in fractions. Similarly, Toluk (2002) and Durmuş (2005) determined that students were able to perform division in rational numbers algorithmically/operationally, but had difficulty in expressing it conceptually.

The comparison of the performances of the pre-service teachers in transitions between representations reveals that the pre-service teachers were quite successful in expressing a fraction whose verbal or numeric (symbolic) expression was provided through other types of representation, but they were very unsuccessful in representing the fractions that were provided via models or on number lines through other types of representation. This is consistent with the findings of Haser and Ubuz (2002) and Şiap and Duru (2004) that students had difficulty in transiting between the different representations of rational numbers.

On the other hand, the pre-service teachers were more successful in the symbolic representations which they stated that they preferred most in comparison to other representations. However, when they were demonstrating division in fractions via multiple representations, the pre-service teachers fell into the error of showing only the result on the model or on the numeric line instead of modeling the operation. Another mistake made by the pre-service teachers while using a model or representing via a number line was showing only the numerical values in the numerator and denominator of the fraction via representations. Based on the mistakes made by the pre-service teachers while demonstrating division in fractions through representations, it can be said that the pre-service teachers ignored the conceptual dimension of division in general. Researchers (Alacaci, 2009; Olkun

and Toluk, 2003; Van de Walle, 2004) state that a considerable part of misconceptions in fractions arises from the generalization of habits about natural numbers over fractions.

The pre-service teachers should believe in the contribution of the use of multiple representations in mathematics to education. This is because; teachers can reflect their beliefs and prejudices concerning multiple representations on learning environments, too (Patterson and Norwood, 2004). Different types of representations should be highlighted for conceptual understanding to be achieved on the subject of rational numbers that constitutes a basis for other subjects of mathematics (Kieren, 1976; Vergnaud, 1983). Based on the fact that multiple representations are included in curricula as of the primary education second grade (MEB, 2009), it can be said that teachers have an important responsibility for establishing a strong infrastructure on this subject among students. Therefore, pre-service mathematics teachers, who are the teachers of future, should improve themselves in representing a mathematics subject through different representations in order to introduce conceptual understanding to their students in the future. The importance of the use of multiple representations should be emphasized in the trainings provided to pre-service mathematics teachers during their university education. In addition, trainings regarding the use of multiple representations by pre-service teachers should be increased. The present study was carried out with pre-service mathematics teachers. A similar study may be carried out with teachers and primary education teachers, thereby investigating their skills of using multiple representations.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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