

# The Effectiveness of Using Comics in Education: A Meta-analytic and Meta-thematic Analysis Study

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## ABSTRACT

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### Keywords:

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The aim of the study is to assess educational comics in the context of meta-analytic and meta-thematic analysis. Within the scope of meta-analysis, studies on educational comics from 2005 to 2021 were obtained from different databases. The effect size of educational comics studies on achievement was medium ( $g=0.71$ ), and on attitudes was also medium ( $g=0.70$ ), with educational comics in favor of academic achievement and attitude points. Moderator analyses were conducted in the meta-analytic process, and it is aimed to address the status of educational comic activity in terms of teaching levels, application process, subject matter domains and sample sizes. The reliability of meta-analysis process was considered and the operations in the meta-analysis process were completed at reliable levels. For the meta-thematic aspect, national and international studies with qualitative dimensions were reached. Despite some minor flaws of the comic, it has been seen that it has positive effects on academic achievement, attitude, and cognitive and affective dimensions of students. These emerging data were combined in two directions, and it was ensured that the study reached a general conclusion. It is thought that performing both meta-analysis and meta-thematic analysis with different data sources contributes to the scope and reliability of the research.

## Çizgi Romanların Eğitimde Kullanmasının Etkililiği: Bir Meta-analitik ve Meta-tematik Analizi Çalışması

### Makale Bilgileri

### ÖZ

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Çalışmanın amacı eğitici çizgi romanları meta-analitik ve meta-tematik analiz bağlamında değerlendirmektir. Meta-analiz kapsamında 2005 yılından 2021 yılına kadar eğitici çizgi roman üzerine yapılan çalışmalar farklı veri tabanlarından elde edilmiştir. Eğitici çizgi roman çalışmalarının başarı üzerindeki etki büyüklüğü orta ( $g=0.71$ ) ve tutumlar üzerindeki etki büyüklüğü de orta ( $g=0.70$ ) olup, eğitici çizgi roman akademik başarı ve tutum puanları lehinedir. Meta-analitik süreç içerisinde moderatör analizleri yapılmış olup, eğitici çizgi roman etkinliğinin öğretim seviyeleri, uygulama süreci, konu alanları ve örneklem büyüklükleri açısından durumunun ele alınması amaçlanmaktadır. Meta-analiz sürecinin güvenilirliğine dikkat edilmiş ve meta-analiz sürecindeki işlemler güvenilir seviyelerde tamamlanmıştır. Meta tematik boyut için nitel boyutları olan ulusal ve uluslararası çalışmalara ulaşılmıştır. Çizgi romanın bazı küçük kusurlarına rağmen öğrencilerin akademik başarıları, tutumları ile bilişsel ve duyuşsal boyutları üzerinde olumlu etkileri olduğu görülmüştür. Ortaya çıkan bu veriler iki yönde birleştirilerek çalışmanın genel bir sonuca ulaşması sağlanmıştır. Farklı veri kaynakları ile hem meta-analiz hem de meta-tematik analiz yapılmasının araştırmanın kapsamına ve güvenilirliğine katkı sağlayacağı düşünülmektedir.

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## INTRODUCTION

Education has a particularly important mission for societies: to compete within the world, to prepare for the future, and to raise generations with qualified life skills. Education is the most basic element for cultivating competent individuals in the context of knowledge, skills, and innovation. With this aim, it is necessary to enrich the material in learning and teaching environments at the point of access because these materials are basic variables directly affecting the teaching and learning of students (Karagöz, 2018). In the current age, visual elements have come to the forefront through the media, especially, and this is an age when learning in all areas and meanings is rendered more effective and permanent due to these visual aids. Differences in styles of learning make educational practices difficult in multiple educational environments. Within this framework, educational tools and equipment differentiate and enrich the learning environment on the one hand, while making learning more enjoyable and meaningful on the other. Education-teaching activities based just on textbooks cause boredom in the target audience after a certain time and remain distant from being a motivational element for new learning. As a result, there is a need for elements that will aid textbooks on the one hand and also make learning more enjoyable, meaningful, and permanent on the other (Doğan, 2014). In fact, currently, teachers are known to bring several types of materials into the classroom environment in the name of ensuring more permanent learning and increasing class motivation to higher levels. Visual materials like caricatures, simulations, cartoons, photographs, etc., especially, bring visual elements to the fore and are frequently used in learning-teaching environments. However, a new type among these materials is comics, with increasing popularity due to both visual impact and expressiveness, especially in recent years (Topkaya, 2016a; Çiçek Şentürk & Selvi, 2023; Yani, et al., 2023).

