A Content Analysis of Mathematics Self-Efficacy Themed Articles Published in Türkiye

Özge NURLU ÜSTÜN [1]

Abstract

Self-efficacy belief, which can affect the performance of individuals by determining their approach to goals, tasks and difficulties, has been the subject of numerous studies in different disciplines. Mathematics self-efficacy has become the focus of researchers all over the world, especially because of its strong impact on achievement in educational research. In Turkey, studies conducted with different variables and research designs on the theme of mathematics self-efficacy add richness to the literature, but make it difficult to reveal the current situation of this theme. This study aimed to investigate mathematics self-efficacy themed articles in terms of the field, subject, study group/sampling, applied method, data collection tools, analysis techniques, and publishing language in Turkey. The study was designed as a descriptive content analysis. 101 articles published between 2010 and 2022 were included in the study. Data were analysed by using the MAXQDA 2022 qualitative analysis program. The analysis of the data was based on the code and category list designed by Baş and Özturan Sağırlı (2017). The research concluded that the number of mathematics self-efficacy themed articles in Turkey has increased with fluctuations over the years, but there has been a significant decrease in recent years and these articles focused on the fields of mathematics and geometry education and the subject matter of mathematics self-efficacy, mathematical literacy self-efficacy, and mathematics teaching self-efficacy. In addition, it was determined that the most frequently used methods are surveys and scale development studies. These are followed by experimental design and mixed method studies. Accordingly, it has been concluded that data is often collected through scales/surveys, and very few studies apply qualitative data collection techniques. Moreover, the most used analysis techniques were correlation, t-test and ANOVA. It was determined that the most frequently studied group consists of middle school students and prospective teachers. Most of mathematics self-efficacy themed articles in Turkey were published in Turkish.

Keywords: Mathematics Self-Efficacy, Mathematics Literacy Self-Efficacy, Mathematics Teaching Self-Efficacy, Self-Efficacy, Descriptive Content Analysis.

[1] Dr., Erzincan Binali Yıldırım University, Education Faculty, Elemantary Education Department, Erzincan, Türkiye, ozge.nurlu@erzincan.edu.tr, ORCID:0000-0002-3429-8162

Türkiye'de Yayınlanan Matematik Öz-Yeterlik Temalı Makalelere Yönelik Bir İçerik Analizi

Özge NURLU ÜSTÜN [1]

Öz

Bireylerin amaçlara, görevlere ve zorluklara yaklaşımını belirleyerek performansına etki edebilen öz-yeterlik inancı, farklı disiplinlerde çok sayıda araştırmaya konu olmuştur. Eğitim araştırmaları içinde özellikle başarı üzerindeki güçlü etkisi sebebi ile matematik öz-yeterliği tüm dünyada araştırmacıların odak noktası haline gelmiştir. Türkiye'de ise matematik öz-yeterliği temasında farklı değişkenlerle ve araştırma desenleri ile yapılan çalışmalar alan yazını zenginleştirmekle birlikte bu temaya dair var olan durumun anlaşılmasını zorlaştırmaktadır. Bu çalışma, Türkiye'de yapılan matematik öz-yeterliği temalı makalelerin çalışıldıkları alanları, konuları, örneklemeleri, kullanılan yöntem, veri toplama aracı ve veri analiz tekniklerini ve yayınlandıkları dilleri incelemeyi amaçlamaktadır. Çalışma, betimsel içerik analizi yöntemi ile tasarlanmıştır. Çalışmaya 2010-2022 yılları arasında yayınlanmış olan 101 makale dâhil edilmiştir. Çalışma verileri, MAXQDA 2022 nitel analiz programı kullanılarak analiz edilmiştir. Verilerin analizinde Baş ve Özturan Sağırlı (2017) tarafından tasarlanmış olan kod ve kategori listesi temel alınmıştır. Araştırma, Türkiye'de matematik öz-yeterliği temalı makale sayısının yıllar içinde dalgalı bir seyir ile arttığı ancak son yıllarda belirgin bir düşüş yaşandığı; makalelerin matematik ve geometri eğitimi alanlarında ve matematik öz-yeterliği, matematik okuryazarlığı öz-yeterliği, matematik öğretimi öz-yeterliği konularında yoğunlaştığı sonuçlarına ulaşmıştır. Bunula birlikte, en sık kullanılan yöntemlerin tarama ve ölçek geliştirme çalışmaları olduğu bunları deneysel desen ve karma yöntem araştırmalarının takip ettiği; buna bağlı olarak sıklıkla ölçek/anket aracılığı ile veri toplandığı sadece birkaç çalışmada gözlem ve görüşme gibi nitel araştırma yöntemlerine ait veri toplama tekniklerinden faydalanıldığı ve korelaston, t-testi ve ANOVA gibi parametrik veri analizi tekniklerinin sıklıkla kullanıldığı tespit edilmiştir. En sık çalışılan grubunun ortaokul öğrencileri ve aday öğretmenler olduğu belirlenmiştir. Ayrıca söz konusu makalelerin büyük çoğunluğunun Türkçe olarak yazıldığı sonucuna ulaşılmıştır.

