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The trends and challenges for early carrier educational researchers in quantitative research in Turkey

Kübra Karakaya Özyer [1]
Eskişehir Osmangazi University, Faculty of Education, Department of Measurement and Evaluation in Education, Eskişehir, Turkey

Abstract*: There are numerous problems in quantitative research in education literature. The purpose of the study was to identify the tendencies and challenges early carrier educational researchers face in quantitative data analysis. A basic qualitative design was applied. The study was conducted in four different phases and in every phase, there are different samples and data collection tools. The research data was obtained from Ph.D. students, lecturers, Ph.D. thesis and Ph.D. programs. The qualitative data were collected through questionnaires, and document analysis to achieve triangulation. The descriptive analysis method was used to analyze the qualitative data for four phases. The study identified the most commonly used statistical techniques which are descriptive statistics, correlation, t-test and analysis of variances. The results of the study also demonstrated issues that novice educational researchers encountered in quantitative data analysis process. Participants had difficulties in defining the conceptual framework, finding the appropriate test and assumption check.*

Keywords: *Educational research trends, quantitative data analysis, research evaluation, Ph.D. students.*

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INTRODUCTION

According to the University Ranking by Academic Performance (URAP) research laboratory (2018), 29,867 articles were published in high-quality journals by Turkish researchers. However, the percentage of articles is way below the average of the world. Even though the number of published articles increased in 2019, most of them were published in journals that had low impact factor (URAP, 2019). To promote the quality of journal articles in Turkish education literature, it is important to study the trends and problems in research. Cohen, Manion, and Morrison (2007) suggested that an understanding of the tendency of educational research may help with the writing process.

Doing a scientific study involves a series of steps (Creswell, 2012) including finding a study idea, developing hypotheses, identifying the methodology, specifying a population-sample or study group, developing data collection materials and applications, collecting data and analysis, and reporting the findings (Tanrıöğen, 2009). Researchers must follow these steps to succeed, but few can publish their work in high-ranked journals. Hence, researchers need to pay attention in every step to create a high- quality study.

There are three different paths that a researcher can take: quantitative, qualitative, and mixed research. Quantitative research can be defined as a "process to identify a research problem based on trends in the field or on the need to explain why something occurs" (Creswell, 2012, p. 13). Quantitative research method is popular in

[1] Corresponding Author: Assist. Prof. Dr., karakayakubra@gmail.com, 0000-0002-0208-7870

Turkish education literature (Doğan & Tok, 2018; Kutluca, Mut & Gündüz, 2017; Özaydın-Özkara, 2019; Selçuk, Palanci, Kandemir & Dündar, 2014). There are, however, certain difficulties in conducting a quantitative study.

Collecting data and statistical analysis are the most problematic and important steps in the research process (Büyüköztürk & Köklü, 1999; İlhan, 2016; Jaykaran, 2010; Karadağ, 2010; Özşahin & Yüreğir, 2008). Some researchers developed statistical software for social science such as SPSS and Minitab to overcome the issues in statistical analysis and simplify the application of the tests (Jaykaran, 2010, 61; Uysal & Güyer, 2014, 34). However, these new trends cause other problems and errors in social science research, especially in educational science. One of the problems in education literature is selecting the wrong research model. Ph.D. students and researchers may have difficulties in identifying the research model in terms of their research problems (Karadağ, 2010). Moreover, some research demonstrated that educational researchers used inappropriate statistical techniques according to their data characteristics and research problems (Erdoğan, 2001; İlhan, 2016; Jaykaran, 2010; Kabaca & Erdoğan, 2007; Ozan & Köse, 2014; Özşahin & Yüreğir, 2008). For instance, one study showed that researchers applied unpaired t-test to pair groups in experimental design (Jaykaran, 2010). Besides that, assumption checking, and usage of parametric tests can be problematic in educational research (Başman, Uluman & Tunç, 2018; Demir, Saatçioğlu & İmrol, 2016; Evrekli, İnel, Deniş & Balım, 2011; İlhan, 2016; Jaykaran, 2010; Kabaca & Erdoğan, 2007). Specifically, it was identified that some of the researchers preferred parametric tests to non-normal distribution (Evrekli et al., 2011; Jaykaran, 2010), improper statistical methods for categorical data (Erdoğan, 2001), and univariate statistical tests when they had more than one dependent variable (Kabaca & Erdoğan, 2007). Beyond the statistical method, the interpretation of the output is also critically important in the academic world. Some of the researchers tend to interpret the results inaccurately (Erdoğan, 2001; İlhan, 2010). Some of them tend to reject the null hypotheses when the p-value is not significant. Others interpreted causation in a regression model. From all this research data, it is clear that educational researchers had mistakes and deficiencies in the research process.

Keskinkılıç and Ertürk (2009) attempted to define the statistical competency of graduate students who are in educational science. They demonstrated that statistics courses in educational science programs were not adequate for graduate students and students claimed that they needed more statistical information to conduct an analysis.

Büyüköztürk and Köklü (1999) conducted a questionnaire to advisors in educational science. The advisors claimed that graduate students had low computer competencies to apply data analysis. For instance, the graduate students should improve their knowledge about inferential statistics and students were needed to help select the appropriate test.

Various researchers (Büyüköztürk & Köklü, 1999; Erdoğan, 2001; İlhan, 2010; Kabaca & Erdoğan, 2007; Karadağ, 2009; Ozan & Köse, 2014; Özşahin & Yüreğir, 2008) have evaluated educational research articles and graduate students, but little attention so far has been paid to the reactions of lecturers and curriculum in an educational institute. The previous research used only graduate students or journal articles to identify the problems and usage in quantitative research. These researches had a lack of providing a holistic analysis of the case of quantitative research in education. A holistic study is needed which includes every aspect of the issue. To help address these gaps, the current study was conducted with educational researchers, lecturers, thesis and graduate school curriculum.

