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RESEARCH IN PHYSICS EDUCATION: A STUDY OF CONTENT ANALYSIS

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ABSTRACT: The current study is a content analysis of research in Physics education published between 2008 and 2013, which was obtained from the Turkish national academic network and information center (ULAKBIM) and EBCSO. Its goal is to guide researchers who plan to undertake studies in this field by describing the tendencies of 105 papers on physics education in terms of their methodology, subject areas, research titles, data analysis strategies, and sampling kinds. The study's data is presented in visual, frequency, and percentage tables. According to the findings, the majority of physics education research was conducted in 2013. When physics is used as a subject title, it is discovered that a large portion of the studies are about mechanical physics and electric physics; however, when they are analyzed from the perspective of their research titles, it appears that teaching methods and cognitive dimensions have gained prominence. The study's findings show that the majority of physics education studies are quantitative in design; achievement tests, interest tests, attitude tests, and aptitude tests are primarily employed as data collection tools; and a descriptive analysis method is used for data analysis. Furthermore, the researchers decided to select their sample group from secondary school pupils, with sample sizes ranging from 31 to 100 individuals. In this study, the researchers of physics education are given the essential advice.

Keywords*:* Physics education, educational research, content analysis, scientific research methods.

1. INTRODUCTION

Scientific education research is crucial to a nation's educational development (Ark and Türkmen, 2009). The field of education studies has grown rapidly. Some studies in this field study the literature to evaluate research credibility, while others suggest education system reforms (Karada, 2009).

Technology has changed schooling and other areas of life. Technology provides rapid dissemination of many types of information to large numbers. Citations include Civelek (2013), Arslan (2011), Cheung (2013), and Demirel (2009). Countries endeavor to establish a qualified and efficient tech workforce to stay competitive in research and technology. Because of rising interest in science and math, governments have prioritized them in schools (Sztajn, 1995). Science and math underpin technology. Technological progress depends on physics research (Bodur, 2006). Physics is integral to current technology. Most technology relies on physical principles (Fishbane, Gasiorowicz, and Thornton, 1996; Dorothy and Siraj 2010).

Research is essential to field education (Apaydn, 2009). Teachers, students, and educators should use science research trends to guide scientific debates. Educational researchers must periodically review and structure research to study important topics (Cohen, Manion, &

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Morrison, 2007). A thorough review of all studies will help researchers use them (Cohen and Manion, 1990).

Reading the literature may reveal education research. A 2004–2011 study by Bacanak, Deirmenci, S. Karamustafaolu, and O. Karamustafaolu examined scientific education publications and research methods. O. Karamustafaolu (2009) and colleagues categorized 2000–2009 primary science and technology education studies by theme.

O. Karamustafaolu recognized key education topics in 2009, guiding scholars. Tatar and Tatar (2008) examined Turkish science and mathematics education research from 2000 to 2006. Ulutaş and Ubuz (2008) examined articles from Educational Research, Faculty of Education, Hacettepe University, Elementary Education Online E-Journal, and Turkish Education Association Education and Science to evaluate mathematics education research.

The study examined 2000–2006 articles. The study found a research gap in mathematics teaching and suggested more research. Hart et al. (2009) classified 1995–2005 mathematics education research by methods. The poll found that 50% of publications utilized qualitative methods, 21% used quantitative methods, and 29% used both. Lubiensky and Bowen (2000) found that 1982–1998 mathematics education research focused on gender, ethnicity, socioeconomic class, and opportunity disabilities using ERIC data.

The most common activities were scientific learning and teaching, student growth, teacher behaviors, curriculum, and technology. Several international scientific journals have examined their practices using document analysis. Domestic literature can reveal content analysis research. (2010), Gülbahar and Alper (2009), Yalçn et al. (2009), Başol (2006), ahin (2005), Bayraktar (2001-2002).