Anahtar Kelimeler: Matematik Öz-Yeterliği, Matematik Okuryazarlığı Öz-Yeterliği, Matematik Öğretimi Öz-Yeterliği, Öz-yeterlik, Betimsel İçerik Analizi

[1] Dr. Öğr. Üyesi, Erzincan Binali Yıldırım Üniversitesi, Eğitim Fakültesi, Sınıf Eğitimi Anabilim Dalı, Erzincan, Türkiye, ozge.nurlu@erzincan.edu.tr, ORCID:0000-0002-3429-8162

Introduction

Social cognitive theory suggests that much human learning and behaviour are shaped by social environments, including the reactions and approval of others. As observing and interacting within social and cultural contexts, people could get knowledge, rules, skills, strategies, attitudes and beliefs. Additionally, people develop ideas about the usefulness, appropriateness, and consequences of modelled behaviours. They then act according to their beliefs regarding their abilities and the expected consequences of their actions (Schunk, 2012). Therefore, social cognitive theory proposes a triadic reciprocal causation model, which argues that the interactions among cognitive and other personal factors, behaviour, and social/environmental events influence human agency (Bandura, 1986). Each of the major factors in the triadic structure constitutes an important component in the dynamic environment. Self-efficacy belief, personal goal setting, and quality of analytic thinking are regarded as main cognitive factors.

Bandura defines self-efficacy as "the belief in one's capabilities to organize and execute the courses of action required to manage prospective situations" (1999, pp. 2). Self-efficacy belief can be described as a person's "I can" or "I cannot" belief. According to Bandura (1999), all people have goals they would like to succeed in, things they want to change and things they want to accomplish. Nonetheless, putting these plans into action is not easy for many people. Self-efficacy beliefs have an impact on shaping the approach to goals, tasks, and challenges. People having high sense of self-efficacy are good at viewing challenging problems as tasks to be solved not threats to be avoided, effectively develop deeper interest in the activities in which they join, feel a stronger sense of commitment to tough tasks, and effectively overcome any setbacks and disappointments encountered. Conversely, people having a weak sense of self-efficacy think that their capabilities are not sufficient to overcome difficult tasks and situations. They have poor commitment to their goals, when they faced with tough tasks, they dwell on their personal failures and all sorts of negative outcomes instead of focusing on how to succeed.

Similarly, Albayrak (2008) states that individuals with strong self-efficacy belief set themselves challenging tasks and persistently try to cope with failure to rise the possibility of success, while individuals who have low self-efficacy prefer to avoid challenging goals and are not able to concentrate on how struggle against difficulties. In other words, individuals with a weak sense of self-efficacy think that the problems they must deal with are more challenging than they really are. Additionally, these people have limited viewpoints from which to evaluate events. On the contrary, people having high self-efficacy feel themselves to be more relaxed and assertive when compared with people who have low self-efficacy, even when coping with difficult jobs (Kiremit, 2006). Therefore, it is possible to say perceived self-efficacy has an effect on outcomes before the relevant action has even occurred.

As Maddux (2002) states, self-efficacy is a belief that develops throughout life, rather than being a personal trait. To clarify the way of developing sense of self-efficacy, Bandura (1997) states, four principles: mastery experiences, vicarious experiences, social persuasion, and physiological and emotional states.

Mastery experience, refers to one's own previous attainments. Mastery experiences are regarded as the most powerful source of self-efficacy because of providing the most

authentic evidence of success (Bandura, 1997). Successful attempts at a particular task in the past have the potential to strengthen one's sense of self-efficacy in future tasks (Maddux, 2002). This is about to one's long-term memory of success or failure. As the old adage states, "Nothing breeds success like success".

Vicarious experiences are the second source supporting people's beliefs about success. This source relates to observing the success or failure of people similar to oneself in a particular task. In other words, others' success or failure effectively creates a social model. According to Schunk (1989), observing others' similar performances provides an opportunity for one to make a judgement about one's own ability. Siegle et al. (2007) indicate that in contrast to self-efficacy belief derived from past performance, self-efficacy based on observing others is less stable. In this sense, Schunk (1989) states that one's own personal achievement is the best ground for developing self-efficacy and occasional failures might not have negative effects; however, perceived self-efficacy gained through observation weakens quickly if observers are subsequently unsuccessful in their own experiences.

Social (verbal) persuasion, and relates to others' persuasive messages about one having the necessary capability to succeed in the given task. Although 'You can do this!' messages from social environments such as parents, peers or teachers are important to rise students' sense of self-efficacy. Social (verbal) persuasion have a less effect on enduring change in self-efficacy than mastery or vicarious experiences. Persuasion alone is not enough to promote adoptive behaviour (Bandura, 1986). Even so, people's self-efficacy beliefs do increase when they are told they have the capacity to do a task by someone they really trust (Siegle et al., 2007).

Emotional and physiological states effect sense of self-efficacy when people attribute failure to unpleasant physiological arousal and achievement to pleasant feelings. Therefore, when a person is aware of aversive physiological state, the person is probably doubt his/her competence compare to the physiological arousal is pleasant or neutral. These physiological states have the potential to undermine people's confidence in accomplishing a particular task. Conversely, feeling comfortable before a new task probably increases people's self-efficacy belief (Maddux, 2002).

