



An Analysis of Research Methods and Statistical Techniques Used By Doctoral Dissertation at the Education Sciences in Turkey

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Abstract

To assess research methods and analysis of statistical techniques employed by educational researchers, this study surveyed unpublished doctoral dissertation from 2003 to 2007. Frequently used research methods consisted of experimental research; a survey; a correlational study; and a case study. Descriptive statistics, t-test, ANOVA, factor analysis, bivariate correlation, Many Whitney-U test, and Kruskal Wallis-H test were frequently used statistical techniques analysis. Though some new statistical techniques analyses were introduced into educational dissertation, the trends of frequently used analysis of statistical techniques stayed relatively steady.

Keywords: Research method, statistical analysis, doctoral dissertation, education sciences

An Analysis of Research Methods and Statistical Techniques Used By Doctoral
Dissertation at the Education Sciences in Turkey

Educational research worldwide has played a major role in influencing and informing educational practice. Indeed, the last decade has seen a proliferation in the number of articles published in educational research journals. Some of these published works have been the basis of educational reform in many settings. Moreover, most investigators utilize previous research in developing their conceptual and theoretical frameworks, as well as in providing qualitative (e.g., content analyses) and quantitative (e.g., meta-analyses) reviews of the literature in which the key findings are summarized. In conducting literature reviews, researchers often assume that the documented findings are trustworthy (Onwuegbuzie & Daniel, 2003).

For the last 20 years a large body of literature on ways of synthesizing research in education has been developed (Dunkin, 1994; Walberg, 1986). Approaches to gleaning the accumulated findings of that research have varied from the narrative through vote counting of box scores to meta-analysis. Some of these approaches make more demands on the conceptual and interpretative skills of the synthesizer than others and, therefore, contain more scope for error and bias than others, although all approaches are subject to the fallibility of the synthesizers and those upon whom they necessarily rely. It is important that the validity of all syntheses is subject to be tested as for they are the main ways in which assessments can be made about the accumulation and development of research-based knowledge. Syntheses of research are influential in regard to subsequent research, policy, and practice. They provide the empirical bases for applications for research grants, for higher-degree dissertations and theses as well as for individual and institutional research. They are used by policymakers both in designing strategies for development and to guide practitioners in the enhancement of professional activity.

They provide the contents of highly regarded publications in handbooks, encyclopedias, and textbooks and become the best known statements of the state of knowledge on the topics to which they are addressed (Dunkin, 1996).

Different research methods and analysis of statistical techniques have been preferred in the research of different disciplines. For example, laboratory experiments tend to be used in physical sciences, while field studies are carried out more often in social investigations. More correlation-related statistics are used in biological and medical research. In agricultural research, however, analysis of variance and covariance (ANOVA/ANCOVA) are used most frequently. What methods/analyses are preferred in educational research? What are the application trends of these methods/analyses over the years? Educational researchers have shown interest in these questions throughout the years. Surveys on methods/analyses used in articles published by educational and psychological journals have appeared in literature continuously (Hsu, 2005).

Surveys on research methods, which were treated separately from statistical techniques analysis in this study, are reviewed first. Walker (1956) identified the following as the commonly used educational research methods in the 1950s: survey, historical research, library method, case study, experimental design, action research, statistical method and content analysis. Observation, interview, measurement and opinion polls were frequently used data collection techniques. Shaver and Norton (1980) reviewed articles in the *American Educational Research Journal* (*AERJ*) published in 1968, 1971, 1973 and 1975–1977 in terms of several design issues such as design types, randomization, replications and sampling. They found that almost more than half of the articles were correlation studies and that the percentage remained about the same throughout the years. The number of true-experimental studies declined as the number of quasi-experimental studies increased.