All branches of research face major issues. Some studies agree, others disagree. Falkingham and Reeves (1998) show that content analysis is routinely used to evaluate studies. Grouping studies into one will aid researchers and guide future research (McDermott and Redish, 1999). The literature review discovered little physics education content analysis research.

This study analyzes ULAKBM and EBSCO data on physics education. The literature review discovered few content analysis studies on physics education, stressing the need for this effort. Physics education research defines methodology, subject areas, study titles, data analysis methods, and sampling groups to guide researchers, educators, and scholars.

This study seeks answers to these questions:

- How are the articles within the context of the study distributed by years?
- How are the articles according to their physics titles within the context of the study distributed?
- How are the articles according to their research titles within the context of the study distributed?
- Most of which research method and design are the articles within the context of the study conducted?
- Which data collection instruments are mainly used in the articles within the context of the study?
- What are the most common sampling type and sampling size used in the articles within the context of the study?

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- How are the data analysis techniques and numbers in the articles within the context of the study?
- How are the articles according to the number of their authors within the context of the study distributed?
- How are the articles according to the number of sources used within the context of the study distributed

2. METHODOLOGY

Model of the Study

This study makes use of document scanning, which is the best way for undertaking content analysis. Content analysis, a qualitative research technique, entails the statistical arrangement of textual elements (Bauer, 2003).

Analysis of the Data

For the data of the study, the research on physics education published between the years of 2008 and 2013 in the data bases of EBSCO and ULAKBIM was scanned. The scanning was confined with "physics education", "educational research", "content analysis", "scientific research techniques" key terms and years from 2008 and 2013. While carrying out the content analysis, the sub objectives of the study are utilized as the basis for evaluating the criteria. The requirements are as follows;

- Publication year
- Physics subject titles
- Research titles
- Research methods
- Research models
- Data collection instruments
- Sampling type and size
- Data analysis techniques and numbers
- Number of authors
- Number of sources used

3. DATA ANALYSIS

Articles that meet the ten basic titles are evaluated for physics subject titles, research titles, research methods, research models, data collection instruments, sampling type and size, data analysis techniques and numbers, number of authors, and number of sources used. The previous study was reviewed, and the titles of Kayhan and Koca (2004) were updated to develop a uniform vocabulary for categorizing future physics education studies. When examining two or more dimensions, the characteristics of each dimension are treated independently. If both teachers and students participate, the study is divided into two groups for sampling. The study was separated into ten major titles and examined in Microsoft Excel 2013. The information is displayed graphically in percentage and frequency tables.

FINDINGS

In this section, the findings of the physics education research are presented in chronological order, along with their interpretations.

The Distribution of Physics Education Research by Years

Table 1 displays physics education research numbers and percentages from 2008 to 2013. According to the data, the study numbers from 2008 to 2012 are comparable. However, the number of publications increased dramatically in 2013.

Table 1.The distribution of the number of articles by years between the years of 2008 and 2013

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Years	Frequency(f)	Percentage(%)
2008	17	16.19
2009	18	17.14
2010	16	15.24
2011	17	16.19
2012	14	13.33
2013	23	21.90
Total	**105**	**100**

The Distribution of Physics Education Research According to Their Physics Subject Titles

The articles examined categorize subjects according to physics subfields. Physics subfields include mechanics, electricity, magnetism, atoms, thermodynamics, optics, and nuclear physics. Papers in physics without subfields are intended for the mixed category. According to Figure 1, mechanics and physics account for 30% of research. Nuclear physics research is also in short supply (1.90%).

Figure 1. The distribution of articles examined according to their physics subject titles

The Distribution of Physics Education Studies According to Their Research Titles

Table 2 depicts the distribution of physics education publications by research title from 2008 to 2013, based on data from the ULAKBM and EBSCO databases. Previous physics education studies were reviewed, and the names of Kayhan and Koca (2004) were changed to better classify future studies and create a uniform language. These are the types of research titles:

- Emotional Dimension
- Cognitive Dimension
- Success
- Education Technology
- Teaching Methods
- Teacher Training Programme in Science/Physics Education
- Assessment and Evaluation

It is clear that physics education research (34.28%) focuses on instructional methods. Following teaching style, cognitive (19.15%), emotional (12.38%), assessment and evaluation (12.30%), physics teacher training programme (11.42%), and education technology (8.57%) were the next most important factors. Success is the attribute that has received the least attention (1.90%).