As mentioned, self-efficacy, as a motivational construct and a predictor of behaviour, is people's belief in their ability to succeed in specific tasks (Bandura, 1986). It plays a role in shaping people's approach to goals, tasks and challenges. In this sense, self-efficacy belief is an influential variable in shaping people's performance and achievement even before the action occurs. With this in mind, among the many self-conceptions in people's, self-efficacy can be regarded as the most effective. Therefore, since the publication of Albert Bandura's 1977 article titled "Self-Efficacy: Toward a Unifying Theory of Behavior Change", the concept of self-efficacy has presented in several disciplines. For instance, the term of self-efficacy has been the focus of scientific research in many disciplines, especially psychology (Davis & Yates, 1982), and in sub-branches of psychology such as social psychology (Bandura, 1983; Manning & Wring, 1983), clinical psychology (Garcia, Smith & Doerfler, 1990), and sports psychology (Lee, 1982). Besides, self-efficacy has been frequently studies in health sciences such as oncology (Lev, 1997), sports branches such as wrestling (Treasure, Monson & Lox, 1996) and educational sciences (Devonport & Lane, 2006; Hwang, Choi, Lee, Culver & Hutchison, 2016; Kim, Wang, Ahn & Bong, 2015; Lane, Lane & Kypriabou, 2004). Since the 1980s an increasing

attention has been paid within educational research to self-efficacy. In examining the application of self-efficacy theory to educational attainment, the relationship between mathematics education and self-efficacy has attracted great interest all over the world (Hackett & Betz, 1989). Mathematical self-efficacy is defined as an individual's beliefs or perceptions regarding their abilities in mathematics (Bandura, 1997). In other words, an individual's mathematical self-efficacy is their confidence in completing various tasks, such as understanding concepts and solving problems, in mathematics. It is evident that mathematics holds a significant place in the academic curriculum and that academic success in this subject is crucial in the rapidly advancing scientific and technological age. Therefore, the concept of mathematics self-efficacy is important as a determinant of performance (Sewell & George, 2000; Reçber, 2011).

The concept of self-efficacy in mathematics education in Turkey has a history of about 20 years. Correlational studies have been conducted on various samples in Turkey that reveal the relationship between some variables such as mathematical resilience (Önsöz, 2021), mathematics achievement (Çağlayan, 2019; Delioğlu, 2017; Öztürk & Kurtuluş, 2017; Özüdoğru & Bümen, 2016), reflective thinking skills (Sevgi & Zihar, 2020), motivation, anxiety, (Özdemir, 2021) self-regulation skills (İpek, 2019), attitude towards mathematics (Çavdar, 2019) and mathematical self-efficacy. Besides, it is seen that the focus is on experimental studies examining the effects of variables such as cooperative learning approach (Tuğran, 2015), realistic mathematics education (Demir, 2017), problem-based learning (Usta, 2013), inquiry-based teaching (Kandil, 2016) on mathematical self-efficacy. Studies conducted with different variables on the theme of self-efficacy in mathematics education add richness to the literature, but also make it difficult to determine the current situation of this theme. It is believed that conducting comprehensive analyses of studies on mathematics self-efficacy can provide a holistic understanding and contribute to the field by offering valuable insights for practical applications.

In addition to providing researchers with information about the current situation (Ulutaş & Ubuz, 2008) and promising avenues for future research (Klassen & Usher, 2010), it may be beneficial to systematically evaluate and combine research in a particular field in order to shed light on scientific debates for educators, teachers and students (Çiltaş, Güler & Sözbilir, 2012), and to shape future research, policies, practices and public perception (Suri & Clarke, 2009). Therefore, this study aims to explore the current place of the mathematics self-efficacy themed articles in Turkey between 2010 and 2022. In order to answer this question, the following research questions will be addressed:

1.   What is the distribution of mathematics self-efficacy themed articles published in Turkey across the years?

2.   What is the distribution of mathematics self-efficacy themed articles published in Turkey regarding to their fields?

3.   What is the distribution of mathematics self-efficacy themed articles published in Turkey regarding to their subject matters?

4.   What is the distribution of mathematics self-efficacy themed articles published in Turkey regarding to their research methods/design?

5.   What is the distribution of mathematics self-efficacy themed articles published in Turkey regarding to their samples?

6.   What is the distribution of mathematics self-efficacy themed articles published in Turkey regarding to their data collection tools?

7.   What is the distribution of mathematics self-efficacy themed articles published in Turkey regarding to their data analyses methods?

8.   What is the distribution of mathematical self-efficacy themed articles published in Turkey by publication languages?

Method

The research aims to investigate in detail the trends of mathematics self-efficacy themed articles in journals that publish research in Turkey. Therefore, descriptive content analysis method which is defined as the assessment of general trends and research results by compiling qualitative and quantitative studies independently of each other on a particular subject (Çalık & Sözbilir, 2014) was used in this study.

Data source

Two sampling strategies were applied in the study: convenience sampling and criterion sampling strategy (Cohen et al. 2005). First of all, the articles were scanned based on the archive pages of the mentioned journals on the internet. Since the previous issues and volumes of some journals are not available on the internet, convenience sampling strategy was used. In addition, criteria such as year, subject and country were also taken into account. For example, to provide a more up-to-date perspective, the study was limited to the issues of the aforementioned journals from January 2010 until October 2022. Since the research aims to present a holistic picture of the mathematics self-efficacy themed articles published in Turkey, the articles whose sample is not in Turkey were excluded. Moreover, all articles containing the words self-efficacy, self efficacy, and selfefficacy in the title were primarily archived. Then those articles examined whether they were related to mathematics self-efficacy and articles examining topics such as general self-efficacy belief, science teaching or foreign language speaking self-efficacy has been excluded from the study. Therefore, criterion sampling strategy was also adopted in the study. Finally, 101 articles that were decided to be studied were archived and prepared for analysis.

Ethical Consideration

In this study, all the rules determined in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" were followed. Besides, none of the "Actions Contrary to Scientific Research and Publication Ethics" were carried out. Published and copyrighted articles belonging to the mentioned journals were included in the research. For this reason, it has been decided that the study is not required by the ethics committee document determined by ULAKBİM. Therefore, it was not necessary to obtain the permission of the ethics committee in order to carry out the study.