The review by Keselman et al. (1998) involves both statistical techniques analysis and research design. Four hundred and eleven articles in the 1994 and 1995 issues of 17 educational and psychological journals were reviewed in terms of the practice of using ANOVA (analysis of variance), MANOVA (multivariate analysis of variance) and ANCOVA (analysis of covariance) in four types of design: between subjects univariate design, between subjects multivariate design, repeated measures design, and covariance design. Results show that many researchers failed to verify assumptions, report effect sizes, and examine power of the statistics employed. However, it is interesting to note that the repeated measures design was used most often, about 55%. The percentages of the remaining three designs range only between 11 and 19.

The trends and shifts of research methods during the past decade are well summarized by Kelly and Lesh (2000). In general, more emphasis is given to qualitative methods than quantitative methods. Experimental method is no longer the only dominant method in math and science research. In determining the existence of certain factors, ethnographic descriptions are often used instead of statistical tests. Designs involving one-time summative measure or pre-post tests are less frequently used. Instead, approaches involving iterative cycles of observations of complex behavior are employed. This article deals with research methods employed in mathematics and science education research. The question to be answered here is whether research practice in education as a whole has made similar shifts in research methodology.

There are many surveys on statistical techniques analysis used in studies published by educational and psychological journals. For example, Edgington (1974) reviewed seven journals of the American Psychological Association each year from 1948 to 1972. His results showed that the percentage using ANOVA increased steadily from 1948 to 1972. However, the percentages using t-test and correlation declined. The percentages employing chi-square and factor analysis

were about the same throughout the period. Willson (1980) surveyed *AERJ* between 1969 and 1978. He discovered that approximately 41% of the statistical techniques analyses were biostatistics (such as correlation, multiple regression, discriminate analysis, multivariate analysis of variance). Approximately 34% were agricultural statistics (such as ANOVA/ANCOVA). In comparing the statistical procedures used in articles published in the *Journal of Educational Research (JER)*, 1970 and 1980, with the exception of descriptive statistics, West, Carmody and Stallings. (1983) found more multivariate statistics were used in 1980. The most frequently used statistics in 1970 were correlation, ANOVA, t-test, chi-square, multiple regression, and non-parametric statistics. The most frequently used statistics in 1980 were ANOVA, multivariate, multiple regression and t-test.

Goodwin and Goodwin (1985a, b) surveyed statistical techniques used in the *Journal of Educational Psychology (JEP)* and *AERJ* between 1979 and 1983. The most commonly used statistics in *AERJ* were ANOVA/ANCOVA (17%), correlation (12%), descriptive statistics (10%) chi-square/non-parametric statistics (7%), multiple-comparison (6%) and t-test (5%). Statistics most frequently used in *JEP* were ANOVA/ANCOVA (26%), correlation (17%), multiple-comparison (13%), t-test (8%) and regression (8%). Elmore and Woehlke (1988) reviewed *AERJ*, *Review of Educational Research (RER)* and *Educational Researcher (ER)* between 1978 and 1987. They discovered that the most frequently used statistics were ANOVA/ANCOVA, descriptive statistics, multiple correlation/regression, bivariate correlation, multivariate and non-parametric statistics. Later, they extended their survey to include 1978 to 1997 (Elmore & Woehlke, 1998). The extension changed the rankings of the most frequently used statistics to descriptive statistics, ANOVA/ANCOVA, correlation/regression, qualitative techniques, bivariate correlation, and multivariate. The discrepancies between Goodwin and

Goodwin (1985b) and Elmore and Woehlke (1988, 1998) were due to the different nature of the articles published in ER (consisting of more interpretive and philosophical articles) and *RER* (consisting mostly of reviews of research). The rankings were almost identical when only the articles in *AERJ* were considered.