Purpose of the Study

The aim of the research is to examine the problems and difficulties in educational statistics for educational researchers. In terms of identifying the discrepancies following research questions were asked:

1. How many statistics courses are offered to Ph.D. students at Institute of Education in Turkey?
2. What are the tendencies of Ph.D. students to use quantitative analysis?
3. What is the opinion of lecturers in terms of educational statistics courses and Ph.D. students who took this course?
4. What are the problems and errors that were made in Ph.D. thesis at Institute of Education in Turkey?

METHOD

Design

The aim of the study is to explore the problems, errors, and tendencies in quantitative research in Turkish Education Literature. A basic qualitative method was preferred for this study. To explore a situation or a perception deeply, basic qualitative research design is the most suitable (Merriam, 2009). In other words, the purpose of the basic qualitative study is to improve the practice in research area and obtain in-depth understanding of phenomenon. The current study was designed in four steps, and it contained the curriculum of Ph.D. in education, published the Ph.D. thesis in education, lecturers' who are teaching educational statistics and quantitative methods, and finally opinions of Ph.D. students in Turkey (see Figure 1).

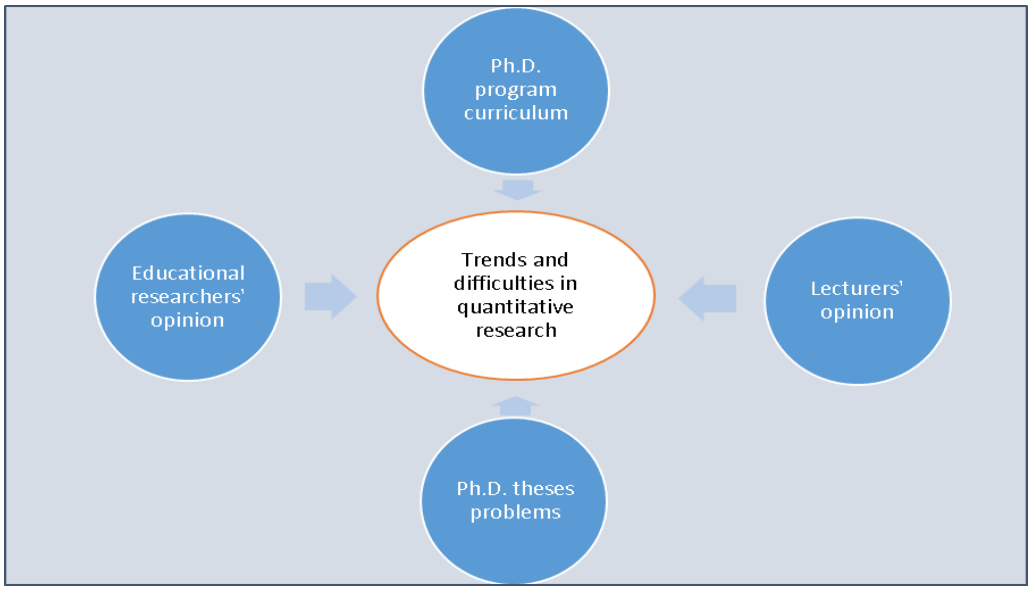

Figure 1. Study design

Participants

Purposeful sampling and convenience sampling methods were used to identify the study groups. There were four study groups for this study (see Table 1).

Table 1. *Description of study groups*

Research questions	Study Group
1. Number of statistics courses	266 Ph.D. programs
2. Tendencies of using quantitative analysis	389 educational scientists
3. Opinion of lecturers	9 lecturers

The first group is the Ph.D. programs at Graduate Schools of Education in Turkey. There were 266 Ph.D. programs in 48 universities. The second study group contained the Ph.D. students who study in Educational Sciences and had experiences in quantitative analysis. 153 students participated in the study. Most of the participants (n= 149, %= 97.4) claimed that they took a statistics course in their graduate education. 22.2% of them took only one statistics course while 33.3% of them took two courses related to statistics. The Figure 2 demonstrates the number of statistics courses that Ph.D. students took in their graduate study.

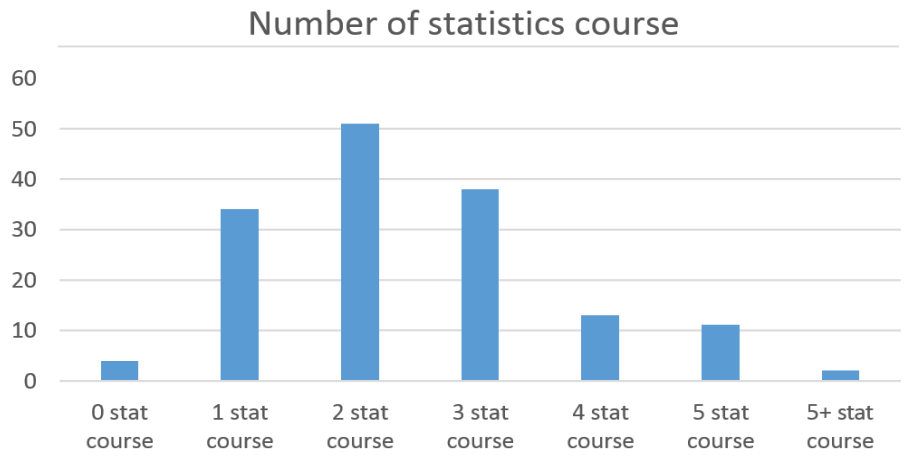

Figure 2. Number of statistics courses that Ph.D. students took

To solve the third research question, the researchers conducted an interview with 9 lecturers who teach educational statistics to the graduate students. The convenient sampling was used to select the participants. The online questionnaire was distributed to the 30 lecturers via email and only 9 of them returned. Those participants lectured educational statistics from one year to 12 years in a Turkish university.