Data Analysis

The research followed a code and category list developed by Baş and Özturan Sağırlı (2017). The code and category list used for analysing each articles are presented in Figure 1 below.

CODES AND CATEGORIES

Year

Field

Language
- Turkish
- English
- Turkish and English

Subject matters
- Mathematics self-efficacy
- Mathematics literacy self-efficacy
- Mathematics teaching self-efficacy
- Geometry self-efficacy
- Problem posing self-efficacy
- Visual mathematics literacy self-efficacy
- Resources of mathematics self-efficacy
- Mathematical connection self-efficacy
- Mathematical virtual manipulatives self-effi..
- Mathematical modelling self-efficacy
- Systems of linear equations self-efficacy
- Self-efficacy towards number sense
- Statistical literacy self-efficacy
- Mathematical reasoning self-efficacy
- Usage of concrete materials in mathematics ...
- Origami related self-efficacy
- Mathematics self-efficacy in science education

Sample
- Early childhood
- Primary school
- Secondary school
- High school
- Undergraduate/Prospective teachers
- Graduate
- Teachers
- Parents

Method
- Quantitave method
  - Descriptive
  - Experimental
  - Developing questionnaire
- Qualitative method
  - Case study
  - Review
  - Action research
  - Phenomenology
- Mixed method
  - Exploratory
  - Explanatory

Data Collection Tools
- Achievement test
- Questionnaire/Survey/Test
- Interview
- Observation
- Document analysis
- Others (Play/Activity sheets)

Data Analysis
- Quantitave data analysis
  - Descriptive
  - Inferential
    - Non-parametric
      - Mann Whitney U
      - Kruskal Wallis H
      - Sperman's rank order
      - Wilcoxon
    - Parametric
      - Correlation
      - T-tests
      - ANOVA
      - Regression
      - Factor analysis
      - Structural equation mo..
      - MANOVA
      - Hierarchical linear mod.
      - Covariance
      - Chi-square,
      - Meta-analysis
- Qualitative data analysis
  - Descriptive analysis
  - Content analysis
  - Discourse analysis
  - Document analysis

Figure 1. Codes and Categories

The list presented in Figure 1 is concerned with eight categories: field, subject matters, method, sample, data collection tools, data analysis methods, year and language. The analyses of the data were conducted with MAXQDA 22 program. The coding process on the basis of categories was carried out as follows:

Field: This category was analysed by considering which subject area the article was conducted, applied or related to. For example, a study aims to "examine pre-service teachers' mathematics self-efficacy beliefs in science teaching", the field was coded as science. Another study which aims to examine "investigation of the relationship between primary school 4th grade students' mathematics anxiety and their mathematics self-efficacy perceptions", was coded as mathematics.

Subject matters: In the analysis of this category, the subject matter section of the code and category list developed by Baş and Özturan Sağırlı (2017) was reorganised for the concept of mathematics self-efficacy. In this process, the problems, sub-problems and purpose parts of the mathematics self-efficacy themed articles included in the study were read several times to define codes and categories. The subject matters of studies were assigned with some codes such as gender, achievement, attitude, cooperative learning, geometry self-efficacy. Then, it was realized that these titles, which were determined as drafts, were studied within the scope of different purposes, and it was decided that this relationship should be stated. For example, some relations emerged such as the effect of the cooperative learning environment on mathematics self-efficacy or whether the perception of mathematics self-efficacy differs according to gender. In the final form has 17 different categories. Besides, only self-efficacy themed problem statements or aims of the studies were evaluated. For example;

1- What is the level of self-efficacy and attitudes of secondary school students towards geometry?

2- Is there a significant mean difference in the attitudes towards geometry of girls and boys attending secondary school?

3- Is there a relationship between secondary school students' attitude towards geometry and self-efficacy?

4- Is there a significant mean difference in terms of self-efficacy level of geometry of middle school students at different grade levels?

From the study that included the sub-problems given below, only sub-problems one, three, and four were analysed within the 'subject matter' category.

Method: Regarding the research methods, each paper was categorised based on the code and category list. In approximately 2% of the examined research studies, the method utilized was not explicitly specified. In such instances, the researcher assigned an appropriate code by taking into account subject matters, data, sample, data tools and analysis process.

Sample: The samples used in the research were examine under nine titles as: Regardless of grade, early childhood, primary, secondary, high school, undergraduate, graduate education, teachers, school administrator and parents.

Data Collection Tools: In the analysis of this category, tools directly related to the word self-efficacy were taken into account. For instance, a research aims to examine the relationship between attitude towards geometry and geometry self-efficacy. The tool used in the research to determine attitude towards geometry was not included in the analysis. However, the tool used to measure geometry self-efficacy was examined under the category of open-ended questionnaire/scale/test.

Data Analysis Methods: In this category, only the data analysis methods used in the analysis of self-efficacy themed data were included.

Language: This category was decided by looking at the language in which the studies were written.

Findings

This section presents the findings of each research questions by using tables, charts and graphs for better clarification.