Purpose

An expressive review of the literature revealed that all authors (*e.g.*, Hall, Ward, & Comer, 1988; Onwuegbuzie & Daniel, 2003; Thompson, 1998; Vockell & Asher, 1974; Ward, Hall, & Comer, 1975) who have examined the research methods and statistical techniques analysis made by researchers have utilized journals published in the United States and these errors occur in the other parts of the world as well. Thus, as the purpose research methods/designs, and data statistical techniques analysis appeared in research studies unpublished by doctoral dissertation from 2003 to 2007 the purpose of the study was to assess the research methods and statistical techniques analysis used by doctoral dissertation at the education sciences in Turkey. More specifically, this study was designed to address the following questions:

- (i) What are the frequently used research methods?
- (ii) What are the frequently used statistical techniques analyses?

Results of the investigation should be of concern not just to the publishers of educational research journals and the practitioners of educational research, but also to the instructors of research methodology as well. Graduate students in education are required to take research method courses so that they can become both/either good consumer of research publications and/or conductors of quality research. However, educators disagree on exactly how much knowledge of methods/analyses should be required for which levels of graduate students.

Information about research practice in the field may provide some helpful guidelines. The present study is different from previous surveys in several aspects. First, it does methods/analyses without considering the subject matters investigated. Second, unlike most of the previous surveys, this survey separates statistical techniques analysis from research methods. Research methods include approaches, plans or designs of investigation with the exception of procedures to deal with data and their interpretations. Third, it covers dissertations published from 2003 to 2007 (Hsu, 2005).

Method

Data for the present study were obtained from a database developed by a cross-cultural study of educational and psychological research methods (Hsu, 2005). The construction of the database included the following steps:

- (i) Initially 211 unpublished doctoral dissertation original research studies in education sciences in Turkey from 2003 to 2007 were indentified. Years were coded by numbers: 6 (2003), 7 (2004), 30 (2005), 79 (2006), 89 (2007).
- (ii) As shown in Table 1, each article was reviewed and classified in terms of three aspects: (i) research methods (15 categories); and (ii) statistical techniques analysis (23 categories). The categories of research methods; and data analysis procedures were adapted from the study of Hsu (2005).

Table 1.

Categories of research methods, and statistical techniques analysis

Categories of research methods	
1-Action research	9-Ethnography
2-Case study	10-Phenomenology
3-Experimental design	11-Histography
4-Causal comparative/model	12-Other methods
5-Comparative approach	13-Interpretative/rhetorical
6-Correlational study	14-Observational study
7-Cross culture	15-Policy study
8-Survey	
Categories of statistical techniques analysis	
1-ANCOVA	13-Linear regression
2-ANOVA	14-MANCOVA
3-Bivariate correlation	15-MANOVA
4-Canonical correlation	16-Many Whitney-U Test
5- Chi-square	17-Meta-analysis
6-Cluster analysis	18-Multiple correlation
7-Descriptive statistics	19-Multiple regression
8-Discriminant analysis	20-Path/structural equation
9-Effect size/power analysis	21-Psychometric statistics
10-Factor analysis	22-T-test
11- Kruskal Wallis H test	23Wilcoxon
12-Kormogrov Smirnov	

The selection of categories for methods/analyses was based on an extensive review of methodology literature (Keeves, 1988), encyclopedias of education and psychology (Alkin, 1992) and categories used in surveys reviewed in a previous section. Unlike some previous studies, as mentioned previously, analyses of statistical techniques were treated separately from research methods because they served somewhat different functions in the research process. For methods that were named after analysis of statistical techniques such as meta-analysis, multilevel analysis and structural equation modeling, they were included in statistical techniques analysis in

this study. Rationales of some subjects/methods/analyses categorizations will be clarified in the following sections when appropriate.

For studies employing more than one research method, up to three of the most important methods were recorded for each study. For data analysis, all procedures in the article were recorded. However, if a procedure was used more than once in the same doctoral dissertation, it was counted only once. It is important to note that qualitative interpretation was also considered as one technique so that data treatment procedures of qualitative research could be considered. To assure that the same criteria were used in classifying the articles, a manual description of the characteristics of each category was prepared.