Data Sources and Instruments

Data were collected through questionnaires and document analyses (see Table 2).

Table 2. *Instruments used in the study*

Research questions	Instruments
1. Number of statistics courses	Curriculum of Ph.D. programs
2. Tendencies and problems of using quantitative analysis	Questionnaire for Ph.D. students
3. Opinion of lecturers	Questionnaire for lecturers
4. Problems in Ph.D. thesis	Matrix of review

The curriculums of Ph.D. programs in a graduate school of education in Turkey were examined by document analysis. The official websites of every Ph.D. program were visited and listed the courses they offered.

To expose the experiences in quantitative research of Ph.D. students, a questionnaire was developed by the researcher and distributed to the Ph.D. students who study educational sciences in Turkey via an online survey website. There were 10 questions in the instrument. Some of sample questions "Which research design do you use most?", "How often do you used the following analysis methods?" and "Which step do you think is the most difficult in a research process? Participants were asked to select one of the options under the question.

A structured questionnaire was used to examine the opinions of the lecturers who lecture educational statistics in years (see Appendix A). This new questionnaire was also developed by the researcher, and it contained three open ended questions. The questions were "What do you think are the difficulties when analyzing data?" and "What are the recommendations to the novice educational researchers for quantitative analysis?". The questionnaire was sent to the lecturers via an online survey service. All the answers were downloaded to a secured computer and combined in a secured file.

Finally, the Ph.D. theses published in 2017 were examined via a review matrix (see Appendix B). The matrix was developed by the researcher, and it contained the title of the thesis, authors, research methodology, statistics used in thesis, assumption check for statistical analysis, errors, and problems in data analysis sections.

Data Analysis

Qualitative data analysis identified the situations of educational scientists in terms of quantitative data analysis. The analysis took place in four different phases. In the first phase, all of the educational Ph.D. programs' curriculums were examined, frequencies and percentages of the mandatory statistics courses were calculated. In the second phase, the questionnaire was distributed to the Ph.D. students in Turkey and the data was analyzed by descriptive analysis. In the third phase, thematic analysis was preferred to examine the opinions of the lecturers and create the themes. In the final phase, 30 Ph.D. theses assessed in terms of the statistical errors and the data was analyzed holistically.

Trustworthiness and Credibility

To explore the quality of qualitative research, writers should take strategic action to ensure validity and reliability of the study. These strategies are "investigator responsiveness, methodological coherence, theoretical sampling, and sampling adequacy, taking an active analytic stance and saturation" (Morse, Barret, Mayan, Olson & Spiers, 2002, p. 9 cited by Corbin & Strauss, 2008). On the other hand, Creswell (2012) proposed prolonged engagement in the field, triangulation, using peer review, negative case analysis, clarifying researcher bias, member checks, rich think description and external audits to achieve trustworthiness and credibility of findings.

Triangulation is one of the important factors to gather evidence for trustworthiness. Triangulation can be explained as using multiple and different sources of information (Yıldırım & Şimşek, 2013); hence, different study groups and data collection tools helped us research a convergence to form themes. For peer review, the first researcher analyzed the qualitative data and created the themes, and then shared the results with another researcher. Working for years as educational researchers and having educational statistics experience provided the prolonged engagement. Also, the researchers tried to write every detail about the research process to clarifying the researcher's bias.

The participants were informed of the purpose and the process of the study. An online consent form was given to the participants to get their willingness to participate in the study. To ensure confidentiality, a code number was

given instead of his or her real name. The data was secured in a personal computer and the collected data was used only for scientific purposes.

FINDINGS

Findings of First Research Question

To identify the importance of statistics and quantitative methods in educational science, all the educational doctorate programs were examined. There were 266 Ph.D. programs in 48 different universities. All of the programs are related to education. Some of them are under the Institute of Education but others are under the Institute of Social Science. The curriculums of all 266 programs were examined to identify compulsory statistics or quantitative data analysis courses. The results demonstrated that only 25.94 % (n = 69) of the Ph.D. programs contained compulsory statistics or quantitative data analysis courses. Compulsory courses may vary in names such as: Quantitative Research Methods (n=31), Educational Statistics (n=20), Statistics (n=17), Scale development (n=7) and Data Analysis with statistical package programs (n= 9). Moreover, 58.65 % (n=156) of the Ph.D. programs offer elective statistics or data analysis courses in 48 universities. These courses can be named as advanced educational science, scale development, Structural equation modeling, quantitative research methods, statistics, or statistical analysis in research.

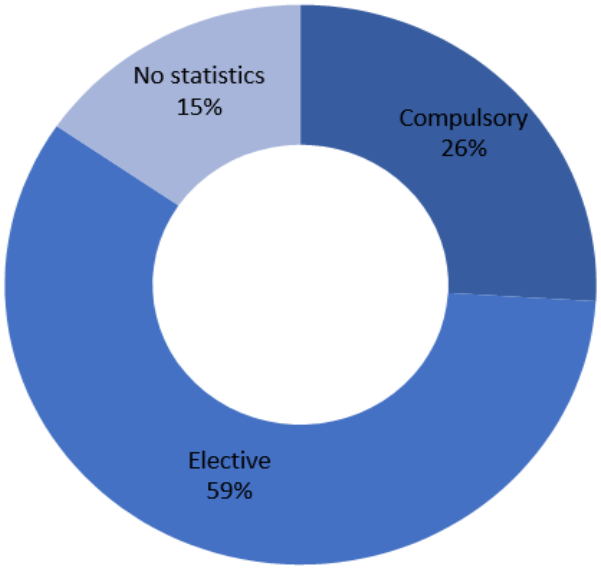

Figure 3. Frequencies of statistics course type

These results showed that the amount of the mandatory statistics course can vary from one program to another. Besides, there are very few educational statistics courses offered by programs. Statistics or quantitative research methods are needed to catch the attention.

