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A Systematic Review of the Studies on WebQuest: Reflections to Mathematics

Buse SAK[1]

Mevhibe KOBAK DEMİR[2]

[1] Balıkesir University, Institute of Science, Department of Mathematics and Science Education, Balıkesir, Turkey

[2] Balıkesir University, Necatibey Faculty of Education, Department of Mathematics and Science Education, Balıkesir, Turkey

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Sorumlu Yazar/Corresponding author: Mevhibe KOBAK DEMİR
E-mail: mevhibekobak@balikesir.edu.tr

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ABSTRACT

The aim of this study is to determine the general trends of the studies on WebQuest in the field of mathematics education. This systematic review was conducted on 46 published studies from the beginning until 2023. The results after thematic analysis were presented through frequency and percentage values, tables and graphs. According to the results of the research, the first study on WebQuest in the field of mathematics education belongs to 2001. Half of the studies were published after 2014. It was concluded that the majority of the studies examined were in English and article type, the effect of WebQuest on academic achievement and the opinions on WebQuest were mostly examined. It was determined that the WebQuests prepared within the scope of the studies were on geometry and measurement. Methodologically, while the majority of the studies were prepared with a quantitative approach, adopting an experimental design, scales were used to collect data and inferential analysis for analysing, purposive sampling method was preferred in the selection of participants, and the participants were frequently composed of pre-service teachers. From the results related to the distribution of research topics according to sample types; it was determined that there was no study on the effect of WebQuest on the academic achievement of primary school students, the studies investigating the attitude towards mathematics and the effect of motivation were carried out only with secondary school students. At the end of the study, the benefits and limitations of WebQuest in the field of mathematics education were revealed.

Keywords: Webquests, mathematics, education, systematic review

Introduction

Technology's acceleration of globalization and digitalization has resulted in a change in the competencies required for individuals to be successful in their personal and professional lives. To adapt to these changes, it's crucial to have the necessary skills. The 21st century skills are constantly being updated with technological developments, but their characteristics include creativity, flexibility, adaptability to changing conditions, effective problem-solving, critical thinking, cooperation, and effective communication. In the information age, the search for skilled personnel has led to a shift in educational paradigms. WebQuests are an specialized web-based learning activity designed to promote research, inquiry, collaboration, critical thinking, creative problem-solving, information literacy, and communication skills. Developing 21st-century skills can be achieved through these teaching strategies (Bayram et al., 2019; Faraniza, 2021; Levin-Goldberg, 2014; Polly & Ausband, 2009).

WebQuest, created by Bernie Dodge in 1995, is defined as an inquiry-oriented activity where students interact with information from the Internet, optionally supported by video conferencing (Dodge, 1997). WebQuest, which is based on the theoretical foundations of constructivism, cooperative learning, scaffolding and fading model (Crawford & Brown, 2002), is an effective method that helps students acquire new knowledge as a guide in the learning environment and organises irregular Internet resources (Patterson & Pipkin, 2001). It has become popular (Lipscomb, 2003) due to its numerous benefits, such as enhancing individuals' motivation, supporting their problem-solving skills (Shang et al., 2015), providing a multifaceted perspective that requires high-level thinking skills (Fiedler, 2002), and contributing to the development of personal expertise (March, 2003). According to March (2007), WebQuests are becoming popular among educators for their ability to engage students in motivating activities that promote critical thinking. As a matter of fact, studies on WebQuest in Web of Science (WOS), which enables researchers to access the most relevant and prestigious publications, show that it has remained popular for about 30 years (Figure 1).

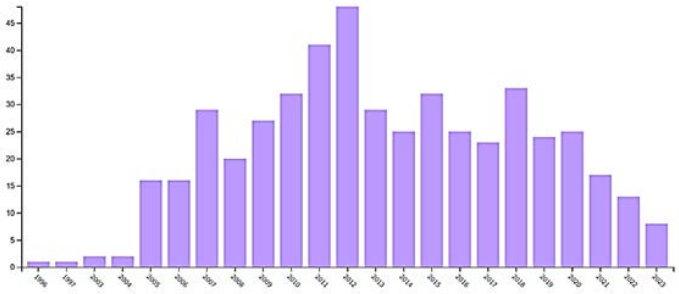

Figure 1.
Distribution of studies on webquest by years (WoS database)

Since 2004, there has been an increase in the number of studies on WebQuest from the Scopus database as depicted by the distribution of studies by year in Figure 2.

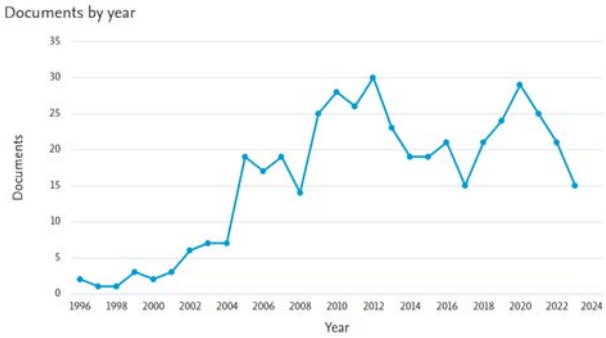

Figure 2.
Distribution of studies on webquest by years (Scopus database)

Changes in educational paradigms since the emergence of WebQuest have enabled the development of WebQuest. An examination of recent studies on WebQuests shows that Web 2.0, which has been heralded as a renaissance for WebQuests, has introduced designs for the combined use of Web 2.0 and WebQuests to increase their effectiveness (Cherner & Kokopeli, 2018; Dell, 2012; Kurt, 2009; Kurt, 2010a; Kurt, 2010b; Levin-Goldberg, 2012; Lin, 2011; Lin & Ward, 2013; March, 2007; Papadopoulou, 2012). WebQuests, which were developed for the effective use of the internet, which is called ill-structured (March, 2007), have turned into WebQuest 2.0 (Dell, 2012; Papadopoulou, 2012) and Web2Quest (Kurt, 2009; Kurt, 2010b; Lin, 2011; Lin & Ward, 2013) with the enrichment of the internet with Web 2.0 tools such as social networking sites, blogs, wikis and podcasts (March, 2007). Another innovation in education is STEM education. Science, Technology, Engineering and Mathematics (STEM) education has recently become a focus of educators. The results of studies combining STEM education and WebQuest (Alias et al., 2014; Chai et al., 2020), show that WebQuest is widely and effectively used in STEM classrooms (Alias et al., 2014; Osman & Saat, 2014). The effectiveness of WebQuest applications in flipped classrooms, which bring a different perspective to learning by turning traditional classrooms inside out (Abdelghafar et al., 2022; Abdelghafar et al., 2023; Nami, 2022; Pongsawat & Jeerungsuwan, 2015; Samiei & Ebadi, 2021) shows the importance of WebQuests for learning environments.

In the literature, there are different meta-analysis, meta-synthesis, content analysis and systematic literature review studies that examine the trend of studies on Webquest from past to present. The characteristics of these studies can be seen in Table 1:

Table 1.
Review studies on WebQuest in the literature

Author	Content of the Study
Kabadayı et al. (2023)	*Method* * Mixed research synthesis * Meta-analysis for quantitative study results * Thematic synthesis for qualitative study results *Year Range of Included Studies* * 2008-2020 *Number of Studies Included* * 12 quantitative, 11 qualitative studies, 23 studies in total *Keywords Used in Identification of Included Studies* * WebQuest, WebQuest and Achievement, WebQuest and Learning, Effect of WebQuest *also in Turkish language: Ağ araştırması, ağ araştırması ve başarı, Ağ Araştırması ve Öğrenme, Ağ Araştırmasının Etkisi, Web Macerası, Web Sorgusu

Bilir (2023)	*Method* * Content Analysis * Thematic Content Analysis *Year Range of Included Studies* * 2007-2022 *Number of Included Studies* * 21 master thesis, 6 doctoral thesis, 16 articles and 3 papers, total 46 studies (in Türkiye) *Keywords Used in Identification the Included Studies* * WebQuest * In Turkish language: Ağ araştırması, Web macerası
Khairunnisa (2021)	*Method* * Systematic Literature Review *Year Range of Included Studies* * all years *Number of Included Studies* * 28 studies (in ELT) *Keywords Used in Identification the Included Studies* * use of Webquest+ webquest as learning media+ the implementation of+ Webquest+ on ELT in seven major journal databases: Taylor and Francis, Springer, Science Direct, Sage, Academic, Emerald, Wiley Online Library
Alias et al. (2013)	*Method* * Content Analysis *Year Range of Included Studies* * 2005-2012 *Number of Included Studies* * 13 studies *Keywords Used in Identification the Included Studies* * The studies on WebQuest published in Educational Technology Research and Development (ETRD), Turkish Online Journal of Education and Technology (TOJET), The Educational Technology and Society Journal (ETS), The Learning and Instruction Journal (L&I), Australasian Journal of Educational Technology (AET), British Journal of Educational Technology (BET), Computer & Education (C&E)
Abbitt & Ophus (2008)	*Method* * Content analysis * Thematic content analysis *Year Range of Included Studies* * All years *Number of Included Studies* * 58 papers, 44 articles, 2 research reports, 2 web pages, 2 theses, total 108 studies *Keywords Used in Identification the Included Studies* * "WebQuest" and "Web Quest" in databases: Educational Resources Information Center (ERIC), EBSCO Academic Search Premier, Educational Research Complete, the Education and Information Technology (ED/IT) digital library, the Ohio Library and Information Network (OhioLINK), Google Scholar