Though educational comics are frequently confused with caricatures by readers, in fact this is a different literary type with a unique concept. The professional use of comics in education was seen in the middle of the 20th century in the USA, and a brief time later, they began to be commonly used in many countries on the European continent (Symeon, 2008). Dealing intensely with topics like fear, adventure, science fiction, fantasy, and detective stories in the first period of production, in later periods it appears comics were used in educational areas (Topkaya, 2016a). The basic reason for this is research by the Gallup Institute (in 1929), which revealed that comics were enjoyed and read by many different sections of society. Research identified that comics were mainly read by professors, bankers, and doctors, while another finding of the research was that 58.3% of males and 56.6% of females read comics with great interest (Metken, 1970). As a result, it was understood that this comprised a substantial proportion of the reading audience.

Educational comics have recently been frequently used in different fields such as science education, social studies education, language education, and mathematics. The main subject of these studies is the effect of educational comics on students' achievement, attitudes towards lessons, interest, motivation, etc. Studies focusing on environmental education, which is a common topic of science education and social studies education, are frequently encountered (Hosler & Boomer, 2011; Richter, et al., 2015; Kirchoff, 2017; Çelik & İlhan, 2021; Çiçek Şentürk & Selvi, 2023; Yani, et al., 2023; Candrayani & Sujana, 2023; Uğureli, et al., 2023; Bozkurt, 2023).

### Definitions of Comics

Many definitions are encountered in the literature about comics, with extremely high effective capability. Accordingly, comics are defined in different ways as any story or tale told through pictures or drawings (Alsaç, 1994); a story-making art through a sequence of pictures or drawings (Chute, 2008); a form of narrative formed as a result of the integration around a theme of any pictures showing continuity drawn by an illustrator (Platin, 1985); an explanation of continuous stories with a sequence of four or more pictures (Diegritz, 1979); or a form of narrative with different characters occurring repeatedly in different situations, with balance between the text and visual movement and antagonists conversing with each other in speech bubbles (Inge, 1997). Eisner (1974) defined comics as the combination of pictures and text with drawings

addressing both the verbal and visual senses of readers. When definitions of comics are examined, all definitions have some common characteristics, such as an explanation of a story through sequential pictures, release at regular intervals, dialogue in boxes, pictures and text overlapping, and the presence of any protagonist appropriate to the scenario (Tuncer, 1993).

For comics, initially, the illustrator expertly ensures the compliance of words and pictures (Liu, 2004) and then presents a comic containing characters with distinctive features prepared for a reading audience (Barker, 1989). As comics are products based on the synthesis of textual and visual information (Hoover, 2012), reading curiosity and desire are stimulated by the fiction along with the life experiences of the reading audience, preparing the reader for a dreamlike and fantastic environment. As a result, there is a common opinion that reading comics positively affects creative problem-solving and recall skills (Muzumdar, 2016; Short & Reeves, 2009). Considering these positive functions of comics, it is thought to be worth studying comics in detail, as this method may be interpreted to provide effective and productive results during lessons.

Although graphic novels and comic books have recently been used interchangeably, they are actually varied materials. Graphic novels contain an entire story, while comics are sequels and serial publications. Graphic novels contain an entire story, while comics are sequels and serial publications. While graphic novels are short-lived, comic books are available in reprints and are kept on bookshelves for a long time (Güngör, 2020). In this study, since these two concepts are used interchangeably, they are managed as educational comics under one title.