Findings of the distribution of mathematics self-efficacy themed articles published in Turkey across the years

Figure 2 provides details about the distribution of examined articles across the years.
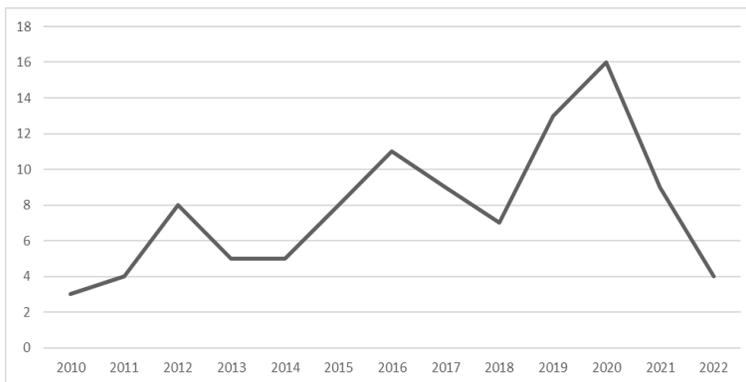
Figure 2. Mathematics self-efficacy themed articles across years

It is immediately apparent that mathematics self-efficacy themed articles were fluctuated years between 2010 to 2020, but the trend was upward. However, it is seen that number of published articles on the topic declined dramatically from 2020 to 2022.

Findings of the distribution of mathematics self-efficacy themed articles published in Turkey regarding to field

Figure 3 illustrates the details of the distribution of the examined articles by disciplines they were conducted on.
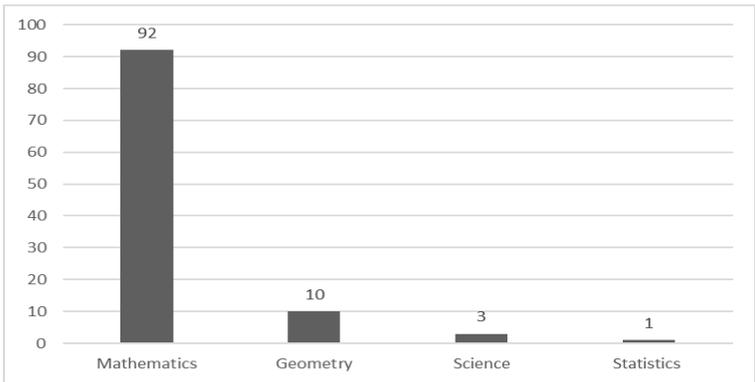
Figure 3. Mathematics self-efficacy themed articles by disciplines

The figure indicates that overwhelming majority of mathematics self-efficacy themed articles was published in the field of mathematics. Mathematics was followed by geometry, which is a field closely related to mathematics. As can be seen from the graph, the least research on mathematics self-efficacy was done in the disciplines of science and statistics.

Findings of the distribution of mathematics self-efficacy themed articles published in Turkey regarding to subject matters

Figure 4 shows findings of the distribution of the subject matters covered in the reviewed articles.
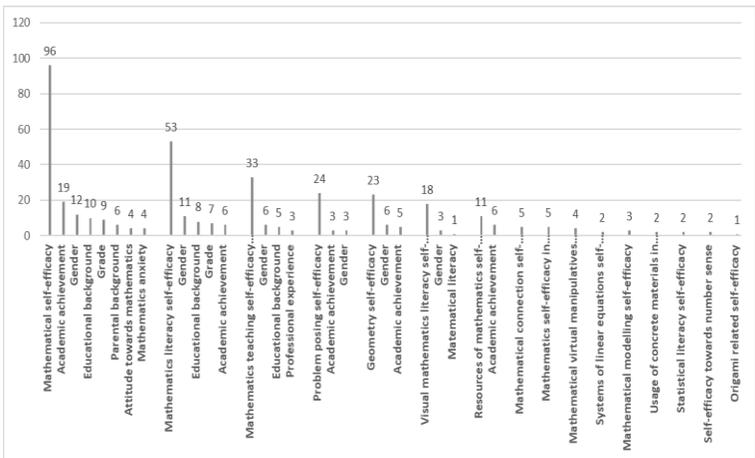
Figure 4. Subject matters of mathematics self-efficacy themed articles

As shown in Figure 4, the most studied subject matters in mathematics self-efficacy themed studies was mathematics self-efficacy. Mathematics self-efficacy is followed by mathematics literacy self-efficacy, mathematics teaching self-efficacy, geometry self-efficacy, problem posing self-efficacy, visual mathematics literacy self-efficacy, resources of mathematics self-efficacy, mathematical connection self-efficacy, mathematical virtual manipulatives self-efficacy, mathematical modelling self-efficacy, systems of linear equations self-efficacy, self-efficacy towards number sense, statistical literacy self-efficacy, mathematical reasoning self-efficacy, usage of concrete materials in

mathematics education self-efficacy, origami related self-efficacy, mathematics self-efficacy in science education subject matters, respectively. The most studied sub-subject matters under the mathematics self-efficacy title are academic achievement, gender, and educational background. The most studied sub-subjects under the mathematics literacy self-efficacy title are gender, educational background, and grade. Gender, educational background and professional experience are the most frequently studied sub-subject matters under the title of mathematics teaching self-efficacy. Academic achievement and gender are the most studied sub-subject matters under the title of problem posing self-efficacy and geometry self-efficacy. Besides, academic achievement is studied as the only sub-subject matter of resources of mathematics self-efficacy title. As it is clear, there are no sub-titles in the studies investigating science and statistics.