Table 1 shows that studies on WebQuest have been compiled using content analysis (Abbitt & Ophus, 2008; Alias et al., 2013; Bilir, 2023), systematic literature review (Khairunnisa, 2021) and mixed research synthesis (Kabadayı et al., 2023). In addition to the studies listed in the table, Kurt (2012) attempted to identify the principles of cognitive load theory, interactivity, accessibility, usability, and visual appearance that should underpin an effective WebQuest design. Aydın (2016) conducted a literature review of WebQuest to assist teachers in their foreign language teaching activities and to provide a basis for further research on the subject. The problem-solving nature of WebQuest activities makes them a suitable way to teach mathematics (Crawford & Brown, 2002). Therefore, it is important to identify the general tendencies of any approach, method or technique, as well as its field-specific tendencies, to guide field-specific studies and future research. In this respect, this study is thought to be important in terms of highlighting the current state of the field and identifying trends for researchers. Unlike other studies, this study attempted to identify the general trends in studies of WebQuest in mathematics education. In addition, it is intended to contribute to the field by examining the research topics focused on in the studies with which sample groups and the benefits and limitations of the results in the reviewed studies in the context of mathematics education. The main target of this research is

to present problems not investigated in the literature to mathematics educators who will study on WebQuest.

This study aims to contribute to the literature by compiling existing studies on WebQuest in mathematics education. The objective is to identify trends of the WebQuest instructional strategy in the field of mathematics education related to WebQuest. In line with the research objective, answers were sought to the following sub-problems:

1. What are the characteristics of the studies conducted on WebQuest in the field of mathematics education in terms of demographic information?
2. What are the characteristics of the studies conducted on WebQuest in terms of content?
3. What are the characteristics of the studies conducted on WebQuest in terms of methodology?
4. What are the results obtained in the studies conducted on WebQuest in the field of mathematics education?

Methods

In this study, the systematic review method was adopted since it was aimed to determine the general trends of the studies on WebQuest in the field of mathematics education and to make inferences from the general results in the literature and to reveal the gaps by analysing and interpreting them according to certain criteria. Systematic review is a research activity in which data are obtained from primary study data rather than direct applications (Needleman, 2002). In this study, the internationally recognised PRISMA checklist was used for reporting systematic review studies. The process of this study is shown in Figure 3 within the framework of the PRISMA checklist:

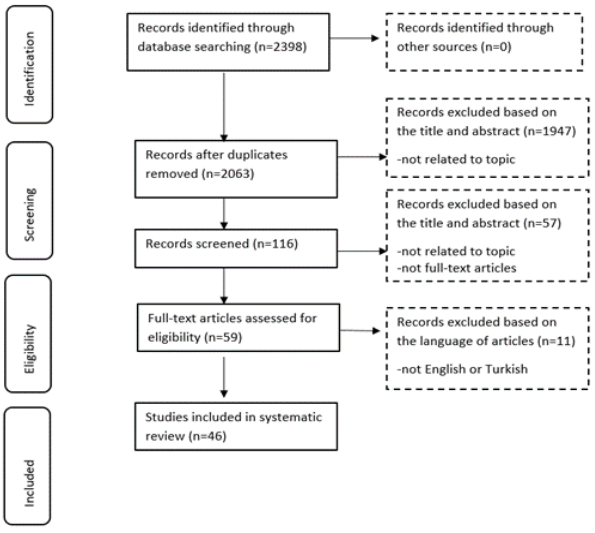

Figure 3.
PRISMA checklist for reporting systematic review studies

In the study, firstly, studies containing keywords in their abstracts and titles were determined as a result of the search conducted in the determined databases (n=2398). In the second stage, the same studies reached in different databases were eliminated (n=2063). The next stage was the elimination of studies containing relevant keywords in their abstracts and titles but not related to the research topic (n=1947). After eliminating the remaining studies (n=116), the studies whose full texts could not be reached (n=57) and those not published in English or Turkish (n=11), 46 studies were included in the study.

A total of 46 studies related to WebQuest in mathematics education from its creation in 1995 to the present day (01.11.2023), were reached by using the keywords "WebQuests and mathematics" and its Turkish translation “WebQuest ve matematik”, "Ag arastırması ve matematik", “ag sorgulaması ve matematik”, “ağ araştırması ve matematik”, "web macerası ve matematik" in the databases such as Council of Higher Education (CoHE) national thesis search centre, proquest, google scholar, science direct, national academic (ULAKBIM), scopus, web of sicence, Educational Resources Information Centre (ERIC), Education Full Text (H. W. Wilson), Taylor & Francis, Australian Education index, British Education index, EBSCO Academic Search Premier and Educational Research Complete. In the review of the scientific studies reached in the scans, the conditions of being in the field of mathematics education, being published in full text, being open to access, and being published in English or Turkish language were sought. The reviewed studies are given in the appendix.

The studies were firstly categorized according to Abbitt and Ophus' (2008) primary classification system as Research, Descriptive, or Information. At the secondary level, the year of publication, type, source of publication, keywords used in the study, research topic, learning domain and mathematics subject to which the WebQuest is related, research model, sample type, sample size, sampling method, data collection tools, data analysis methods/techniques and the results of the studies related to WebQuest in mathematics education were examined by thematic analysis. Due to the heterogeneous nature of the articles included in the current review (i.e., quantitative experimental studies, qualitative studies, literature reviews, and case studies), it was not possible to conduct a meta-analysis or further quantitative comparison. Therefore, the results were analysed using thematic analysis. To ensure validity and reliability in determining themes and reduce researcher bias, we followed the Collaborative Constant Comparative Qualitative Analysis

Process (Richards & Hemphill, 2018) guideline. Consensus coding was performed through the constant comparative method (Strauss & Corbin, 2015) in weekly meetings, and disagreements were discussed until the coders reached consensus.

The ethical process in the study was as follows:

- Ethics committee approval was obtained from Balıkesir University Science and Engineering Sciences Ethics Committee (Date: 28.02.2023, Number: E-19928322-108.01-235510)

Results

In this part, the results of 46 included studies on WebQuest in mathematics education were presented.

Analysing the Studies in Terms of Demographic Information

The distribution of studies analysed within scope of this study by years is shown in Table 2 and the change by years is shown in Figure 4.

Table 2.

Distribution of studies by years

Year	Code	f	Year	Code	f
2001	A24	1	2014	A11,A19,A25	3
2002	A21,A39	2	2015	A18	1
2005	A1,A37	2	2016	A23,A38,A40,A42	4
2007	A2,A9,A22,A35	4	2017	A8,A14,A43	3
2008	A15,A28	2	2018	A10, A41	2
2009	A29,A32,A36	3	2019	A33	1
2010	A12,A20	2	2020	A17	1
2011	A4,A5,A16	3	2021	A26,A31,A44	3
2012	A13,A27,A30	3	2022	A46	1
2013	A6	1	2023	A3,A7,A34,A45	4

Upon examining Table 2, the frequencies of 46 studies published in various sources vary according to years. Although WebQuest was introduced in 1995, the first study on WebQuest in mathematics education (A24) was conducted in 2001. While no study was found in 2003, 2004, 2006, the years in which the studies in the sources increased were 2007 (A2,A9,A22,A35), 2016 (A23,A38,A40,A42), 2023 (A3,A7,A34,A45). There are f=4 studies in these years. Although there are studies with variable frequency in terms of mathematics education literature, it can be said that WebQuest is still a model that attracts the attention of researchers and remains up-to-date. The changes in Table 2 are shown in Figure 4.

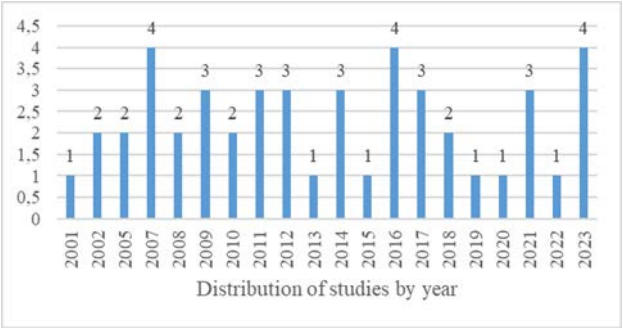

Figure 4.

The change of the studies by years

The frequencies and percentages of source languages found in the publications analysed are shown in Table 3.

Table 3.

Distribution of studies by publication language

Language	Code	f	%
Turkish	A1,A2,A3,A4,A5,A6,A7,A8,A9,A10, A11,A12,A13, A14,A20,A46	16	34.78
English	A15,A16,A17,A18,A19,A21,A22,A23 ,A24,A25,A26,A27,A28,A29,A30, A31,A32,A33,A34,A35,A36,A37,A38 ,A39,A40,A41,A42,A43,A44,A45	30	65.72
Total		46	100

It was found that 16 of the 46 studies were published in Turkish and 30 studies were published in English. The majority of the studies on webquest in mathematics education (65.72%) published in English. Since the inclusion condition for this review was articles published in Turkish and English, only these languages were analysed. Considering the foreign literature, it is expected that there are more English studies than national studies. The pie chart of the data on the distribution of studies by language in Table 3 is shown in Figure 5.