### **Objectives of the Research**

This research investigates studies in the relevant literature related to comics containing a theme worked through pictures with the aim of determining the efficacy of comics and completes a new study about a topic chosen according to the results of the screening. Screening of the relevant literature at national and international levels encountered studies investigating the effect of educational comics on different lessons and topics. It was determined that educational comics were effective for motivation towards lessons (Olson, 2008; Özdemir, 2017; Topkaya & Yılar, 2015; Wright & Sherman, 1994), academic success and attitudes (Purnell & Solman, 1991; Topkaya, 2016b; Topkaya & Şimşek, 2016), and language teaching (Akkaya, 2013; Cary, 2004; Freeman & Freeman, 2000; Khoii & Forouzesh, 2010; Megawati & Anugerahwati, 2012; Meriç, 2013; Sones, 1944; Williams, 1995). Each study determined the effect of EGN on the relevant dimensions within their scope. However, as these studies are not as detailed and comprehensive as the present research, they do not appear to present rich data containing different analyses. As a result, it is considered that the study will contribute to the literature with significant and original qualities. In fact, the current research performed meta-analytic and meta-thematic analyses about the topic of educational comics, including an investigation of both qualitative and quantitative aspects. As the research is multidimensional, it makes the process more robust and the results more reliable. In this context, the research examined the efficacy and effect in the following dimensions, in line with the basic aim of evaluating educational comics:

- The effect of educational comics on attitudes and academic achievement.
- Whether educational comics have affective and cognitive aspects and their critical features.

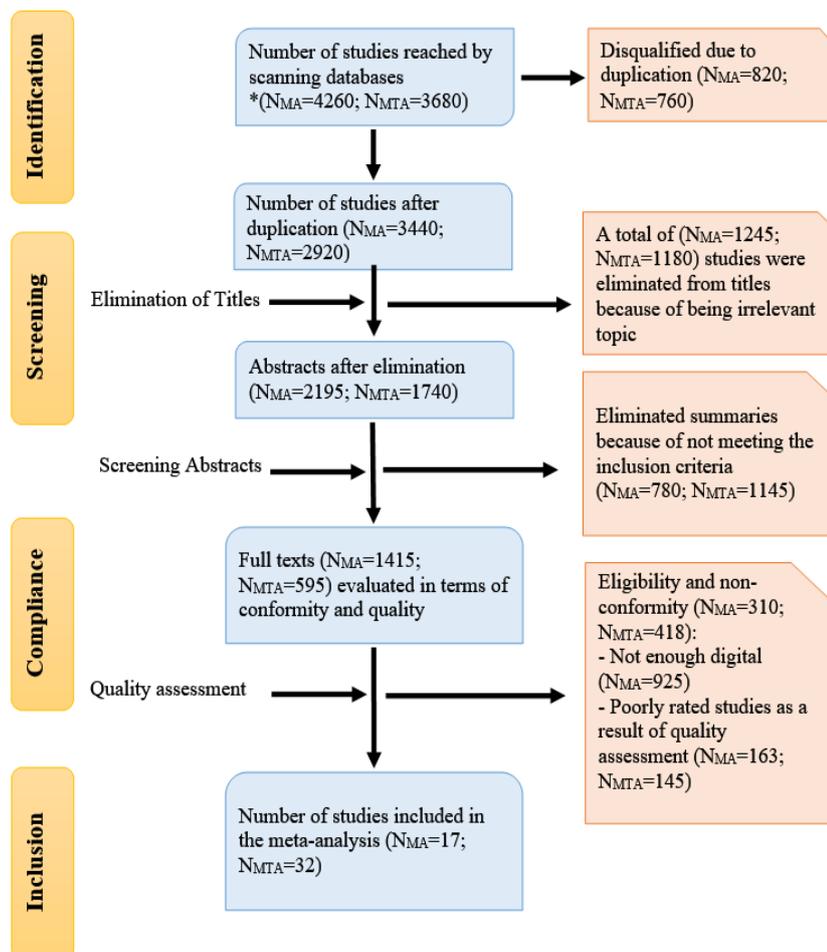
### **METHOD**

In this stage, with a clear investigation of the framework of the research, studies related to the use of educational comics were evaluated with methods such as document analysis, investigation, and review (meta-analytic and meta-thematic analysis). The first aspect of the research includes the qualities of scientific research in national and international publications like articles, theses, reports, and books about the topic of educational comics in the relevant literature, and an attempt was made to determine the place held by the topic in the literature. With this identification, attempts were made to clarify which aspects of the educational

comics' topic were missing and the topics, years, lessons/publication types in which research was performed. As a result of the identifications at this point, the gaps in the field were determined to increase awareness of the topic and attract the attention of other researchers to research it.