Table 2 The distribution of studies examined between the years of 2008 and 2013 according to their research titles

Subject Variables	f	%
Emotional Dimension	13	12.38
Cognitive Dimension	20	19.15
Success	2	1.90
Education Technology	9	8.57
Teaching Methods	36	34.28
Physics Teacher Training Programme	12	11.42
Assessment and Evaluation	13	12.30
Total	**105**	**100**

The Research Methods Used in the Physics Education Research

Table 3 shows research approaches for physics education research from 2008 to 2013, based on data from the ULAKBM and EBSCO databases. The quantitative method (55.24%), the qualitative method (37.14%), and the mixed method (7.62%) were used by the researchers.

Table 3. The research methods of the examined studies

Research Methods	f	%
Quantitative	58	55.24
Qualitative	39	37.14
Mixed	8	7.62
Total	**105**	**100**

The Research Designs Used in Physics Education Research

Table 4 summarizes the article research design outcomes from the study. Semi-

experimental design, a quantitative research method, is used the most (19.05%) in experimental investigations, according to these figures. However, for full and weak experimental designs, 7.62% and 2.86% are utilized, respectively. There were no single-subject studies in the papers reviewed. The descriptive design is used in the majority of non-experimental research models (12.38%). Researchers choose comparison (2.86%) and correlation (1.9%) designs and use 8.57% scan patterns. Literature (26.66%) and concept analysis (10.48%) are preferred in qualitative research. In mixed methods research, exploratory studies (4.76%) outweigh explanatory studies (2.86%).

Table 4. The research designs of the examined studies

Research Design			f	%
Quantitative	*Experimental*	Fully Experimental	8	7.62
		Semi-experimental	20	19.05
		Weak experimental	3	2.86
		Single subject	0	0
	Non-experimental	Scan pattern	9	8.57
		Descriptive	13	12.38
		Comparative	3	2.86
		Correlation	2	1.9
Qualitative		Literature	28	26.66
		Concept analysis	11	10.48
Mixed		Explanatory	3	2.86
		Exploratory	5	4.76

Data Collection Instruments and Their Numbers in Physics Education Research

Table 5 covers the data collection tools used by physics education researchers. According to the data collection instruments in the papers, some research use several data collection methods, such as achievement exams and interviews. Each data instrument is coded, and the frequencies are set. As a result, Table 5 contains more frequencies than Table 1. The most common exams are achievement (28.12%) and interest, attitude, and aptitude (23.75%). The collection of documentary data is less valued by physics education researchers. Notably, the researchers do not use observation.

Table 5. The distribution of data Collection Instruments

Data Collection Instruments	Frequency(f)	Percentage(%)
Multiple Choice	34	21.25
Open ended	11	6.87
Questionnaire	**31**	19.38
Likert Type	27	16.87
Open ended	6	3.75
Interest, attitude, aptitude tests.	**38**	23.75
Interview	**26**	16.25
Structured	7	4.37
Semi-structured	15	9.37
Unstructured	3	1.87
Unspecified	1	0.62
Documents	**20**	12.5
Observation	**0**	0

Figure 2 depicts the data collection instrument numbers. One data collection instrument is preferred (64.76%), whereas three or more (11.44%) are disliked. In 23.80% of the studies, two data gathering tools were preferred.