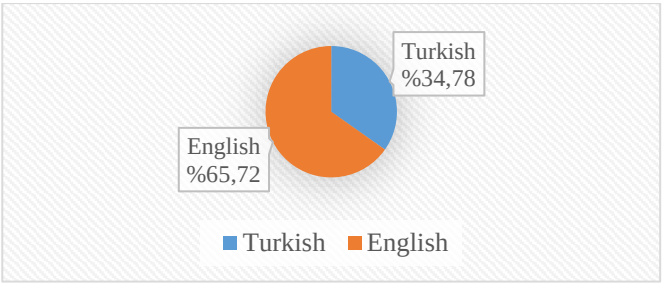

Figure 5.

Distribution of studies by language

The distribution of the studies according to the publication type are shown in Figure 6.

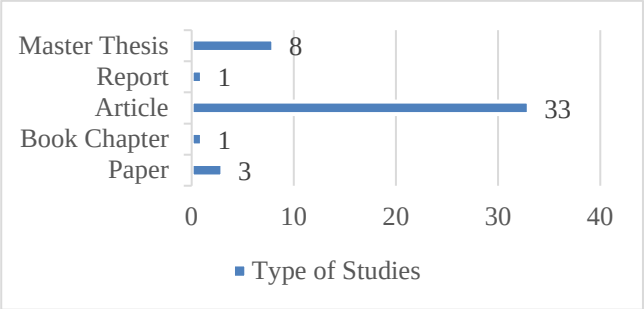

Figure 6.
Distribution of studies by type

In Figure 6, it is seen that article publication is the most common type of publication, followed by thesis and paper. Detailed analysis shows that 71.74% (f=33) were published as articles, 17.39% (f=8) as dissertations, all of which were Master's theses, 6.52% (f=3) as conference papers and 4.34% as book chapters (f=1) and reports (f=1). Table 4 shows the distribution of studies by the publication sources.

Table 4.
Distribution of studies by publication sources

Type	Publication sources	Code	f
Paper (f=3)	9th International Conference on Technology and Education: Tallahassee, Florida	A24	1
	5th World Conference on Educational Sciences - WCES İtaly	A25	1
	6th International Conference on Advanced Learning Technologies (ICALT), Austin, TX, USA	A40	1
Book Chapter (f=1)	International Research in Educational Sciences XI	A46	1
Article (f=33)	Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education	A8	1
	Elementary Education Online	A9	1
	The Journal of Balikesir University Institute of Science and Technology	A10	1
	Journal of Qualitative Research in Education	A11	1
	E-Journal of New World Sciences Academy	A12	1
	Kırşehir Education Faculty Journal (KEFAD)	A13	1
	Mustafa Kemal University Journal of Graduate School of Social Sciences	A14	1
	The Clearing House: A Journal of Educational Strategies, Issues and Ideas	A15	1
	Tojet: The Turkish Online Journal of Educational Technology	A16	1
	International Electronic Journal of Mathematics Education	A17	1
	Revista Latinoamericana De Etnomatemática	A18	1
	Computers & Education	A19	1
	Ankara University, Journal of Faculty of Educational Sciences,	A20	1
	Nade Diegest	A22	1
	Educational Research and Reviews	A23	1
	Teaching and Teacher Education	A26	1
	The New Educational Review	A27	1
	International Journal of Mathematical Education In Science and Technology	A28	1
	Turkish Online Journal of Distance Education-TOJDE	A29	1
	Teaching Mathematics and Its Applications	A30	1
	Eurasian Journal of Educational Research	A31	1
	Journal of Applied Sciences	A32	1
	International Journal of Recent Technology and Engineering (IJRTE)	A33	1
	Information Sciences Letters	A34	1
	International Journal For Technology in Mathematics Education	A35, A36	2
	Computers in the Schools	A37	1
	International Journal of Education in Mathematics, Science and Technology	A38	1
	Eric Document EA1174086	A39	1
	European Journal of Education Studies	A41	1

Report (f=1)	World Journal on Educational Technology	A42	1
	Universal Journal of Educational Research	A43	1
	Bulletin of Science and Practice	A44	1
	Chancellor's Honors Program Projects	A21	1
Thesis (f=8)	Balıkesir University Institute of Science	A1, A6, A7	3
	Eskişehir Osmangazi University, Institute of Social Sciences	A2	1
	Ordu University, Institute of Social Sciences	A3	1
	Suleyman Demirel University Graduate School of Applied and Natural Sciences	A4	1
	Gazi University, Graduate School of Educational Sciences	A5	1
	Mansoura University Faculty of Specific Education Computer Teacher Preparation Department	A45	1

According to Table 4, mostly studies (A1, A6, A7) are seen as theses (f=3) published in the same source (Balıkesir University Institute of Science). In addition, in the article category, the studies coded A35 and A36 are seen in the same source (International Journal for Technology in Mathematics Education).

Analysing the Studies in Terms of Content

In this part, the findings related to the keywords of the studies, the research topics and the mathematics subject that the prepared WebQuests focus on are presented.

The keywords specified by the authors of the reviewed study were first recorded in a Microsoft Excel worksheet, and then a word cloud was prepared with the specified keywords (Figure 7):

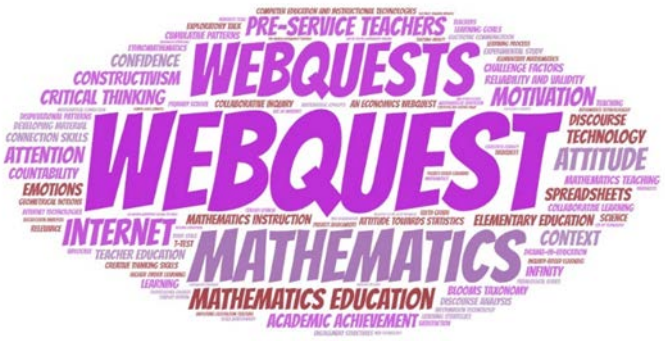

Figure 7.
Word cloud related to the keywords
Created by utilising https://wordart.com/

The word cloud highlights prominent keywords such as WebQuest, WebQuests, mathematics, mathematics education, pre-service teachers, internet, academic achievement, attitude, motivation indicating their significance in the context. Detailed analysis shows that the word "WebQuest" (f=23) and "WebQuests" (f=8) was the most used out of 161 keywords, followed by 'mathematics' (f=8) and "mathematics education" (f=7).

Table 5 shows the distribution of research topics in studies. The purposes of the studies were analysed using Abbitt and Ophus's (2008) primary classification method. According to Abbitt and Ophus's (2008) primary classification method; the studies including WebQuests such as experimental design, action research, case study, etc. were classified under the themes of research; studies in which the theoretical foundations were laid regarding the concept of WebQuest in general or the use of WebQuest in education were classified under the themes of informational and studies involving the development of a WebQuest were classified under the themes of descriptive.

Table 5.
Distribution of research topics in studies

	Research topics	Code	f
Research (f=36)	Academic success	A1, A2, A13, A19, A34, A41, A45, A43	8
	Attitude towards mathematics	A1, A2, A13, A19, A27	5
	Opinion review	A1, A6, A24, A9, A36, A38, A11, A43	8
	Critical thinking	A4, A8, A31	3
	Creative thinking	A5	1
	Motivation	A5, A16, A28, A42	4
	Learning satisfaction	A19	1
	Geometric thinking	A46	1
	Analysing mathematical discourses	A3, A37	2
	Understandings about the nature of mathematics	A18	1
	Dialogue between students	A18	1
	The ways of learning mathematics	A18	1
	Qualifications of developing WQ activities	A6, A10	2
	Levels of including connections in WQs / used Contexts in WQ activities	A6, A14	2
	Statistical literacy	A7	1
	Attitude towards statistics	A7	1
	Statistical self-efficacy belief	A7	1
	Teaching anxiety level	A32	1
	Electronic communication skills	A34	1
	Problem posing skills	A35	1
	Attention	A42	1
	Confidence	A42	1
	Relevance	A42	1
	Satisfaction	A42	1
	The higher cognitive levels of Bloom's taxonomy	A40	1
	Professional development	A26	1
	The potential to help students tolerate ambiguity associated with the dialectic interplay of collaborative inquiry	A17	1
	Scale development	A20, A23	2
Informational (f=3)	To reveal the advantages of using WQ in mathematics	A44	1
	Introducing how to use WQ in mathematics	A12	1
	To introduce the integration of WQ with bloom taxonomy and higher order thinking skills in mathematics learning environments	A39	1
Descriptive (f=7)	To introduce a sample WebQuest	A15, A21, A22, A25, A29, A30, A33	7

In terms of study purpose classification, the majority of the studies (f=36) are research studies. An analysis of Figure 7 shows that 8 of the 55 research studies focus on opinion review, while a further 8 studies focus on academic achievement. Additionally, 5 studies were conducted on attitude towards mathematics, and 4 studies were conducted on motivation. Among the 7 studies categorised as descriptive, aim to intoduce a sample WebQuest (Fig. 8).