### The Part of Meta-analysis and Inclusion Criteria

Future research by other researchers can be reviewed by considering all studies about the use of educational comics based on certain criteria. For this, screening of the ProQuest Thesis database (PQDT), Higher Education Authority (HEA) National Thesis Centre, Google Academic, Ebscohost-Eric, Taylor-Francis, and ScienceDirect databases from 2005–2021 in the national and international field for “effect of educational comics on academic achievement and attitude” was performed. "Comics", "educational comics", "achievement", "attitude", "benefits," and "limitations" were searched as keywords. When scanning the literature related to the use of educational comics, care was taken to include studies containing pre- and post-test points and data allowing the calculation of the effect size ( $x$ ,  $sd$ ,  $n$ ). Additionally, a limited number of the screened studies allowed access to databases. Information about the author names, publication year, study title, topic, and aim were collected for the studies. In line with this, while a total of 4260 theses and articles were screened for the meta-analysis, 3680 studies were reached for the meta-thematic analysis. However, 43 data points from 17 studies complying with the criteria for academic achievement in the meta-analysis and 32 studies including the effect of educational comics in the meta-thematic analysis were chosen. Information about the inclusion and exclusion process is given in the PRISMA flow diagram presented in Figure 1 (Moher et al., 2009).



$N_{MA}$ : Number of academic achievement studies for meta-analysis.

$N_{MTA}$ : Number of studies for meta-thematic studies

**Figure 1.** *PRISMA Flow Diagram*

Examining Figure 1, the screening of databases to determine the effect of educational comics on achievement appeared to reach  $NMA = 4260$  in the context of meta-analysis, while a number of 3680 ( $NMTA = 3680$ ) was reached considering qualitative studies in terms of meta-thematic analysis. Of these 4260 studies for meta-analysis, 820 were excluded as equivalent copies; 1245 were eliminated after reviewing the abstracts of the studies and it appeared that they had unrelated topics. 780 of the remaining 2195 studies were also removed because they did not meet the inclusion criteria for the review. As a result of a more detailed and comprehensive review, the remaining 1415 studies were assessed for appropriateness, quality and data sets. The assessment removed 310 inappropriate studies, 163 low quality studies and 925 studies with insufficient data sets. Finally, a total of 1498 studies were excluded from the meta-analysis for related reasons. Thus, 43 effect size comparisons from 17 publications were considered relevant to the research question. The effect of educational comics on learners' attitudes was also a meta-analysis objective in this research, although the numbers of attitude studies ( $NMAAT$ ) were not presented in the PRISMA diagram. Thus, after scanning the studies related to educational comics and attitudes, a total of 1200 studies were obtained. Taking into account duplication ( $NMAAT = 250$ ), relevance to title and content ( $NMAAT = 631$ ), agreement ( $NMAAT = 59$ ), sufficient digital data ( $NMAAT = 23$ ), and scientific quality ( $NMAAT = 11$ ), 20 effect size comparisons from 8 publications were selected for the attitude research question in the meta-analysis.

Otherwise, for the meta-thematic process,  $NMTA = 3680$  studies were obtained through screening, with 760 equivalent copies removed and 1180 discarded due to inappropriate content. The remaining 1740 studies were screened against the study criteria and 1145 were found to be irrelevant. Later, the remaining 595 were assessed for compliance and it was found that 418 studies were not sufficiently compliant and 145 were not scientifically of high quality. Therefore, 32 studies were preferred for the meta-thematic analysis.

### **Coding Process in Meta-analysis**

In order to compare the study results for the academic and attitudinal dimensions in the research, a coding form had to be created. For this purpose, the researchers synthesized data with key information qualities obtained during the screening of research in the meta-analysis aspect and designed a coding form for comparisons. The data to be coded are generally divided into four basic categories: (i) basic and methodological characteristics, (ii) study quality, (iii) intervention descriptors, and (iv) outcome criteria. Basic and methodological characteristics in the literature include features such as source of research, year of publication, research design/type, and author/researcher characteristics that define important variables to be coded for each research synthesis. These details were coded with the goal of associating these characteristics with study outcomes. Study quality markers (Brown, 1991) should be considered. Intervention descriptors and relevant outcome criteria are specific to a study and should clearly address the study questions (Brown, Upchurch & Acton, 2003). For the present review, abstracts and full texts of studies selected according to the above inclusion criteria were reviewed. In addition, two independent reviewers contributed to the reliability of the research and detailed investigations were conducted to reach a common consensus on studies with differing opinions to ensure that these studies were included in the coding process. In other words, two coders independently coded each study and discussed disagreements together. After reaching a compromise, coding reliability was assessed using the intercoder reliability formula.