Findings of Second Research Question

To answer the second research question, the questionnaire was developed by the researchers and distributed to the educational scientists in Turkey. For every item, the participants can select more than one response. The results demonstrated that more than half of them had experience with survey design (%81.0), correlational analysis

(%67.3), scale modification or development process (%54.2) and experimental designs (%45.8). On the other hand, only 20.9 % of the scientists conducted cause-and- effect studies and only 10.4% applied meta-analysis in their research (see Figure 4). Seven participants selected the other option and they claimed that they had experience with mixed design, metaphor analysis, and social network analysis.

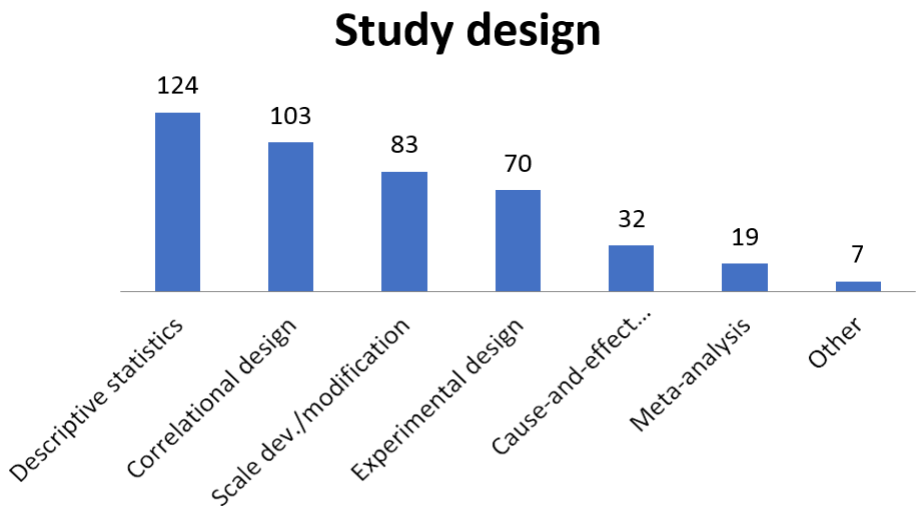

Figure 4. Frequencies of study design types

In the questionnaire, the participants were asked about the usage of the frequency of their statistical analysis. It was revealed that the participants used descriptive statistics, t-test, Analysis of Variance (ANOVA) and reliability analysis most frequently (see Table 3).

Table 3. *Frequently used data analysis types*

Data Analysis Type	Not used (%)	Barely Used (%)	Frequently used (%)
Descriptive statistics	4.6	20.6	74.8
Correlation	14.9	37.5	47.6
Regression	35.2	38.0	26.7
t-test	9.0	23.1	67.9
Factor Analysis	21.3	36.5	42.2
ANOVA	13.1	26.0	60.9
ANCOVA	56.6	33.4	10.0
MANOVA	56.8	34.2	9.0
Structural Equation Modelling	60.7	26.2	13.1
Reliability Analysis	17.0	26.0	57.1
Cluster Analysis	81.0	16.2	2.8
Discriminant Analysis	83.3	14.7	2.1
Non-Parametric analysis	21.3	41.4	37.3
Other	92.5	4.6	2.8

The results of the data demonstrated that the participants had experience with descriptive statistics, correlation, regression, t-test, factor analysis, ANOVA, reliability analysis and non-parametric tests. The participants who selected the other option claimed that they used canonical correlation, hierarchical linear modeling, Rasch analysis, Multivariate Analysis of Covariance, Multivariate Analysis of Variance and Markov chains methods in their research.

After the description of what type of analysis, the participants mostly used in the research, it was important to know the steps where there were difficulties and where help was required. The qualitative analysis has revealed a wide range of difficulties among educational researchers when conducting a quantitative study.

Table 4. *Frequencies of problems face in data analysis process*

Steps in quantitative process	Frequencies	Percentage
Literature review and defining conceptual framework	138	35.5
Finding the appropriate statistical test	133	34.2
Assumption check	98	25.2
Access to statistical package programs	87	22.4
Interpretation of the results	80	20.6
Usage of statistical package programs	71	18.3
Reporting finding according to APA style	42	10.8
Identifying the variables and variable types	37	9.5
Derive general conclusions from findings	37	9.5
Other	31	8.0

The results revealed that the literature review and defining conceptual framework was the most difficult part of quantitative research (% 39.9). Moreover, the second difficult part is identifying a suitable analysis method (% 35.3). 27.5 % of the participants state that testing necessary assumptions for analysis was the 3rd difficult section in the quantitative research process. It was followed by interpretation of the results and accessing statistical computer programs to apply the analysis. Besides that, 13.7% of the participants claimed that they need help when they are using computer programs for data analysis. Furthermore, the participants claimed that they had problems when they need to derive general conclusions from the findings. Another important step for quantitative research was reposting the findings. Most of the journals in education literature require the APA style for academic writing. The educational scientist should know the type of table when they are reporting specific statistical tests. For instance, the table of correlation analysis is different than the ANOVA table. Hence, properly reporting the finding is crucial. The questionnaire results demonstrated that only 10.5% of the Ph.D. students had problems while reporting. Finally, people who preferred the other option stated that they had difficulties in the data collection process, getting access to the research site and conclusion part.