The frequencies of methods/analyses appearing in each doctoral dissertation from 2003 to 2007 were tabulated and their percentages were computed. To compute the percentage for each subject matter, its frequency was divided by the total number of doctoral dissertation and multiplied by 100. The frequency for each category was divided by the total number of methods/analyses and multiplied by 100 because a doctoral dissertation may have more than one method/analysis.

To explore the trends of application, categories for plotting were selected because they were classified as frequently observed (at least 5%) in at least two of the doctoral dissertations. The unpublication years from 2003 to 2007 were divided into seven periods with five years each. In situations where a combination of categories was required (*e.g.*, where experimental research is a combination of pre -quasi- and true-experimental designs) frequencies of the combined categories were summed for that period before the percentage was computed (Hsu, 2005).

Findings

Table 2 shows frequently used research methods and the least frequently used methods in unpublished doctoral dissertation. Four of the frequently used methods are identical for all unpublished doctoral dissertations: experimental research, survey, correlational study, and case study. Comparative approach was used to describe a study when it compared different techniques, methods, instruments, procedures, or objects and when it was neither an experimental study nor a correlational study. Descriptive research involves the collection of data to describe the existing conditions of the problem under investigation. Some publications use this term to include most non-experimental studies such as case studies, developmental studies, and observational studies, which were treated separately in this study. Descriptive research was used only to identify studies describing existing characteristics that were not case studies, developmental studies, or observational studies. *Action research, phenomenology, causal-comparative approach, grounded theory, ARGE* is also shown in Table 2 as the least frequently used methods.

Table 2.
Research methods/designs used most and least frequently in the unpublished doctoral dissertation

Methods	η	%
1-Experimental design	85	37.1
2-Survey	78	34.0
3-Correlational study	28	12.2
4-Case study	26	11.3
5-Action research	5	2.1
6-Phenomenology	4	1.7
7-Causal-Comparative approach	1	0.4
8- Grounded Theory	1	0.4
9-ARGE	1	0.4
Total	229	100

Percentages of statistical techniques analysis most frequently appearing in articles published by unpublished doctoral dissertations presented in Table 3. Again, there are similarities among these unpublished doctoral dissertations. In fact, five of the six frequently used analyses are identical: descriptive statistics, t-test, ANOVA, factor analysis, bivariate correlation, Many Whitney-U Test and Kruskal Wallis-H Test. Actually, if the percentages were rounded to a whole number, psychometric statistics (3%) for unpublished doctoral dissertations could be classified as a frequently used data analysis procedure too. Psychometric statistics included statistics designed for data collection instruments such as indices of reliability and validity. This category did not include factor analysis because it was treated as a separate category. In the present study, we deliberately included two categories that were normally omitted in surveys of analysis of statistical techniques: Descriptive statistics and qualitative interpretation. Descriptive statistics is the foundation of quantitative analysis. Its role cannot be overlooked simply because advanced statistics are also used in the same studies. With the increasing popularity of qualitative research, qualitative interpretation should be included to account for treatment of qualitative data.

Fifteen (15) of the statistical techniques analyses were classified as the least frequently used procedures in Table 3. This large number is unusual but was expected because the categorization is so specific. For example, multiple regression, linear regression, Kormogrov Smirnov, MANOVA, and path analysis on this list can be grouped into a single category of multivariate statistics. Same table also presents the percentages of the number of different statistical techniques analysis used in the same study.

Table 3.

Statistical techniques analysis used most and least frequently in the unpublished doctoral dissertation

Analysis of statistical techniques	η	%
1-Descriptive statistics	181	28.46
2-t-test	138	21.70
3-ANOVA	114	17.92
4-Factor analysis	58	9.12
5-Bivariate correlation	33	5.19
6-Many Whitney-U Test	29	4.56
7-Kruskal Wallis-H Test	19	2.99
8-ANCOVA	19	2.99
9-Chi-Score Test	12	1.89
10-Wilcoxon	10	1.57
11-Multiple regression	8	1.26
12-Linear regression	7	1.10
13-Kormogrov Smirnov	4	0.63
14-MANOVA	2	0.31
15-Path analysis	2	0.31
Total	636	100

Results and Discussion

This study identified and tabulated research methods and statistical techniques analysis from studies unpublished in doctoral dissertation from 2003 to 2007. In addition, it also identified the subject matters under which these methods/analyses were applied. Percentages of frequently used methods and analyses were plotted over for being unpublished in doctoral dissertation so that its trends of practice could be assessed and compared.