Findings of the distribution of mathematics self-efficacy themed articles published in Turkey regarding to research methods/design

Figure 5 shows the findings regarding the distribution of research methods/design used in the reviewed articles.
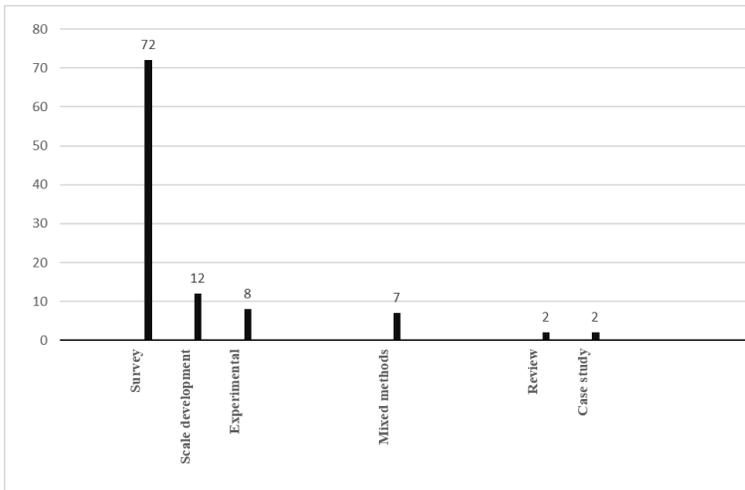
Figure 5. Used methods in mathematics self-efficacy themed articles

As presented in Figure 5, mathematics self-efficacy themed studies were mostly designed as survey study and scale development. These methods were followed by experimental and mixed method research, respectively. Review and case studies were the least used methods.

Findings of the distribution of mathematics self-efficacy themed articles published in Turkey regarding to sample

Figure 6 shows findings of the distribution of the samples studied in the reviewed articles.
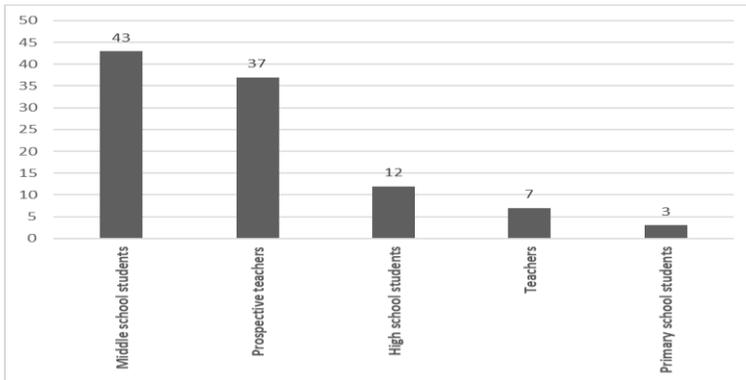
Figure 6. Studied samples in mathematics self-efficacy themed articles

Figure 6 shows that the data of mathematics self-efficacy themed articles were mostly collected from secondary school students and prospective teachers. There were also studies focusing on high school students and teachers. However, little studies were conducted with primary school students.

Findings of the distribution of mathematics self-efficacy themed articles published in Turkey regarding to data collection tools

Figure 7 demonstrates that the distribution of data collection tools used in mathematics self-efficacy themed articles in Turkey.
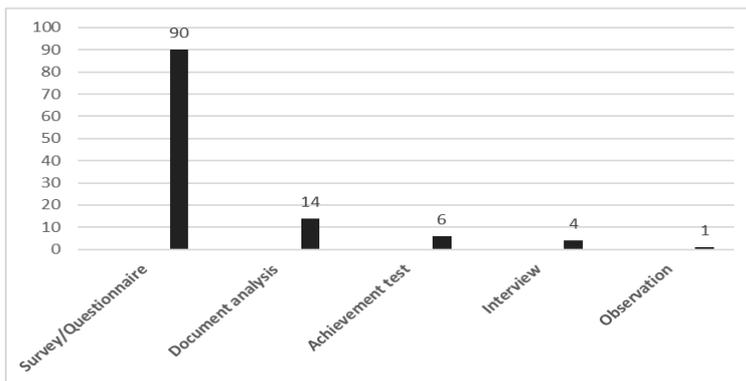
Figure 7. Data collection tools used in mathematics self-efficacy themed articles

As presented in Figure 7, the most common data collection tool was survey/questionnaire in mathematics self-efficacy themed articles in Turkey. Documents and achievement tests were also widely used. Parallel with the findings of research methods/design, few studies used interviews and observations.

Findings of the distribution of mathematics self-efficacy themed articles published in Turkey regarding to data analysis methods

Figure 8 demonstrates that the distribution of data analysis methods used in mathematics self-efficacy themed articles in Turkey.
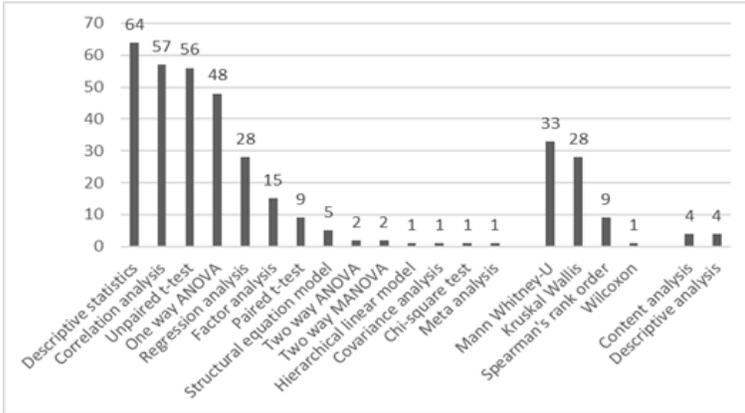
Figure 8. Data analysis methods applied in mathematics self-efficacy themed articles

A variety of data analysis methods were applied in mathematics self-efficacy themed articles. As seen from the figure, the most frequently used data analysis method was descriptive analysis. Amongst the inferential methods the most common ones were correlation, unpaired t-test, one-way ANOVA, Mann Whitney-U, Kruskal Wallis, regression, factor analysis, paired t-test and Sperman's rank order, respectively. It is also seen that structural equation model, two-way ANOVA, two way MANOVA, hierarchical linear model, covariance analysis, chi-square test, meta-analysis and Wilcoxon test were used in mathematics self-efficacy themed research articles. Descriptive analysis and content analysis were the only data analysis methods used in qualitative studies.