Figure 8.

The distribution of research topics in the studies

Figure 9 displays the distribution of the learning area prepared WebQuests focus on, as found in the analysed studies.

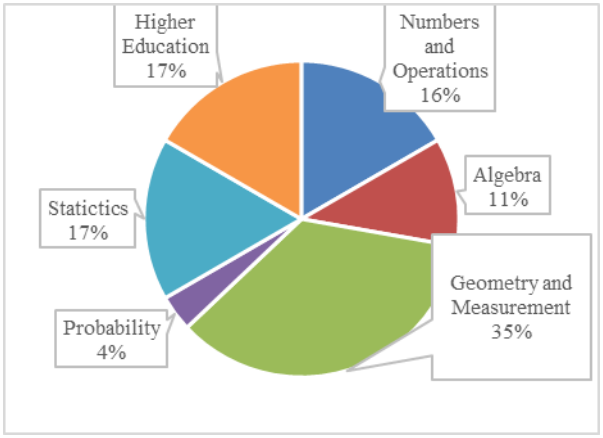

Figure 9.

Distribution of the learning area prepared WebQuests focus on

Upon examining the learning areas covered by webquests in mathematics education (Fig. 9), it is evident that the majority of WebQuests are related to the learning area of geometry and measurement (35%). In contrast, the area of probability is the least focused upon when compared to other learning areas (4%). Details regarding the frequency distributions according to the subjects related to each learning area are given in Table 6.

Table 6.
Distribution of mathematics subject prepared WebQuests focus on

LA	f	Subject	Code	f
Numbers and Operations	9	Decimal notation	A1, A17	2
		Division Operation	A2	1
		Percentages	A17, A21	2
		Ratio and Proportion	A18, A19	2
		Pattern	A18	1
		Decimal Base System	A37	1
Algebra	6	Introduction to Algebra	A40	1
		Solution of Linear Equations	A17	1
		Average Speed	A17	1
		Coordinate system	A25	1
		Cryptography associated with matrices	A21	1
		Setting up equations	A21	1
Geometry and Measurement	19	Plane and Volume Measurement	A2	1
		Geometric objects and shapes	A3, A12, A20, A29, A40	5
		Surface area and volume in prisms	A4, A8	2
		Area and volume relations of cylinder	A5, A13	2
		Volume of Cube	A17	1
		Perimeter of a rectangle	A17	1
		Perimeter of the square	A17	1
		Angles in a triangle	A17	1
		Area of Composite Shapes	A17	1
		Area of the Circle	A17	1
		Mass Unit	A17	1
		Symmetry	A18	1
		Area of Circle Slice	A46	1
Probability	2	Probability of Simple Events	A17	1
		Probability	A43	1
Statistics	9	Arithmetic Mean	A2, A27	2
		Line graph	A2, A27	2
		Histogram	A11	1
		Column chart	A20	1
		Data analysis	A43	1
		Drawing data set graphs	A21	1
		Basic statistical calculations	A21	1
Higher Education	9	Conics	A30	1
		Derivative	A33	1
		Infinity and Countability	A41	1
		Topology	A34, A38	2
		Geometry concept	A34	1
		Number concept	A34	1
		Basic maths skills	A45	1
		Descriptive and Inferential statistics	A7	1

As seen Table 6, it becomes apparent that 5 studies (A3, A12, A20, A29, A40) addressed "geometric objects and shapes" (f=5) in the "geometry and measurement" learning area (f=19). In some of the analysed studies, WebQuest was prepared by the participants (A6, A9, A10, A14, A16, A24, A28, A31, A32, A35, A36, A42). The topics covered in these studies were as follows: Introduction of three-dimensions, volume in three-dimensions, two-dimensions, perimeter and area calculations, numbers, fractions, length units in the field of geometry in the study coded A9; numbers and

operations and numbers, operations, fractions, three-dimensional shapes, volume, quadrilaterals, triangles, area, perimeter in the field of geometry in the studies coded A16 and A28; triangles or quadrilaterals in the field of geometry in the study coded A24; triangles or quadrilaterals in the field of geometry in the study coded A31; middle school 5-8. In the study coded A35, Pythagoras and Euclidean Theorems, Fractal Geometry, The Role of Graphing Calculator in Solving Equations, Mental Mathematics Basic Education, Mathematicians in Arab civilisations and Mathematics and unknown sports; in the study coded A36, triangles, circles, rectangles, area, perimeter, etc. in the field of geometry; in the study coded A42, functions, sets, logarithms, 3-dimensional figures, ratios and proportions, triangles, verbal problems, factorisation. In addition, the participants prepared WebQuests activites by choosing different levels in the mathematics curriculum for example 6-8. Grades level (A6), 5-8 grades level (A12), any mathematics subject (A10).

Analysis of The Studies in Terms of Methodology

This section presents the findings obtained from the data analysis regarding the methodological tendencies of the analysed studies. Figure 10 shows the distribution according to the research methods adopted in the studies.

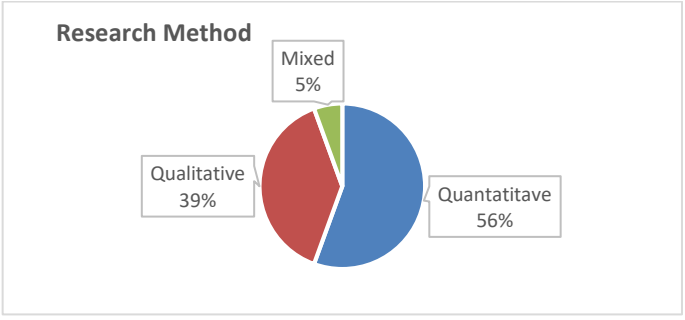

Figure 10.

Distribution according to the research methods adopted in the studies

Figure 10 shows the distribution of research methods: 56% quantitative, 39% qualitative, and 5% mixed methods. Additional details can be found in Table 7.

Table 7.

Distribution of the studies according to research methods and designs

RM	Code	f	RD	f	%
Quantitative	A2,A4,A5,A8,A10, A13,A16,A18,A19, A20,A23,A27,A28, A32,A34,A35,A40, A42,A43,A45	20	Experimental design	14	36.84
			Descriptive research	3	7.89
			Scale development	2	5.26
			Teaching experiment	1	2.63
			Correlational research	1	2.63
			Unspecified	1	2.63
Qualitative	A3,A6,A9,A11,A14, A17,A24,A26,A31, A36,A37,A38,A41, A46	14	Document Analysis	4	10.53
			Case study	3	7.89
			Phenomenology	2	5.26
			Action Research	1	2.63
			Unspecified	4	10.53
Mixed	A1,A7	2	Variation	1	2.63
			Parallel Convergent Pattern	1	2.63
Informational/ Descriptive studies		10			
Total		46			

Upon analysing Table 7, it is evident that 36.84% of the 20 quantitative studies were conducted using an experimental design (f=14), 7.89% using a descriptive design (f=3), and 5.26% using scale development (f=2). In qualitative studies, 10.53% of the studies were document analysis (f=4), 7.89% were case studies (f=3), and 5.26% were phenomenology (f=2). Mixed designs were explained as variation (f=1) and parallel convergent design (f=1) with a rate of 2.63%.

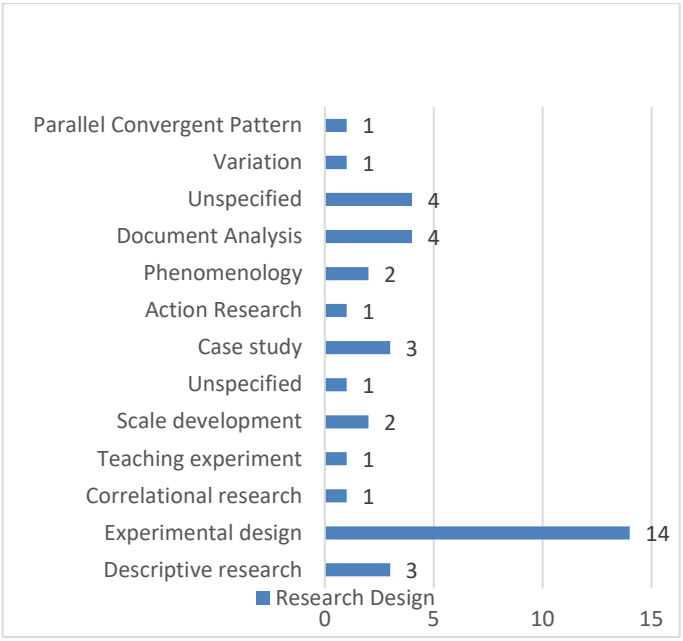

Figure 11.
Distribution according to the research design adopted in the studies

Results related to the sample group determined in the studies are shown in Figure 12.