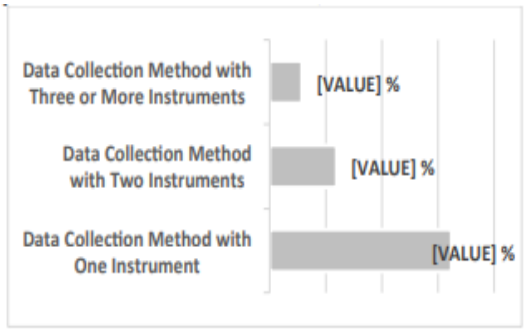


Figure 2. The distribution of the numbers of data collection instrument used

The Sampling and Sampling Size Used in Physics Education Research

Table 6 presents outcomes from physics education research conducted between 2008 and 2013 utilizing the ULAKBM and EBSCO data sets.

Some research studies use only one sort of sampling, while others use several. Coding

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is used to assess articles with various methods of sampling. Each sampling type was recorded separately if a study included secondary school students and teachers. As a result, the sampling-type-specific data number rather than the publication number was taken into account. The articles are dominated by secondary school students (39.05%) and instructors (36.19%). Postgraduate students (0.95%) and families (1.90%), on the other hand, are rarely sampled. Because publications use a variety of sample methods, the total proportion of sampling is greater than 100%.

Table 6. The distribution of the sampling types used and their usage percentages in articles

Sampling Types	f	%
Secondary Education	41	39.05
Students of the Faculty of Education	34	32.38
Postgraduate	1	0.95
Teachers	38	36.19
Families	2	1.90
Other	6	5.71

Figure 3 shows that physics educators studied in groups of 31-100 (41.90%). They also disliked working with more than 1000 (2.86%) people. The percentage of papers that do not include sample size information is 0.95%.

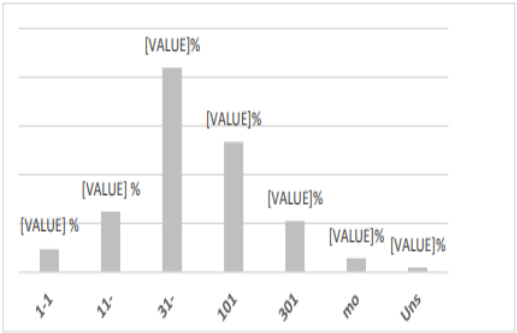


Figure 3. The sampling size that physics educators use

Data Analysis Methods and Numbers Used in Physics Education Research

Table 7 displays data analysis approaches and tactics from physics education articles published between 2008 and 2013. The most commonly utilized descriptive methods in quantitative data analysis are frequency/percentage (15.24%) and mean/standard deviation (8.57%). The most commonly utilized prediction methods are the T-test (13.33%) and ANOVA/ANCOVA (7.62%). One of the qualitative data methodologies that gained popularity was descriptive analysis (27.62%).

Table 7. The distribution of data analysis method and techniques

Data analysis method and techniques			f	%
QUANTITATIVE	*Descriptive*	Frequency/Percentage/Chart	16	15.24
		Mean/Standard Deviation	9	8.57
		Illustrating with Graphics	2	1.90
	Predictive	T-test	14	13.33
		ANOVA/ANCOVA	8	7.62
		Correlation	3	2.86
		Factor Analysis	3	2.86
		Non-parametric tests	6	5.72
		Regression	2	1.90
		MANOVA/MANCOVA	2	1.90
QUALITATIVE		Descriptive Analysis	29	27.62
		Content Analysis	11	10.48

According to Table 8, 73.33% of the researchers selected to use a single type of data analysis approach. While research has been conducted utilizing two unique data analysis approaches (18.10%), using three or more strategies (8.57%) is not advised.

Table 8. The number of data analysis methods used in the research

Number of Data Analysis Method	f	%
Single data analysis method	77	73.33
Two different data analysis method	19	18.10
Three or more data analysis method	9	8.57

Author Number of the Physics Education Research

Table 9 shows the number of physics education authors from 2008 to 2013. There are 219 authors listed in the scanned papers. Two people contributed 54 articles, while four contributed eight.