As for being connected with the research model, it is related to the distribution of the models used in dissertation studies. In the case it has been determined that totally 9 different research models were used in 211 doctoral dissertation studies. Among the models determined,

Experimental Design (37.1 %), Survey (34.0 %), Correlational Study (12.2%) and Case Study (11.3 %) models are frequently used ones. Besides this, only a few researchers carried on their works by taking the improvement on research methodology into the consideration and applying to causal-comparative approach and qualitative models. Hsu(2005), who has studied a similar matter about methodological errors, suggests that the frequently used research methods, mentioned through the articles published by American Educational Research Journal (AERJ), Journal of Experimental Education (JEE) and Journal of Educational Research (JER) between 1971 and 1998, are composed of experimental, defining, correlational, causal-comparative approach and case study, but, till middle of 1980s, percentage of the experimental and defining studies have continuously decreased in number; on the contrary, causal-comparative and the qualitative research has increased.

When the results of this study are discussed in terms of these outputs, the experimental and scanning model applications in the three of four thesis studies in Turkey can be shown as an indication of lack of an adaptation to innovations in this field, compared to the international tendency. Furthermore, frequent use of experimental and scanning models in the study held by Balcı (1993), and the findings of Akkoyun's study (1989) that show the existence of a modeling difference between the researches on consultation physiology held in America and Turkey, supports this comment.

As far as the data analysis dimension is concerned, the other comprehensive result relates to the distribution of the statistical techniques applied during data analysis in dissertation studies. It has been determined that 23 different statistical techniques were used in 205 doctoral dissertations in which statistics applied. Among the techniques determined, descriptive statistics (28%), t-test (21%) and ANOVA (17%) are most frequently used. When these techniques

analyzed, it can be said that descriptive statistics and differential statistics are applied in most of the dissertations. Other statistical techniques which are limitedly applied are MANOVA, MANCOVA and Path analysis. On the contrary, while there exists more than one variable in most of the dissertations, an evaluation has been done as if there were only one. Thus it has prevented the study from achieving its purpose by using the techniques with one variable such as t-test and ANOVA instead of applying multi variable statistical techniques in dissertation studies in which attitude and success are discussed together as a sample.

Most favorable explanation of this situation was done by Loftus (1994). He states that a force effect exists on differential researches and relatively a negative view has been encountered in some studies. Corresponding with this dimension of the research lots of works can be encountered in international literature; these studies mostly include the published articles on education. (Table 4). Wilson (1980) stated in his articles in *American Educational Research Journal* (AERJ) between 1969 and 1978 that ANOVA, ANCOVA, correlation, multiple regressions, discriminate analysis and MANOVA are mostly applied tests. In 150 articles issued at *Journal of Educational Psychology* (JEP) between 1979 and 1983, ANOVA and multiple regressions, correlation tests were stated as mostly applied ones (Goodwin & Goodwin, 1985a). In another study held by Goodwin & Goodwin (1985b) variant and covariant analyses, multiple regressions, correlation, descriptive statistics and MANOVA were stated as largely used ones in the articles issued in AERJ between 1979 and 1983 and t-test was found to be the one among the least preferred methods. The research results, which were repeated to determine the statistical techniques used in AERJ published by Elmore & Woehlke (1998) since 1997, are parallel to the research outcomes of Goodwin & Goodwin's (1985b). Kieffer, Reese & Thompson (2001) determined that variant and covariant analyses, regression analyses, and correlation analyses had

been frequently used in 756 articles issued in *Journal of Counseling Psychology (JCP)* and *American Educational Research Journal (AERJ)* between 1988 and 1997. In addition to American oriented Journal analysis, at Onwuegbuzie's (2002) studies published in *British Journal of Education Psychology (BJEP)* in 1998, the most applied analyses techniques were variant, covariant and factor analysis. Some parts of these outcomes are relevant to those found in this research.