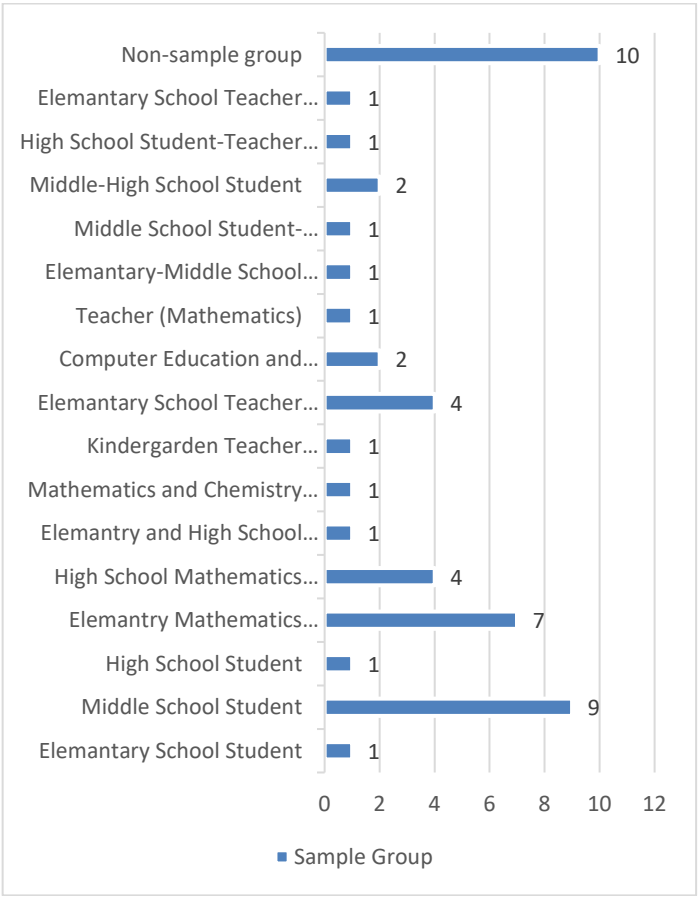

Figure 12.
Distribution according to the sample group in the studies

There is no sample group in 10 studies (informational/descriptive). The majority of the 36 research studies was conducted with middle school students (f=9). As can be seen in Figure 12, there are a significant number of studies that include pre-service elementary mathematics teachers (f=7) in the sample group. Considering that pre-service elementary mathematics teachers will also teach in middle school in grades 5-8, it can be said that middle school mathematics is given importance in the studies on WebQuest in mathematics education.

The codes, frequencies and percentages of these studies are presented in Table 8.

Table 8.
Distribution of the studies according to the sample group

Sample Group		Code	f	%
Elemantary School Student		A3	1	2.17
Middle School Student		A1,A2,A4,A5,A8,A13, A19, A27,A46	9	19.57
High School Student		A18	1	2.17
Teacher Candidate (TC)	Elemantry Mathematics TC	A6, A31, A14, A24, A35, A38, A41	7	15.22
	High School Mathematics TC	A7, A10	2	4.35
	Elemantry and High School Mathematics TC	A36	1	2.17
	Mathematics and Chemistry TC	A42	1	2.17
	Kindergarden TC	A34	1	2.17
	Elemantary School TC	A9, A16, A28, A32	4	8.70
	Computer Education and Instructional Technologies TC	A23, A45	2	4.35
Teacher (Mathematics)		A11	1	2.17
Elemantary-Middle School Student		A40	1	2.17
Middle School Student-Teacher (Mathematics and Science)		A26	1	2.17

Middle-High School Student	A17, A37	2	4.35
High School Student-Teacher (Mathematics)	A43	1	2.17
Elemantary School Teacher Candidate and Teacher (Elemantary School)	A20	1	2.17
Non-sample group	A12, A15, A21, A22, A25, A29, A30, A33, A39, A44	10	21.74

The distribution of studies on WebQuest according to the type of sample group shows that there are f=14 studies with students (elemantary school, middle school, high school, elemantary school-middle school, middle school-high school), f=19 studies with teacher candidates, and f=4 studies with teachers. Based on the analysed studies, it is seen that researchers studying in mathematics education mostly prefer to conduct the study on teacher candidates, and this finding is followed by the studies conducted with students. As a matter of fact, it can be said that the effects of WebQuest activities are mostly investigated at the middle school level among students.

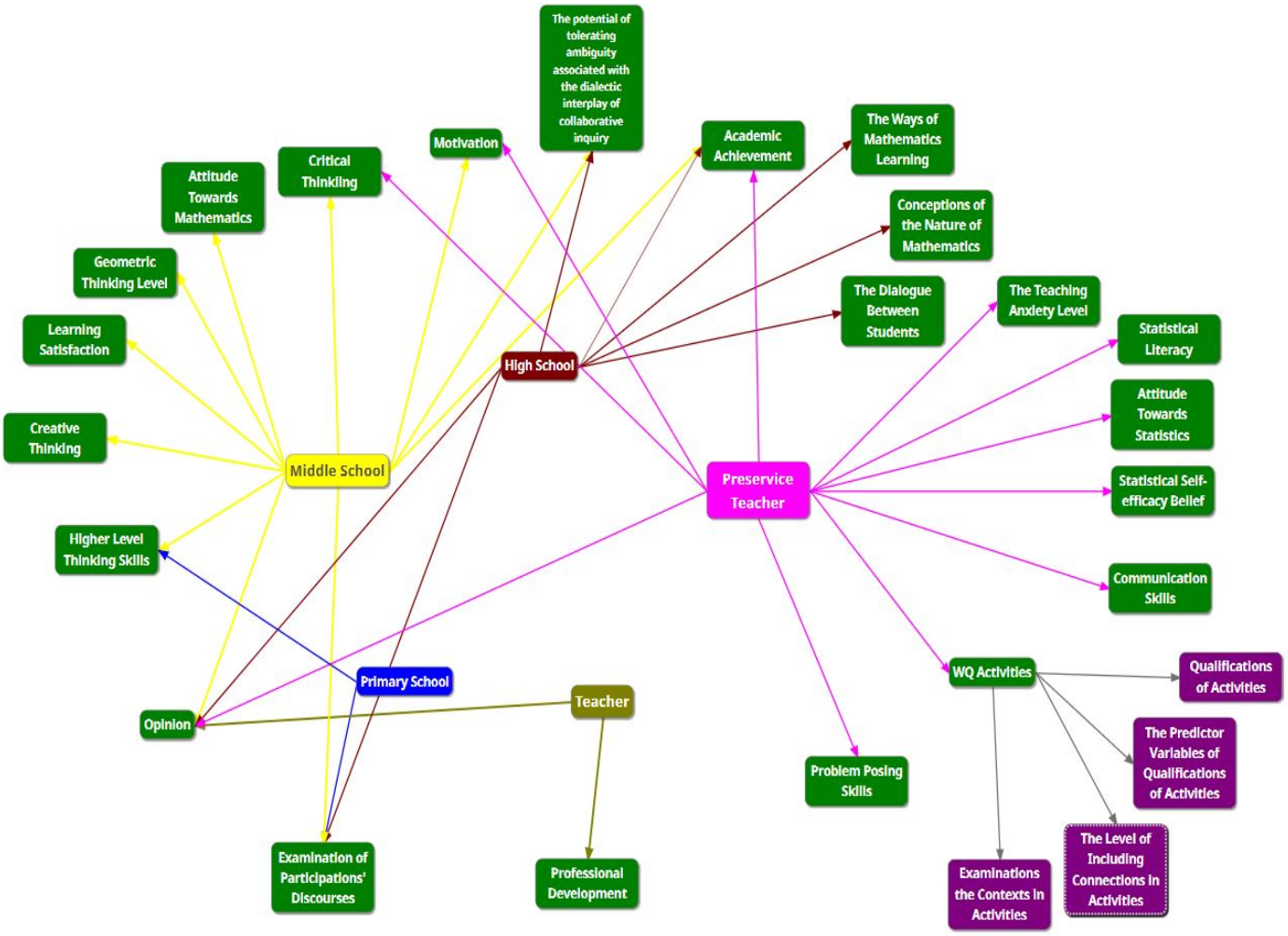

Figure 13.
Distribution of research topics in the studies based on sample groups Created by utilising https://www.mindmup.com/

Figure 13 shows a network of themes explored in the sample groups. The most common research topics of the studies on WebQuest in mathematics education are academic achievement (f=8), opinion review (f=8), attitude towards mathematics (f=5) and motivation (f=4) (Table 5). The findings on the sample groups on which these topics were investigated show that the effect of WebQuest on the academic achievement of middle school, high school and teacher candidates has been examined, but no study has been conducted with elemantary school students on this subject. The studies in which attitude towards mathematics was investigated were carried out only with middle school students. While the studies on the effect of WebQuests on motivation, which is an important part of learning, were conducted with middle school students, the studies in which participant views were examined were conducted with all sample groups except elemantary school students.

When analysing the sample group separately, studies have been conducted on the development of higher-order thinking skills and the examination of discourses among elemantary school students. However, the effects of

WebQuest on academic achievement, attitude, motivation, critical and creative thinking, ways of learning mathematics, problem-posing skills, and learning satisfaction in mathematics courses are yet to be investigated on the elemantary school students. Although many topics in high school mathematics courses have been studied, the impact of WebQuest on the problem-solving skills has not been investigated. Previous studies with high school groups have consulted student opinions about WebQuest applications and examined student discourses and dialogues during the applications. Furthermore, research has also explored the impact of WebQuest on academic achievement, mathematics learning styles, and perceptions of the nature of mathematics among high school students. Investigating the effects of WebQuest on motivation, higher-order thinking skills, problem-posing abilities, as well as creative and critical thinking in this age group would make a valuable contribution to the field.