Table 9. The distribution of articles according to their author number

Author Number	f	%
1	25	23.80
2	54	51.42
3	18	17.14
4	8	7.61

Source Number of the Physics Education Research

Table 10 summarizes the study's findings based on the number of physics education research sources. The sources used in the articles are largely between 61 and 100, with less between 31 and 60. It's also worth noting that no study includes more than 100 sources.

Table 10. The distribution of articles according to their source number

Source Number	f	%
1-30 sources	45	42.86
31-60 sources	52	49.52
61-100 sources	8	7.62
101-300 sources	0	0

4. DISCUSSION AND RECOMMENDATIONS

The current study analyzes content. The study reveals physics education research trends to help scholars. ULAKBM and EBSCO databases were utilized to examine 2008–2013 physics education research.

The annual count of physics education research articles was consistent from 2008 to 2012. Article publication also increased significantly in 2013. Recently, science education has garnered attention, prompting the Higher Education Commission to reorganize educational faculty. Studies by Karamustafaolu (2009) and Salam Arslan and Paliç (2012) favor additional physics instruction.

Physics-focused analysis of the study's articles shows that mechanics and electrical physics are prioritized above other fields. It is expected to rise in solid-state, nuclear, and atomic physics.

According to the report, educational approaches and cognition are prioritized. This matches Kayhan and Koca (2004). Some studies have examined emotional and assessment-evaluation qualities, but others have called for greater research.

Analysis showed a considerable use of quantitative methods. This study uses few qualitative methods. Imşek (2008) and Ark and Türkmen (2009) found similar results. They also preferred quantitative methods. Only a few mixed method research publications use qualitative and quantitative methods. Quantitative studies use numbers, while qualitative research assess findings in their natural environment (Creswell, 2003). Detailed physics education research requires qualitative methods. These are research suggestions. Mixed studies utilize qualitative and quantitative methods to analyze and evaluate data, according to Creswell (2003). Research journals have few inconclusive results. According to the report, more thorough and qualitative physics education studies are needed. Multiply and analyze data from multiple categories.

Experimental design is a common quantitative method in this research. The experimental design manages variables,

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environmental circumstances, and sampling to detect correlations. Experimental design is common in physics education research. Qualitative research emphasises contemporary material analysis.

Researchers choose accomplishment, interest, attitude, and aptitude tests. No study employed observational methods since data collection takes time. Achievement evaluations are the most popular data gathering method in math and science, according to imşek (2008). This study demonstrated a correlation between achievement tests and quantitative studies. More research instrument ratings (64.76%) are based on a single data collection instrument. Increased quantitative investigations may explain this conclusion. To assure physics education research reliability and accuracy, use multiple data collection methods.

Physics education articles often sample secondary school pupils, educators, and education students. Researchers may employ certain groups more due to their accessibility. Professors should prioritize faculty education to improve physics education. Physics educators often employed 31-100 and 101-300 sampling groups, according on relevant literature. This shows that smaller samples are better. This may be because small sampling groups capture data faster. It supports Göktaş et al. (2012) research.

Due to their preference for quantitative study, physics instructors employed descriptive analysis. Another prevalent occurrence is individual data analysis (73.33%). The study examines how a single variable affects the research problem and provides quick solutions utilizing one data analysis method. Multiple data analysis methods are recommended to validate the study's reliability and validity.

Three-quarters of articles have one or two authors. This indicates physics education research lacks teamwork. Multi-author papers are rare due to insufficient teamwork and confused tasks. This could damage the study's credibility (Emirolu, 2005).

Research shows 31 to 60 sources are used. There are few papers with 61 to 100 sources and none with more than 100. Thus, a thorough literature review and current sources are essential for tracking this field's progress.

Content analysis research can help academics and educators discuss physics education research subjects, methodology, and data analysis. Given the lack of content studies in physics education, studying experts' research interests should boost their enthusiasm. Physics education research should be included in Turkish Republic of Northern Cyprus journals, particularly in the ULAKBM and EBSCO indexes.

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