However, when a comparison made among the studies carried on after 2000, the fact that the research going along with the results of the study are desperately dated, can be interpreted as an indication our being behind the international progress with regard to statistical analysis in the research on education held in Turkey. Fortunately, some slow, glacial progress in the incremental movement of the field was reflected in the APA (1994, p. 18) style manual "encouraging" the reporting of effect sizes. But enlightened editorial policies now provide the strongest basis for cautious optimism (Thompson, 1998).

Finally, even the criteria for the combination of different categories might not be identical; the differences of the results among surveys are relatively minor. It should be noted, however, that the percentages presented in Table 4 were aggregated over the time periods covered. The percentages of procedures might vary from one year to another for different surveys, which was not addressed in this table. To have a more accurate comparison among these results, trends of application over the years should be explored (Hsu, 2005).

Table 4.

A comparison of most commonly used statistical techniques analysis identified by selected surveys

Reference	Journals	Statistical techniques analysis (%)	
Edgington [1974]	7 APA journals [1948-1972]	[54%] ANOVA [26%] Correlation [22%] t-test	chi-sq. [15%] Non-parametric [15%] Factor analysis [3%]
Willson [1980]	AERJ [1969-1970]	[41%] Based correlation/regression [34%] ANOVA/ANCOVA [12%] Factor analysis	
Goodwin & Goodwin [1985a]	JEP [1979-1983]	[26%] ANCOVA/ANOVA [17%] Correlation [13%] Multiple comparison	t-test [8%] Regression [8%]
Goodwin & Goodwin [1985b]	AERJ [1979-1983]	[17%] ANCONA/ANOVA [12%] Correlation [10%] Descriptive statistics	Non-parametric [7%] Multiple comparison [6%] t-test [5%]
Elmore & Weohlke [1988]	AERJ [1978-1987]	[25%] ANCOVA/ANOVA [15%] Correlation/regression [10%] Multivariate	Bivariate correlation [9%] Non-parametric [8%] t-test [8%]
Elmore & Weohlke [1998]	AERJ [1978-1997]	[31%] ANCOVA/ANOVA [19%] Multiple regression [12%] Multivariate	bivariate correlation [11%] nonparametric [10%] t-test [10%]
Onwuegbuzie [2002]	BJEP [1971-1998]	[38%] ANOVA [22%] MANOVA [19%] Factor analysis	Correlation [11%] Regression [11%] chi-sq. [8%]
Hsu [2005]	AERJ [1971-1998]	[24%] Descriptive [19%] ANOVA/ANCOVA [13%] Correlation	Regression [7%] Qualitative interpre. [7%] t-test [6%]
Hsu [2005]	JEE [1971-1998]	[29%] Descriptive [24%] ANOVA/ANCOVA [13%] Correlation	t-test [7%] non-parametric [6%] regression [6%]
Hsu [2005]	JER [1971-1998]	[29%] Descriptive [23%] ANOVA/ANCOVA [12%] Correlation	t-test [8%] Regression [7%] Non-parametric [6%]
This study	[2003-2007]	[28%] Descriptive [21%] t-test [17%] ANOVA	Factor analysis [9%] Non-parametric [6%] Bivariate correlation [5%]

Note: APA: American Psychological Association, AERJ: American Educational Research Journal, JEP: Journal of Educational Psychology, BJEP: British Journal of Education Psychology, JEE: Journal of Experimental Education, JER: Journal of Educational Research

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