Table 5. *Frequencies of source of help for problems in quantitative data analysis*

Sources	Frequencies	Percentage
Advisor or experienced colleagues	319	82.0
Main books	303	77.9
YouTube videos by experts	237	60.9
Analysis part of published articles	216	55.5
Published Ph.D. and Master's Degree thesis	194	49.9
Using websites related with data analysis	75	19.3
Students experienced with statistics	38	9.8
Find someone to do data analysis	17	4.4
Buying service from Data analysis companies	15	3.9
Other	3	0.8

In terms of difficulties, the Ph.D. students claimed the lack of the sources. When they have difficulties in data analysis, the advisor or experienced colleagues are the major sources to overcome problems. 88.2% of the participants asked for help from the supervisor. In addition, the main books are the second preferred source for help (%= 83.7). YouTube videos are another popular option for educational scientists because it is easy to access and are free. Hence 64.7 % of the participants in the study claimed that they watch YouTube videos when they need help. Analysis section of published articles and theses are other important sources for more than half of the participants. Ph.D. students tend to look for similar articles or thesis and follow these sources. Only 20.3% of the participants used paid websites to get help for data analysis and 13.7% of the participants asked for help from the students who had experienced statistics. Finally, 4.6% of the scientists tend to find someone else to do data analysis and 1.3% of the participants gave money to the statistical counseling services rather than doing the analysis by themselves.

There are many statistical computer programs nowadays. However, for educational scientists in Turkey SPSS is the most frequently used computer package program for quantitative analysis. 98.7% of the participants claimed that they had used SPSS. Secondly, 49.7% of the participants used LISREL, especially for multivariate analyses. AMOS is similar to LISREL so people can analyze Confirmatory Factor Analysis and Structural Equation Modeling with AMOS. However, AMOS is not popular like LISREL and only 32.0% of the participants stated that they used AMOS for data analysis. R, Mplus, SAS, Minitab, and STATA are other programs that are fewer than 8% of the participants used in the past. People who checked the other option claimed that they had used CMA, Winstep, ITEMAN, Origin, Mathlab and SPSS.

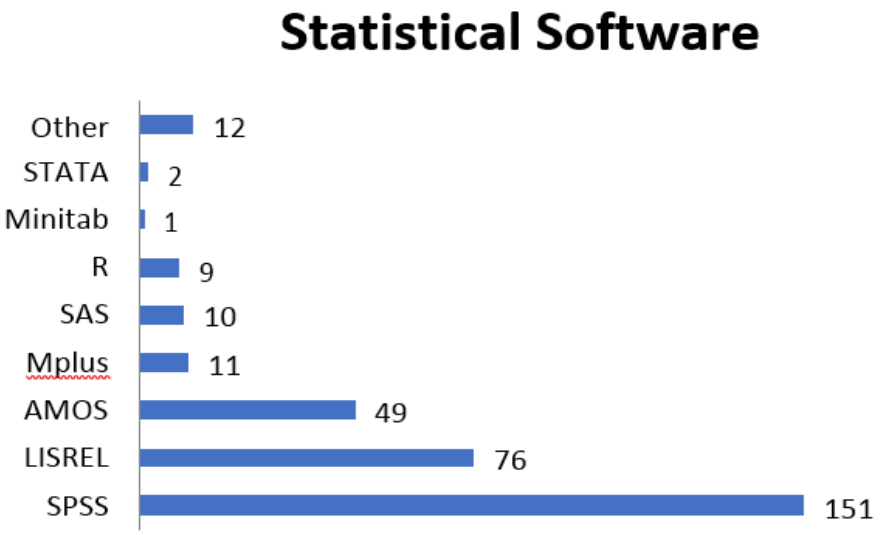

Figure 5. Frequencies of statistical software preferences

Finally, the participants stated why they used statistical software in data analysis. 65.4% of the Ph.D. students preferred software to do data analysis rapidly and without error. More than half of the participants claimed that statistical package programs are suitable to do an analysis when they didn't know the formula of the analysis. Participants in the study tend to enter the data to the software and click the button and calculate the analysis. Similarly, 51.0% of the participants used software to get a table of findings. 39.9% of the participants claimed that they can use the software to find the perfect analysis for the data. On the other hand, 34.0% of the participants preferred to use the statistical programs because they didn't have other options to calculate the analysis results.

Table 6. *Frequencies of reasons to use statistical software*

Reasons to use statistical software	Frequencies	Percentage
Error-free and quick computation	268	68.9
Doing analysis without knowing formulation of the analysis	211	54.2
Getting findings in table	193	49.6
Selecting the appropriate statistical analysis for the data	175	45.0
No alternative to do analysis	120	30.8
Other	2	0.5

In summary, Ph.D. students had more experience with descriptive statistics, correlation, regression, analysis of variance, reliability statistics, exploratory factor analysis and confirmatory factor analysis. To conduct these analyses, the students preferred mostly SPSS and LISREL computer programs. According to the results, computer programs are helpful enough to do computation without error and the softwares enables them to do analysis even when they didn't know the formula of the tests. Together with the benefits of computer programs, the Ph.D. students had faced challenges in quantitative research. The participants believed that defining the conceptual framework at the beginning of the study and selecting the appropriate statistical tests for the research questions are the most problematic steps in quantitative methods. Checking assumptions for specific analysis is another important step for the participants. The Ph.D. students looked for help when they faced a challenge in data

analysis, and advisors, colleagues, textbooks, YouTube videos, and published studies (articles and theses) are main sources to overcome the issue.

Findings of Third Research Question

For the third research question, three questions were asked to the nine lecturers. The aim was to investigate the problematic topics and the reasons for statistics education for graduate students.

First of all, the researchers asked the questions related to the subjects where they thought that the graduate students might have had difficulties in. The lecturers were split into two parts. Some of the lecturers thought that graduate students had difficulties in basic statistics such as hypothesis testing and probabilistic distributions. The students cannot apply basic statistics because they didn't have a mathematics background. L3, L7, L8, and L9 believed that graduate students in educational sciences are not capable of mathematics and matrices.