Findings of the distribution of mathematics self-efficacy themed articles published in Turkey regarding to languages

Figure 9 shows findings of the distribution of languages used in the reviewed articles.
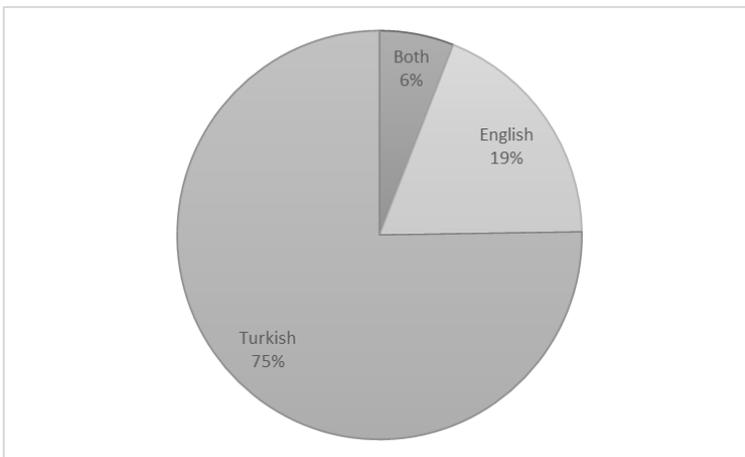

Figure 9. Languages used in mathematics self-efficacy themed articles

As can be seen in Figure 9, most of mathematics self-efficacy themed articles were published in Turkish. This is followed by articles in English. However, it has been determined that very few studies have been published in both English and Turkish.

Discussion and Conclusion

The following results were reached in this research, which purposes to determine the distribution of articles on mathematics self-efficacy in Turkey by years, fields, subjects, study groups, methods, data collection tools, data analysis methods and publication languages, in detail.

A fluctuating increase is observed in the number of articles on mathematics self-efficacy between 2010 and 2020. The scales adapted to Turkish (Yurt & Sünbül, 2014) or developed (Baypınar & Tarım, 2019; Göloğlu Demir & Çetin, 2010) and the new dimensions of mathematics self-efficacy have begun to be investigated such as origami related self-efficacy in mathematics education (Arslan & Işıksal Bostan, 2016), self-Efficacy in the usage thereof in mathematics education (Aydoğdu İskenderoğlu, Türk & İskenderoğlu, 2016) could explain the increase. However, it is seen that there is a sharp decline in the number of publications after 2020. It is possible to attribute this to the difficulties of data collection during the COVID-19 pandemic.

The research shows that studies mostly belong to disciplines of mathematics education. It is also evident that research studies on geometry education are represented by published articles on mathematics self-efficacy themed. The reason for the predominance of mathematics education and as a very close discipline geometry education research articles would be the fact that the scope of this research is mathematics self-efficacy. It is also seen that mathematics self-efficacy themed papers on Science education are investigated. Considering that mathematics is the scientific language of science, it would not be surprising that mathematics self-efficacy themed articles are studied on science education. Besides, interdisciplinary studies have increased with the changing science education curriculum (Şen, 2013).

This research shows that most of the mathematics self-efficacy themed articles are related with mathematics self-efficacy, mathematics literacy self-efficacy, mathematics teaching self-efficacy, geometry self-efficacy, problem posing self-efficacy, visual mathematics literacy self-efficacy and resources of mathematics self-efficacy. These results are parallel to literature (Gerez Cantimer & Şengül, 2020; Kıran, 2018). It is actually supported by Bandura (1997) to study mathematical self-efficacy themed articles towards such sub-fields. Because, Bandura (1997) indicates that self-efficacy is domain-specific. For instance, preservice teachers may exhibit high levels of confidence in their capacity to solve mathematical problems accurately, while simultaneously experiencing a lack of confidence in their ability to effectively teach mathematics. Consequently, requesting preservice teachers to provide a general assessment of their overall confidence in mathematics could yield responses that may be misleading. A wholesale approach to self-efficacy may not yield accurate results. Also, new topics such as mathematical connection self-efficacy, mathematical virtual manipulatives self-efficacy, mathematical modelling self-efficacy, systems of linear equations self-efficacy, self-efficacy towards number sense, statistical literacy self-efficacy, mathematical reasoning self-efficacy, usage of concrete materials in mathematics education self-efficacy, origami related self-efficacy, mathematics self-efficacy in science education are

studied subject matters in mathematics self-efficacy themed articles. As mentioned above, the study of the concept of self-efficacy in more specific areas confirms Bandura's (1997) argument in our country, as well.