One of the sample groups studied were teacher candidates. The research topics covered critical thinking, motivation, academic achievement, problem posing skills, statistical literacy, attitude towards statistics, and statistical self-efficacy belief. Although there have been studies on the impact of WebQuest on teacher candidates' anxiety levels, researching on teachers related to this topic would make a valuable contribution to the field of mathematics education literature. One crucial aspect of the studies conducted with teacher candidte is their preparation of WebQuest activities and obtaining feedback on them. These studies aimed to examine the applicability of WebQuest in mathematics lessons, the contributions and limitations of preparing WebQuest activities, as well as the qualifications of the WebQuest activities they prepared and the mathematical associations and contexts of these activities. The studies conducted with teachers also examined the effect of WebQuest on teachers' professional development, in addition to obtaining opinions on the applicability of WebQuest.

Figure 14 displays the distribution of studies based on sample sizes. There are 16 studies with sample sizes between 36-70, 9 studies with sample sizes between 0-35, 6 studies with sample sizes of 101 and above, and 4 studies with sample sizes between 71-100.

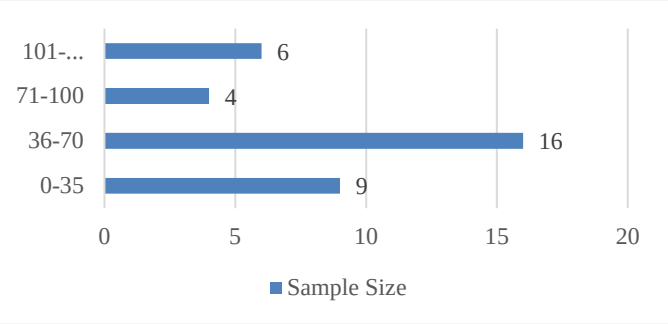

Figure 14.
Distribution of the studies according to the sample sizes

Upon examining the findings related to the sample sizes in Figure 14, it is observed that 11 of these studies did not mention the sample size. In 10 of these studies, document analysis is performed, and informational content related to the introduction of a webquest is discussed. However, 1 study did not indicate the size of the sample group. Table 9 discusses the sampling methods and characteristics in the studies.

Table 9.
Distribution of the studies according to the sampling methods

SM	Code	f		f
Random Sampling	A1,A2,A5,A13,A34, A41,A43	7	Simple Random Sampling	6
Non-random Sampling	A3,A6,A7,A14,A16, A19,A23,A26,A28, A32,A38,A41,A42, A46	14	Purposive Sampling	7
			Convenience Sampling	7
The whole population included in	A4,A8	2		

the sample group		
Unspecified	A18,A35,A36,A37, A27,A31,A20,A24, A40,A45,A17,A9,A10, A11	14

The 36 studies, excluding the 10 informational/descriptive studies that did not have a sample group, were analysed in terms of the methods used in the selection of the sample. The findings in Table 9 show that the samples in the studies were mostly determined by non-random sampling method (f=14). It is seen that 7 of the studies conducted with non-random sampling were determined by purposive sampling and 7 were determined by convenience sampling. In addition, Table 9 shows that there were 2 studies (A4, A8) in which the entire population was included in the sample, and 14 studies (A18, A35, A36, A37, A27, A31, A24, A20, A40, A45, A17, A9, A11, A10) in which the sampling method was unspecified. In addition, pie charts related to the sampling method are presented in Figure 15.

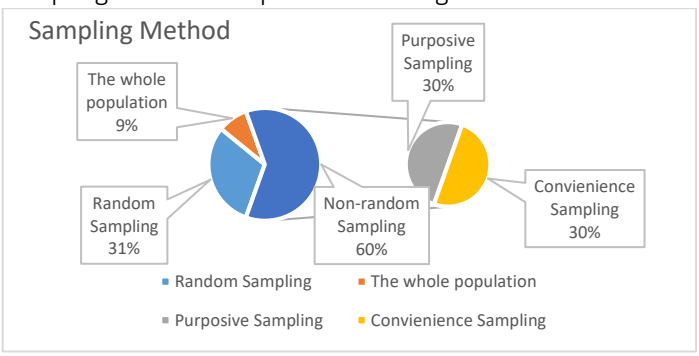

Figure 15.
The distribuiton of studies according to sampling method

Figure 15 shows that non-random sampling method was preferred in 64% of the studies that mentioned sampling characteristics and methods. Purposive sampling and convenience sampling each represented 30% of these studies. In contrast, 31% of the sample was determined by random sampling. Additionally, 9% of the studies included the whole population in the sample.

Table 10 displays the data collection tools and techniques used in the methodology of the studies.

Table 10.
Distribution of the studies according to the data collection tools/techniques

Data Collection Tools/ Techniques	Code	f	%
Achievement test	A1,A2,A5,A10,A13,A20, A34, A35,A41,A45	10	17.54
Attitude/perception /interest etc. scales	A1,A2,A4,A5,A7,A20, A27,A28, A32,A8,A10,A13,A16, A42,A35	15	26.32
Interview	A1,A5,A6,A7,A9,A11, A14,A17,A18,A24,A36, A38,A41,A46	14	24.56
Observation	A6,A14,A18,A34,A46	5	8.77
Personal information form/survey	A2,A6,A5,A20	4	7.02
Researcher/student notes/reflection reports	A3,A31,A18	3	5.26
Document review	A14	1	1.75
Student products	A6	1	1.75
Voice recorder	A3	1	1.75
Video	A18	1	1.75
KWL charts	A37	1	1.75
Rubric	A40	1	1.75

According to Table 10, it was discovered that 26.32% of the studies employed scales related to affective characteristics, such as attitude, perception, and interest (A1, A2, A4, A5, A7, A20, A27, A28, A32, A8, A10, A13, A16, A42, A35). Interviews were used as data collection tools in 24.56% of the studies (A1, A5, A6, A7, A9, A11, A14, A17, A18, A24, A36, A38, A41, A46), while 17.54% of the studies used achievement tests (A1, A2, A5, A10, A13, A20, A34, A35, A41, A45). Other studies collected data through observation (8.77%), personal information forms/survey (7.02%), and researcher/student notes/reflection reports (5.26%). Figure 16 shows the frequency distribution of the data collection tools and techniques used in the studies.

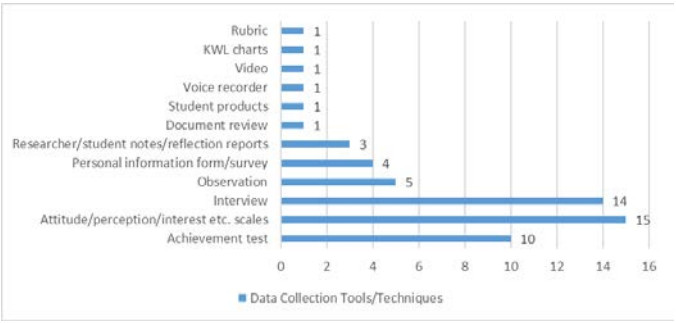

Figure 16.
Distribution of the data collection tools/techniques used in the studies

As seen in Table 10, the majority of the data collected in the analysed studies are quantitative data. The findings

obtained regarding the methods used in the analysis of this data are presented in the pie chart in Figure 17.

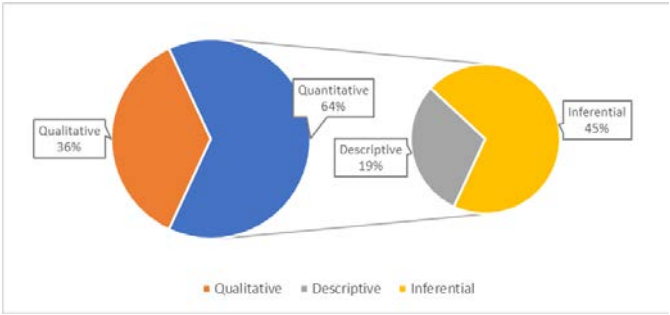

Figure 17.
Distribution of data analysis methods used in the studies

It is seen that 64 of the studies on WebQuest in the field of mathematics education preferred quantitative data analysis methods, 45% of which were inferential and 19% analysed the data with descriptive statistics (Figure 17). The preference rate of qualitative data analysis methods is 36%. Therefore, it can be concluded that quantitative studies are more commonly used. Detailed findings regarding the methods and techniques used in data analysis are presented in Table 11.