> "Students' readiness in Mathematics subjects is low" (L3)

On the other hand, some of the lecturers stated that multivariate statistical techniques were the most problematic methods. Confirmatory factor analysis and structural equation modeling or Multivariate Analysis of Variance (MANOVA) are topics that students didn't understand because they cannot interpret the formulas. L1, L2, L4, L5, and L6 claimed that most of the graduate students had difficulties in multivariate statistical analyses. Students tend to memorize the analysis steps and the interpretation of the results hence they didn't fully understand the meaning of the parameters that they had.

> "Because the multivariate analyses require high level of awareness and information, the graduate students have difficulties to apply a multivariate analysis. "(L2)

Then, the researchers wanted to know the difficulties that graduate students in data analysis faced. The lecturers stated that students had problems in selecting appropriate statistical techniques, using computer programs for data analysis, interpreting and reporting the findings.

L8 claimed that "students have problems when they need to decide the right test and interpret the SPSS output". Similarly, L3 stated in the interview that "graduate students have difficulties in identifying the variable types (dependent- independent) and selecting the appropriate method". Moreover, she expressed that there are deficiencies in interpreting the table results from a software output.

L7 stated that if a student didn't have adequate computer skills, she or he has difficulties in using package programs and doing analysis. Similarly, L4 said, "they may have trouble while doing the analysis via computer program, but they didn't have problems in data entering step".

L5 expressed that students overcome the problems in data entering and doing analysis steps by practice; however, interpreting the result from the output and reporting in the right way could create problems. L1 agreed with the L5, and she stated that computer programs produced many tables in the output section, but students cannot interpret and report the results appropriately because students can do the analysis by rote.

Finally, the lecturers were asked if they had recommendations /advice to the novice educational researchers. L1, L2, L3, and L9 recommended improving the mathematics skills and understanding the basic statistical topics completely. They may read educational statistics books to overcome the difficulties in data analysis. Hence, L6 and L8 suggested finding a high-quality course in Turkish and in English as well. Practice was another important advice

from the lecturer. L6, L5, and L8 believed that students should practice more after they learned the theoretical knowledge.

> "Examples should be taken together with students and if necessary, analysis and reporting should be done in the computer laboratory" (L5)

Also, using real-life data for practice can be more useful to understand the analysis. Not only the statistical and mathematical background but also computer skills should be improved to do the data analysis in statistical software. Finally, L4 recommended that researchers should pay attention to control the assumptions of the statistical tests and missing values.

In conclusion, the graduate students in educational science had challenged both basic statistics and multivariate statistics. The reason they had difficulties in multivariate statistics was based on the mathematical background. Students asked for help to decide the right technique, using package programs, interpreting and reporting the results from the output. Hence, the lecturers' advice to novice researchers to find the appropriate and high-quality sources and improve their basic skills in statistics and computers.

Findings of Fourth Research Question

For the fourth research question, 30 Ph.D. theses were examined by the researchers. The results of descriptive statistics, exploratory and confirmatory factor analysis, one way- analysis of variance (ANOVA), correlation, and regression are the most used techniques in the thesis reviewed. Moreover, six of the theses didn't indicate any statistical software but most of them preferred SPSS to do the data analysis. AMOS, LISREL, ITEMAN, R and Hierarchical Linear Modeling (HLM) programs were also used in these.

There were several errors that were identified such as typos, checking of normality assumption and doing the wrong analysis. For the errors in writing, graduate students used the scale, questionnaire, and inventory terms interchangeably. However, those terms should be used in different cases. In addition, point and comma were used for the decimal point but they need to be consistent with what they preferred. In Turkish literature, the writers should prefer the comma for the decimal point. One of the theses stated the "principal component factor analysis" but "principal component analysis" and "factor analysis" are two different methods.

When examining the thesis for normality assumption checking, six of the theses didn't provide any information about the distribution of the data. One study claimed that the data was not normal because the sample size is under 30. Most of the graduate students preferred skewness and kurtosis values to check the normality assumption. Seven of them take +-2 for a cut of scores while two studies indicated that the data is normal because skewness and kurtosis values are between -1.96 and +1.96. Two theses stated that skewness and kurtosis should be between -1 and +1. In addition, only one research preferred ± 3.29 cut of points for normal distribution.

Then, the normality tests (Kolmogorov Smirnov and Shapiro-Wilks) are other popular methods in the theses. However, most of the theses are not preferred multivariate normality checking for multivariate statistical analysis (such as Structural Equation Modeling (SEM), Confirmatory Factor Analysis (CFA), Multivariate Analysis of Covariance). Only one study used Mahalanobis distance for multivariate normality.

The thesis which used exploratory factor analysis preferred principal component analysis with varimax rotation. However, all of the studies didn't provide any information about the reason for the preference. Moreover, the studies which used the ANOVA method, there are some post-hoc tests such as Tukey, Tamhane's T2, Scheffe and Bonferroni. The most preferred post-hoc tests are Tukey and Scheffe, but the writers didn't give any reasons to use the specific tests.

In addition to these errors, there are some theses that had specific problems. In one study, for instance, the SEM results demonstrated that NFI=.89 and GFI=.85. Those values were accepted for SEM, but they didn't give any source. In the SEM literature, NFI and GFI should be higher than .90. In general, the writers of the thesis didn't provide citations for an acceptable range of parameters in CFA, Exploratory Factor Analysis, and SEM. Moreover, some of the theses didn't state the normality check or give the results of normality tests.

The results of the document analysis revealed that there were substantial errors and deficiencies in Ph.D. theses. The writers tend to mention the assumption checking in brief.