Regarding to research methods, it is found out that quantitative methods are prominent in mathematics self-efficacy themed studies. Mixed methods and qualitative studies are less frequently chosen. This result is also supported by earlier thematic analysis research on mathematics self-efficacy (Gerez Cantimer & Şengül, 2020; Kıran, 2018), and other education fields (Göktaş, Hasançebi et al., 2012; Gül & Sözbilir, 2015; Özturan Sağırlı & Baş, 2020), as well. The vast majority of studies using quantitative research methods may derive from some of the strengths of the quantitative method. For example, the quantitative findings are able to be generalised to a whole population or a sub-population because the findings are relevant to the large samples which is randomly selected (Carr, 1994). Data collection and analysis of quantitative studies require less time and money as it could use online forms and surveys or the statistical soft wares. Besides the advantages of quantitative research methods, Ekiz (2004) attributed less preference of qualitative research methods in educational research to most of the academicians educated in the field of education has had science background in our country. The general assumption of these scientists is that research results should be expressed with statistical values, generalizations should be made and research should be conducted with a traditional approach. Similarly, Yıldırım and Şimşek (2013) state that at least some of these scientists trained in the positivist tradition do not accept qualitative research methods that are not suitable for a positivist paradigm or method as science. These scientists, who have a voice in universities, directly or indirectly has prevented the development and spread of qualitative research methods in educational studies in Turkey (Ekiz, 2004). Therefore, researchers do not have sufficient knowledge and skills on qualitative research methodology (Gül & Sözbilir, 2015).

When the quantitative studies are investigated in detail, the majority of them are carried out with descriptive methods such as survey. Survey is followed by scale development studies. However, it is seen that there is a little research employed experimental research design. According to Gül and Sözbilir (2015), the existence of small number of experimental research could come from the many features of the design. For instance, in experimental studies, at least two groups should be formed as experimental and control groups; the implementation needs more time and the data analysis process may be more complex than descriptive research. This result indicates that researchers tend to investigate mathematics self-efficacy mostly prefer to focus on identifying existing situations rather than developing solutions them or determining the cause-effect relationship between variables. Similarly, descriptive studies are dominant in qualitative research, as well. It was found that the qualitative studies carried out were only reviews and case studies. Action research, phenomenological research or grounded theory as qualitative research design were not encountered.

The most frequently studied samples are secondary school student in the mathematics self-efficacy themed articles. However, in very little research, the samples consisted of primary school students. The reason for this is that secondary school students can better understand their feelings, evaluate and reflect their own characteristics about an affective variable such as mathematics self-efficacy. Additionally, when examined in detail, it is seen that there is a shortage of mathematics self-efficacy scale toward

primary school students in Turkish. Given the Turkish researchers' tendency to conduct quantitative studies by using questionnaires and tests, the finding may not be surprising. Another sample group studied most frequently is prospective teachers. Gerez Cantimer and Şengül (2020) state that the reason of studying with prospective teachers frequently may stem from the importance of determining the profile of the future teachers and their reflections on students. On the other hand, according to Gül and Sözbilir (2015), the sample of prospective teachers is frequently studied because it is more accessible.

Regarding data collection tools used, most of the mathematics self-efficacy themed research papers are based on data collected through questionnaires, achievement and attitude tests. Interviews and observations are rarely applied in these studies. Similar results may be found in the earlier research aimed to analyse mathematics self-efficacy themed articles (Gerez Cantimer & Şengül, 2020; Kıran, 2018). It is possible to think that surveys are often preferred because the data obtained by surveys are more quality, anonymous, honest and intimate, and have well response rates than for instance interviews. Besides questionnaires can provide more data in the shortest time and minimum amount of money (Marshall, 2005).

Research articles on mathematics self-efficacy in Turkey mainly include descriptive and inferential statistical methods. This finding is not surprising given that analysis methods should be compatible with research methods. Among those methods usage of frequencies, percentages, means and standard deviation tables, graphs together with correlation, regression, t-test, and ANOVA are the most commons. These results are supported by earlier research (Kıran, 2018). Chin and Lee (2008) state that parametric tests are more powerful than non-parametric tests. Thus, the good thing is that parametric tests are applied more often than non-parametric tests in articles with the theme of mathematics self-efficacy. Conversely, the small number of research articles on mathematics self-efficacy use advanced statistical techniques like MANOVA, hierarchical linear model and covariance. As Gül and Sözbilir (2015) indicate that this finding likely means that advanced statistical techniques are not well known by researchers. Besides, the limited number of research applied qualitative analysis methods such as content or descriptive analysis. However, in-depth information can be collected and interpreted with qualitative analysis for variables that include the affective dimension like self-efficacy.

The comprehensive content analysis of mathematics self-efficacy themed articles determines that the most research is published in Turkish. In the study, this finding is expected, since mathematics self-efficacy themed articles are selected within the journals published in our country. It is also understandable that Turkish academics generally publish in Turkish, given that their foreign language is not good enough (Göktaş, Küçük et al., 2012) and employment and academic promotion are heavily dependent on the quantity of articles published (Gül & Sözbilir, 2012).

To conclude, this study provides a guide for researchers who study and tend to study mathematics self-efficacy research and educators by considering the following points.

Studies on mathematics self-efficacy are mostly investigated in mathematics and related fields such as geometry and science education. In this respect, multidisciplinary research can be designed in which mathematics self-efficacy and Turkish or social studies education can study together.

New topics such as origami use in mathematics education related to mathematics self-efficacy were examined. Considering the domain-specific nature of self-efficacy (Bandura, 1997), subject matters that reveals different aspects of mathematics self-efficacy can be studied.

The majority of mathematics self-efficacy themed research papers in Turkey are produced by using quantitative methods, its data collection tools and analysis. Therefore, it is necessary to conduct qualitative and mixed method studies in order to obtain a deeper understanding of the concept of mathematics self-efficacy.

Future mathematics self-efficacy themed research should study with different sample groups, especially teachers and primary school students. Teachers should be an important sample group for the future mathematics self-efficacy themed studies because of the greatest influence of teacher quality on students' achievement (Stronge 2010). Besides, the mathematics self-efficacy of primary school students should be investigated. Since mathematics is a cumulative discipline, it is important to build mathematics instruction in primary school on solid foundations (Önal & Aydın, 2018).

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