Table 11.
Distribution of the data analysis techniques used in the studies

DAM		Code	f	DAT	f	%
Quantitative (f=30)	Descriptive	A4,A5,A6,A7, A8,A9,A13, A19,A43	9	Frequency/ percentage	5	8.77
				Mean/standard deviation	7	12.28
	Inferential	A1,A2,A4,A5, A7,A27,A28, A32,A34,A35 A40,A42,A43 A45,A16,A8, A10,A13,A19 A20,A23	21	T testi	11	19.30
				Anova/Ancova	9	15.79
				Manova/Mancova	2	3.51
				Wilcoxon signed-rank test	1	1.75
				Effect Size	1	1.75
				Regression Analysis	1	1.75
				Reliability coefficient	2	3.51
				Item discrimination index	1	1.75
				Factor analysis	2	3.51
Qualitative (f=17)	Qualitative	A1,A3,A6,A7, A9,A11,A14, A31A41,A43, A46,A26,A17 A24,A36,A38 A37	17	Descriptive Analysis	3	5.26
				Content Analysis	7	12.28
				Discourse analysis	1	1.75
				Thematic analysis	1	1.75
				Continuous Comparative Analysis	2	3.51
				Existential-phenomenological data analysis	1	1.75
Informational/ Descriptive Studies			10			
Total			57			

The findings in Table 11 show that inferential analysis (f=21), one of the quantitative research methods, was mostly preferred in the studies. Additionally, it is observed that 11 studies using inferential statistics from quantitative analysis methods preferred t-test, while 9 studies preferred anova/ancova methods. Detalied analysis shows that t-test (f=11) and anova/ancova (f=9) were mostly used in the studies. If these techniques are considered as group scores used to make a comparison, it can be said that the studies are used to compare the situation between groups. Here, considering the group or groups and time or times in which the technique was used, it is thought that there are 27 studies in which it is desired to reach results such as "Webquest's ... effect/webquest's difference from ...- in terms of ...". Additionally, we found 7 studies that used descriptive statistics to report mean/standard deviation and 5 studies that used it to report percentage/frequency. Detailed analysis of the studies that preferred qualitative analysis methods shows that they mostly preferred content analysis (f=7), 3 studies used descriptive analysis and 2 studies analysed the data with constant comparative analysis. The graph regarding the distribution of data analysis techniques of the studies accompanying these frequency values is shown in Figure 18.

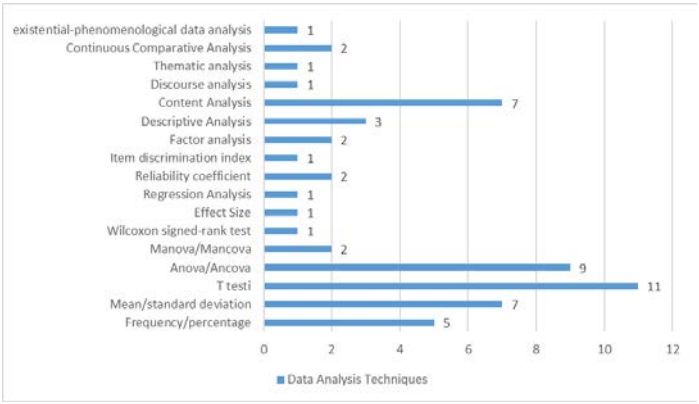

Figure 18.

Distribution of data analysis techniques used in the studies

Analysis of The Studies in Terms of Results

The findings obtained from the analysis of the results obtained from the studies on WebQuest in the field of mathematics education were interpreted under two themes: the benefits and limitations of WebQuest in the field of mathematics education:

Benefits of WebQuest in Mathematics Education

-WebQuest increases students' success in maths lessons (A1, A2, A19, A34)

-Since WebQuest supported mathematics learning environments give students the opportunity to construct knowledge, the retention of learning increases (A6, A43).

-In WebQuest supported classes, students' attitudes towards mathematics lessons are positively affected (A2, A5, A13, A27, A28). In addition, the use of WebQuest increases students' attitudes and self-efficacy beliefs in terms of statistics (A7).

-The use of WebQuests in mathematics learning environments positively affects students' motivation (A11, A16, A33) and self-confidence (A11).

-In mathematics classes using WebQuest; student discourses (A3), especially exploratory discourses increase (A37) while students use language for learning purposes, their knowledge of mathematical concepts is revealed, and students' learning becomes observable with the discourses that emerge as their mathematical communication skills improve (A3).

-WebQuest improves students' statistical literacy skills (A7).

-WebQuest supported activities positively affect students' beliefs about problem posing (A35).

-WebQuests are fun in terms of mathematics lesson (A1, A7, A9); it encourages students to think (A1, A9) and research and saves the lesson from monotony (A9). The entertaining structure of WebQuests enables students to actively participate in the lesson (A6).

-It increases visuality in mathematics lessons (A1). The visual elements in the WebQuest benefit the teacher in terms of attracting students' attention and increasing their motivation (A6).

-WebQuest increases students' electronic communication skills (A34)

-WebQuests are useful in terms of using technology and the Internet appropriately and efficiently in mathematics lessons (A6, A7, A24). Not only using but also designing WebQuests contributes positively to individuals' skills of searching the internet, preparing websites and using office programmes (A6).

-With WebQuests, students produce creative and high quality products, develop higher level thinking skills and social skills (A12).

-The use of WebQuests improves students' creativity and research skills (A33).

WebQuest supports student-centred learning environments (A17) and collaboration in mathematics lessons (A17, A24).

- WebQuests create a productive learning environment in a mathematics classroom where ethnomathematical research and drama techniques are used together, leading to greater student engagement and a higher level of cognitive engagement, benefiting students' understanding of both the nature of mathematics and mathematics as a discipline (A18).

- They provide authentic contexts for questioning real life problems (A26).

- While the use of WebQuest in mathematics courses reduces pre-service teachers' anxiety levels towards teaching (A32), it positively affects their attitudes towards learning and teaching (A36).

- In learning environments, WebQuests enable teachers to use time effectively by enabling them to reach more than one student at the same time (A6).

-WebQuests increase the high level of basic and applied mathematical knowledge of the users, which is necessary for future professional activities (A33)

-WebQuests can be used not only as a teaching technique but also as a measurement and evaluation tool in mathematics lessons (A9). Short-term WebQuests can be used as performance tasks and long-term WebQuests can be used as projects (A11). As an assessment tool, WebQuests offer reliable, highly valid and objective assessment (A6).

-The process of designing WebQuest activities increases the contextual knowledge and association skills of the preparer (A14).

-WebQuest design increases the mathematical knowledge level of the preparer and positively affects teaching competences in terms of mathematical associations, permanent learning and problem posing (A6).

The benefits of WebQuests in mathematics education are summarised in Figure 19.

Limitations of WebQuest in Mathematics Education

-Preparation of WebQuests is difficult and challenging (A9). It is time consuming for the preparers (A6, A9, A24)

-It is difficult to find reliable internet resources to prepare WebQuests (A6, A24). The fact that internet resources are not related to the subject and are not appropriate for the level of the students is one of the important limitations encountered (A6).

-The limited number of WebQuests that can be used in learning environments and the fact that the existing ones are not appropriate for student level make it difficult to use (A6).

-The adequacy of a WebQuest is related to the level of use of information and communication technologies by those who prepare it and those who will use it (A6, A10). It is difficult to use when the technology usage skills of teachers and students are not sufficient (A6). As a matter of fact, students had difficulties in WebQuest supported learning environments due to their ability to research on the internet and use technology (A1, A7).

-In WebQuest learning environments, it is difficult to apply if the prerequisite knowledge of individuals is not sufficient (A6).

The limitations of WebQuests in mathematics education are summarised in Figure 20.

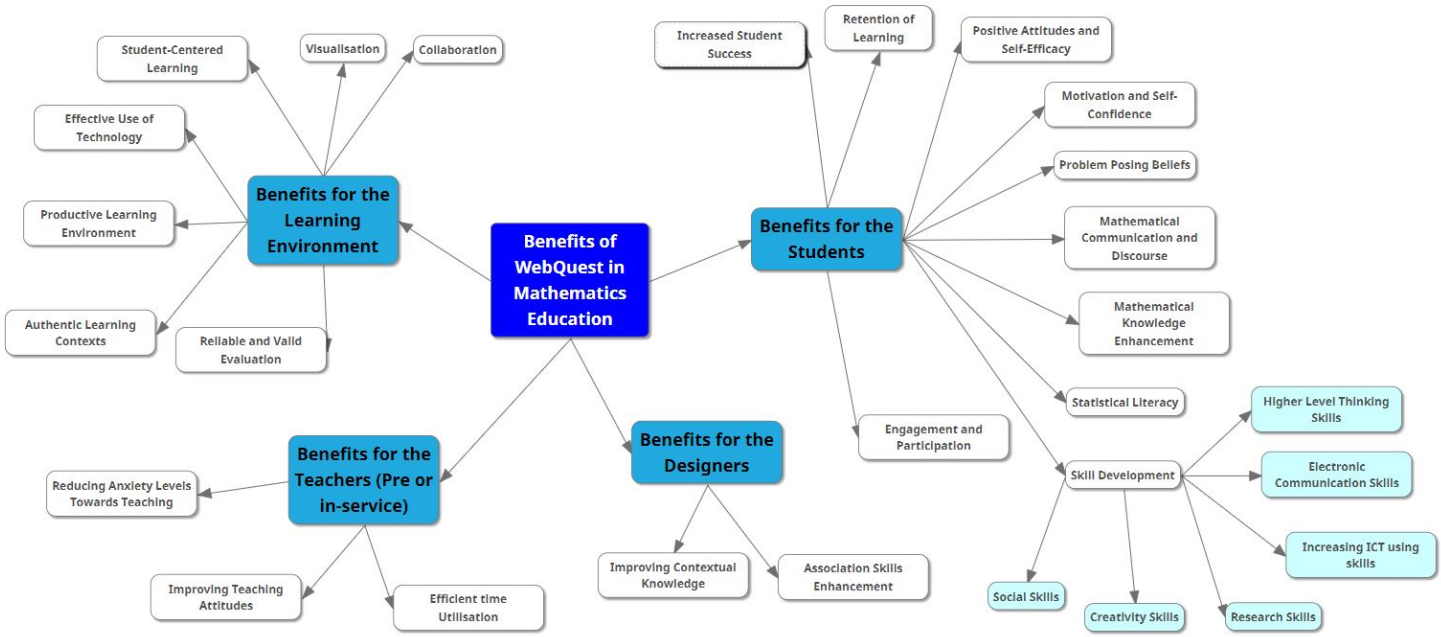

Figure 19.