Also, there are differences between cutoff scores and what the writers used for normal distribution. Some of the theses didn't provide any information about assumptions or the citations that they accepted.

To combine all the results from different data tools, Figure 6 was developed. This figure shows the important part of research process for Ph.D. students.

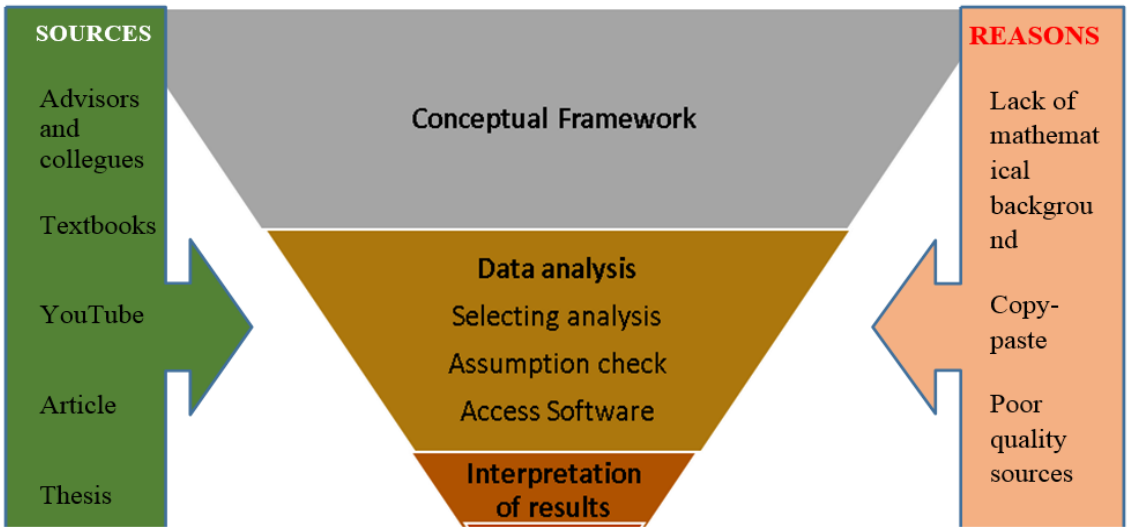

Figure 6. Themes in trends and problems in quantitative research

DISCUSSION & CONCLUSION

Recent years have certainly seen more pressure for promoting research skills to publish high-quality journal articles. Although the reports showed that the rate of the articles in a higher-ordered journal is low compared to OECD countries, identifying the problems and trends may help the early carrier researchers in Turkey. This study aimed to identify the current trends and issues in quantitative research for educational researchers. Also, this research intended to demonstrate the current situation in educational research and provides new research directions for future studies.

At the beginning of the study, the curriculums of the Ph.D. programs were examined in terms of statistics courses. Mandatory educational statistics courses are provided only to 26% of the Ph.D. programs. This showed that students who graduated from Ph.D. programs were not capable of educational statistics and quantitative research methodology. Aslan (2010) has researched graduate students who enrolled in Turkish Education and claimed that almost all of the participants didn't have experience with qualitative and quantitative research methods. Akgün and Güntaş (2018) conducted a study to investigate the graduate students' scientific research skills according to

their advisors. They found that graduate programs were not contain adequate education for developing research skills. This result is similar to the findings in the current research. It can be concluded that graduate students were not satisfied with the courses that they took in educational statistics.

In the second phase of the study, the tendencies of Ph.D students in terms of quantitative research were presented. The results showed that the Ph.D. students employed survey design, correlational design, scale development, and modification and experimental design to explain the data. Another important result obtained through this study was that descriptive statistics (i.e., frequencies, mean, and standard deviation), univariate statistical techniques (i.e., correlation, simple linear regression, t-test, reliability coefficients, and ANOVA) and factor analytic techniques were the most frequently used in education research. The results revealed that multivariate statistics (such as SEM and MANOVA) and more complex designs (such as cause-and-effect designs and meta-analysis) were not preferred by educational researchers. The current results supported the previous studies. For instance, Özaydın-Özkara (2019) examined 830 articles in 14 educational journals in Turkey and found that survey designs (descriptive and correlational models) and experimental designs (quasi and real experimental designs) are frequently used by the researchers. Also, Kutluca et al. (2017) evaluated 525 articles published in Turkish journals between 2011 and 2015. In that article, they point out that t-test, descriptive statistics, and ANOVA were mostly used data analysis techniques. Moreover, the survey results showed that SPSS is a popular statistical package to analyze the data in quantitative research. Similar results were found in the literature (Doğan and Tok, 2018; Muenchen, 2019). Doğan and Uluman (2016) examined 1627 articles and they found that SPSS and LISREL were the most used statistical soft wares in education literature.

Even though Ph.D. students tend to use descriptive statistics and univariate statistical techniques more frequently, the results of the questionnaire and lecturer interview revealed that novice researchers had difficulties in deciding and applying these methods to data analysis. Büyüköztürk and Köklü (1999) conducted a study with academicians, and they mentioned that the graduate students had difficulties on statistics and research methodology.

The next part of the study focused on the issues in the educational research. The main challenge faced by Ph.D. students is deciding the research methodology. The results revealed that researchers should be aware that research design and variable type determine the data analysis technique to be used. Based on the nature of the variables and study design, the researchers can determine the statistical analysis method. The scaling of independent variables and the assumptions of the statistical analysis are matters to select an analysis method. Hence, it is important to learn the basic terminology in statistics before the analysis. In conclusion, the analysis results of the questionnaire and review of the thesis indicate that Ph.D. students had difficulties in deciding the appropriate test for research problems. The study by İlhan (2016) in the literature reached similar results and he concluded that some researchers select the statistical method improperly.