Benefits of WebQuests in mathematics education Created by utilising https://www.mindmup.com/

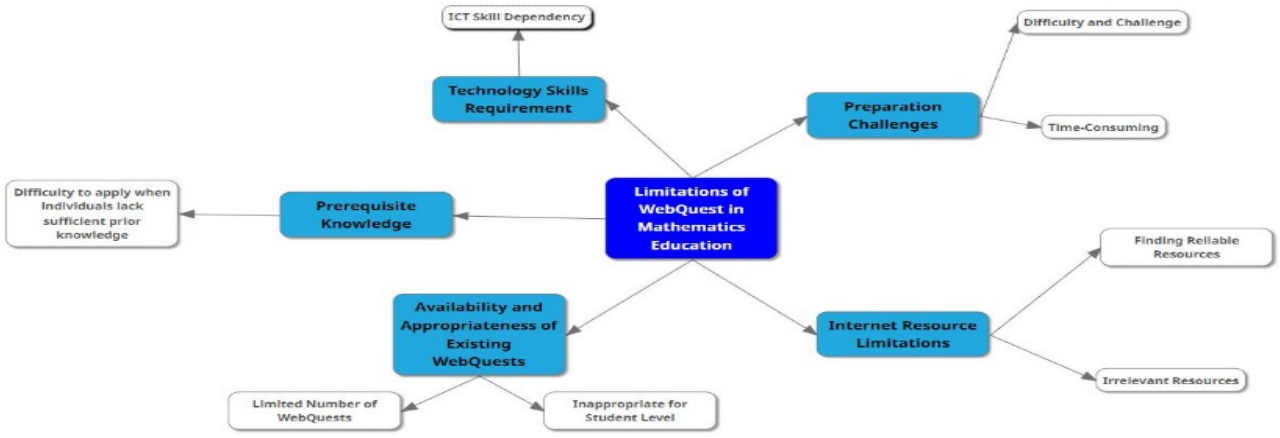

Figure 20.

Limitations of WebQuests in mathematics education Created by utilising https://www.mindmup.com/

Discussion

This study aims to contribute to the literature by compiling studies on WebQuest in mathematics education between 1995 and 2023 and to identify trends of the WebQuest instructional strategy in the field of mathematics education related to WebQuest.

The results of our study show that although WebQuest emerged in the 1990s, the first study in mathematics education was conducted in 2001. While WebQuest studies have appeared in the literature with varying frequency over the last 30 years, the fact that almost half of the 46 studies (f=24) were conducted in the last decade shows its popularity in mathematics education research. An analysis of the distribution of studies by language shows that the majority (65,72%) were written in English. The distribution of studies by type showed that most of the studies on WebQuest in mathematics education were articles (71.74%) and a small number of theses (17.39%). Bilir (2023) analysed the studies on WebQuest conducted in Turkey between 2007 and 2022 and concluded that the majority of the studies were master's theses (45.7%). The most important reason for this situation may be that Bilir (2023) concentrates only on the studies conducted in Turkey and determines the general tendencies towards WebQuest rather than a specific field.

It can be seen that the most recurrent keyword in the studies analysed in terms of content is "WebQuest". In addition, "WebQuests", "mathematics" and "mathematics education" are frequently used keywords in the studies. This is an expected result in line with the focus of the study. The primary classification of studies according to Abbitt and Ophus (2008) shows that 36 out of 46 studies are research studies. Abbitt and Ophus (2008) concluded that the majority of studies on WebQuest (f=53) were descriptive studies. In the secondary classification of the analysis, the research topics were analysed and it was found that the studies mostly aimed to examine the effect of WebQuest on academic achievement (f=8) and to examine the views of the participants on WebQuest (f=8). The number of studies presenting sample WebQuests for the use of WebQuests in mathematics education is considerable (f=7). The analyses made on the basis of learning areas show that the WebQuests are located in the learning area "geometry and measurement" (35%) and the topic is related to "geometric objects and shapes" (f=5) compared to other learning areas. Bilir (2023) study shows that in the studies related to WebQuest conducted in Turkey, WebQuest related to prisms and measurement (10.7%) was prepared the most in the field of mathematics.

The results obtained regarding the methodological tendencies of the studies show that the majority of the studies (56%) were designed with a quantitative approach, and the experimental design (36.84%) was adopted in terms of research design. Similarly, Bilir's (2023) study shows that a quantitative approach is adopted in the majority of the studies on WebQuest (50%) and experimental design (43%) is adopted from quantitative research methods. Khairunnisa (2021), who examined the studies on Webquest in the field of ELT with a systematic literature review, also shows that the majority of the studies conducted are quantitative (60.7%) and experimental design (67.8%). The frequently used methods/techniques used to collect data in the studies examined in this study are Attitude/perception/interest etc. Scales (f=15), interview (f=14) and achievement test (f=10). It can be said that the collected research data are mostly analysed by using quantitative analysis method (64%), while this is mostly inferential statistics (45%). T test is a statistical technique frequently used in research (f=11). Bilir (2023) also concluded that the most frequently used statistical technique to collect data is scale (40,7%) and t-test is preferred to analyse the data (27%). Similarly, it is seen that pre-post test (60.7%) is frequently used in studies on WebQuest in the field of ELT (Khairunnisa, 2021). Alias et al. (2013), who analysed 13 studies on WebQuest conducted between 2005 and 2012, concluded that quasi-experiment research design (60%) was mostly used in the studies.

The distribution of the studies according to the sample groups shows that the majority of the studies were carried out with pre-service teachers (f=19), and in terms of K-12 level students, most secondary school students (f=9) participated in the studies. This result supports the result of Bilir (2023) that the majority of the studies on WebQuest conducted between 2007 and 2022 were conducted with secondary school students. Khairunnisa (2021) concluded that studies on WebQuest in the field of ELT were mostly conducted on students (39.3%) regardless of the level of education. It is among the results that the majority of the sample groups in the studies consisted of 36-70 people, and the sampling technique preferred in the selection of these participants was purposive and appropriate sampling (64%), one of the non-random sampling methods. Bilir (2023) shows that the majority of the studies on WebQuest were conducted with a sample size of 0-80. As a matter of fact, when the participants of this study between 0-70 people are analysed, the fact that more than half of the 46 studies (f=25) are in this range coincides with the results of Bilir (2023).

In current research, the studies on WebQuest in the field of mathematics education have been evaluated based on sample groups and research topics. The results indicate the following:

Academic Achievement:

The impact of WebQuest on academic achievement has been examined among middle school, high school, and pre-service teachers, while no studies have been conducted with elementary school students in this regard.

Attitudes and Motivation:

The studies on the effect of WebQuest on attitudes towards mathematics have been conducted exclusively with middle school students. Its impact on motivation has been researched with middle school students and pre-service teachers.

Participant Opinions:

The studies investigating participant opinions have been conducted with all sample groups except elementary school students.

The results according to the sample groups show that:

Elementary School Students:

The studies have focused on the development of higher-order thinking skills and discourse analysis through WebQuest activities among elementary school students. However, the effects on academic achievement, attitudes, motivation, and other skills have yet to be explored in this group.

High School Students:

While many topics have been studied in high school mathematics classes, the impact of WebQuest on problem-posing skills has not been examined. It is recommended that future research investigates the effects of WebQuest on motivation, higher-order thinking skills, and creative/critical thinking within this age group.

Pre-Service Teachers:

The studies involving this group have covered topics such as critical thinking, motivation, academic achievement, problem-posing skills, and statistical literacy. Although studies have examined the impact of WebQuest on pre-service teachers' anxiety levels, no such research has been conducted with in-service teachers. Additionally, studies have explored the process of pre-service teachers preparing WebQuest activities, the quality and limitations of these activities, and their mathematical contexts. The effect of WebQuest on the professional development of pre-service teachers is an issue waiting to be researched.

In-Service Teachers:

The studies have also been conducted on the impact of WebQuest on teachers' professional development and its applicability in the classroom. The teachers' competences in preparing webquests, WebQuests' effect on their teaching anxiety levels are still research questions.

These results underscore the need for further research into the effects of WebQuest in mathematics education across different student and teacher groups, highlighting the potential for significant contributions to the literature.

Limitations and Suggestions for Further Research

This study examines the studies on WebQuest in mathematics education. By determining the trends of the studies carried out in different fields and trends in the related field can be revealed. In this study, the descriptive features of the studies in the mathematics education literature were revealed through a systematic literature review. Further studies can be evaluated through meta-analysis and meta-synthesis analysis.

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