Multivariate analysis methods are complex to use but crucial for multiple dependent variables in a study. Multivariate methods can decrease the type 1 error and can allow determining the complex relationships. Previous study results demonstrated that descriptive statistics and factor analysis were mostly used by educational researchers. However, the lecturers in the study stated that graduate students had problems in multivariate statistics (e.g., EFA and CFA) and even in basic statistics (e.g., descriptive statistics). The review of the Ph.D. thesis supported the same result. Assumption checking in multivariate statistics could be especially problematic. Moreover, some of the authors of the theses preferred the wrong method to analyze their data. The mistakes in statistical approaches are in line with the results in the study by Jaykaran (2010) and Evrekli et al. (2011). Balcı and Keleş (2011) showed that some researchers preferred parametric analysis techniques without considering whether the data was normally distributes. Another study was conducted to evaluate the repeatability of factor analytic techniques in educational research articles (Aydın, Kaplan, Atılgan & Gürel, 2019). This study examined the 275 articles and the findings demonstrated that most of the articles didn't claim about the structure of variables and

assumptions they need to check. Başman et al. (2018) examined the thesis in educational science and found that graduate students tend to check sample size correctly; however, normality and homogeneity of variances are still problematic. Furthermore, more than half of the graduate theses didn't provide the evidence of assumption checking for normality, homogeneity of variance, multicollinearity, autocorrelation, and linear relation. For normality assumption, Demir et al. (2016) designed a study to examine the 788 articles in 5 international journals. They concluded that 60.9% of the articles didn't provide information about the data distribution. Moreover, 40 articles claimed that they tested normality but didn't give the technique that they used. The validity and reliability of research results can be affected by the inappropriate statistical method used.

İlhan (2016) also claimed that the researchers could not interpret the results of statistical analysis correctly. Moreover, Karadağ (2010) examined the quality of research, and types of analytical error in doctoral dissertation in the area of educational sciences. He found that the authors could make mistakes to interpret the outputs from statistical softwares. These findings are similar to the results of the current study. The findings of the questionnaires demonstrated that interpreting the output was difficult if the researcher didn't know the concept of statistical technique.

Another important contribution of the study is about sources for help. Educational researchers tend to get help from advisors or colleagues at first and it was followed by textbooks and YouTube videos. Moreover, SPSS is the most used software in the Turkish education literature, but the researchers need to know the background of the analysis before they interpret the tables in the SPSS output.

Creswell (2012) mentioned some problems in educational research. According to him, publishing in a higher-order journal didn't mean it is good to research. One of the major problems in educational studies is questionable data. This situation may be caused by inarticulate statements about the study aim, unrepresentative sample group, low-quality instruments, and inappropriate statistics for data analysis. As a reader, we need to evaluate journal articles in detail and seek for different findings to find a way for our own research. To over this issue, Karasar (2016) gave some suggestions for research methodology education. Research methods, statistics, measurement and evaluation, and computer areas should be combined to develop a research methodology course curriculum for graduate students.

There are several obvious reasons why conducting good quantitative research is challenging. The quality of graduate school education, fundamental statistics knowledge, adequate practice, finding the right source are some of them. The current study results revealed that the graduate school curriculum doesn't contain adequate statistics and research methodology courses. In addition, educational researchers didn't have enough mathematical background. Moreover, the researchers tend to copy and paste the sources that they used (in print or online). They also cannot inference the findings of analysis.

Practical Implications

This study has some limitations. The data was collected in a limited area which is educational research, but a study can be conducted for social science. This study is only focused on the current situation in quantitative research in education literature. However, there are also problems and misconceptions in qualitative research in Turkey. It is thought that it will be beneficial to examine the qualitative research and identify the errors.

Regarding the results of this study, there are some implications that can be taken into consideration for educational researchers and policymakers.

Researchers need to select appropriate statistical methods that suit their aim and variable type. Hence, it is better to be familiar with the data collection tools and variables intensely.

This study demonstrated the most and the least studies of statistical methods in educational literature. Understanding the reason why some methods are less popular for educational researchers would contribute richly to the literature. The studies should not prefer univariate statistics but try to practice more complex designs and statistical techniques to examine complex issues. Educational researchers must be encouraged to use advanced statistical techniques in different fields. Additionally, educational researchers need more advanced statistical courses or workshops. Institutes of Education would offer scale development, structural equation modeling and multivariate regression courses to the graduate students; hence, this might help improve some of the problems such as assumption checking and inferences from the output.

An intervention wasn't in the scope of this study. Future research can provide a seminar to the educational researchers to overcome the problems and examine the differences via experimental design. As indicated by the current study results, educational researchers need assistance in selecting the test, applying the test, and interpreting the output. Future studies may focus on improving the researchers' skills in problematic steps.

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Ethical Approval Ethical approval was granted by the Social Science Research Ethics committee at Eskişehir Osmangazi University (reference number: 64075176-900-E.128269).
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Appendix A. Online Questionnaire 1

1. What do you think is the most difficult topic in statistics for graduate students? Why?
2. What do you think are the difficulties when analyzing data?
3. What are the recommendations to the early carrier educational researchers?

Appendix B. Evaluation Matrix

Criteria	Thesis 1	Thesis 2	Thesis 3	Thesis 4
Thesis number				
Thesis name				
Department				
Statement of purpose				
Research methodology (Quan:1, mixed:2)				
Research design				
Define variables specifically (Yes, No)				
Compatibility of the statistical tests with purpose (1-10)				
Are they careful to use the parametric and non-parametric tests?				
Are there errors and typos in data analysis part?				
type of the scale(s)				
Is the data normally distributed? If yes, is there any statement?				
What type of normality test was used?				
Which statistical techniques were used in the thesis?				
Which statistics software was used?				