### **The Effect Size**

The effect size value provides information about the difference in magnitude and direction between two groups or about the correlations of two variables (Durlak, 2009) and has the quality of coins in meta-analysis studies (Rosenthal, 1995). Hedges' *g*-value uses the degrees of freedom to estimate the total standard deviation in two independent groups. All studies included at this point had at least two checks performed. One was a general assessment and the other was a review of the lessons in which the study was completed. To calculate the effect size, values were entered for sample size, pretest mean and standard deviation, and posttest mean and standard deviation. All effect sizes reported were calculated using Hedges' calculation. As noted above, the reason for choosing Hedges' *g* is the use of a pooled standard deviation with less potential for bias in estimating effect size using the standard deviation value and control group weighting given the sample size (Hedges, 1982).

### **Data Analysis**

The Comprehensive Meta Analysis (CMA) and MetaWin programs were used to analyze the data in the research study. Sample size error may cause the distribution of effect sizes in the meta-analysis to be larger than the expected variability (Lipsey & Wilson, 2001). In this situation, the use of a random effects model (REM) is chosen. The relevant meta-analysis results were graded according to the classification of Thalheimer & Cook (2002). In addition, to ensure inter-rater reliability in the analysis, the formula recommended by Miles & Huberman (1994) was noted [ $\text{fit} / (\text{fit} + \text{incompatibility}) \times 100$ ] and results are reported as 100%.

### **The Part of Meta-thematic Analysis**

Apart from a meta-analytic investigation related to the use of educational comics, a meta-thematic review was performed to ensure a richer data set. Meta-thematic analysis can be defined as investigating screened qualitative studies about any topic from the perspective of the researcher and involving comprehensive and overall quality findings by dealing with the themes and related codes in the studies on a common plane and gaining meaning in this way (Batdı, 2017). In other words, it can be explained as the process of reviewing the literature and developing new meanings from the findings obtained. Within the research, it ensures increased internal validity by broadening the scope and using a variety of sources for data collection (Yıldırım & Şimşek, 2013), which, as a result, positively affects the reliability and persuasive power of the study. With this aim, 32 qualitative studies found as a result of screening the relevant national and international literature were added to the meta-thematic analysis in the research. These studies were collected via document investigation routes appropriate for the targeted content analysis to present the contents clearly for readers. In the coding process for meta-thematic analysis, care was taken to ensure that the data collected related to educational comics were explanatory and clear concepts (Silverman, 2001). Firstly, the data obtained in the research was coded, and then the related codes were combined to create themes (Çokluk, Şekercioğlu & Büyüköztürk, 2016). In this way, codes and themes obtained from participant opinions were presented as summaries. Additionally, details are required to support these views after coding.

In the screening process, some criteria were noted. These criteria were determined as studies being completed from 2005 to 2021, presenting qualitative data, and investigating the effect of educational comics on academic achievement and various aspects (cognitive, affective, and critical). The analysis of studies reached within this framework was completed with the Maxqda program. At this point, studies were coded considering their types. Studies were coded as articles "A," ProQuest theses "PQDT", other theses "T" and ScienceDirect database "SD". Additionally, when giving details within the text related to these codes, the number of pages in the study was added to the codes (for example, PDQT1-94 refers to the study coded

ProQuest thesis 1, page 94). Reliability during the analysis process was found by calculating the fit value called Cohen kappa between coders (McHugh, 2012), which had a value .692 and this was interpreted as showing a “good level of fit”.

## FINDINGS / RESULTS

### Results of Using Educational Comics Considering the Academic Achievement, Attitude and Moderator Analyses

In Table 1, the analysis results show academic achievement and attitude data according to the random effects model (REM). It was recorded that with an overall effect size of the academic achievement test (AAT) being “0.71 [.47; .94]” and attitude being “0.70 [.32; 1.08]”, academic achievement and attitude are at a higher level in instruction with educational comics compared with instruction through traditional methods. When these effect sizes are investigated, it is found that there are meaningful positive values at a medium level. Accordingly, the value of  $p < 0.05$  results showed that the analyses have statistical significance.

**Table 1.** Meta-Analysis Results

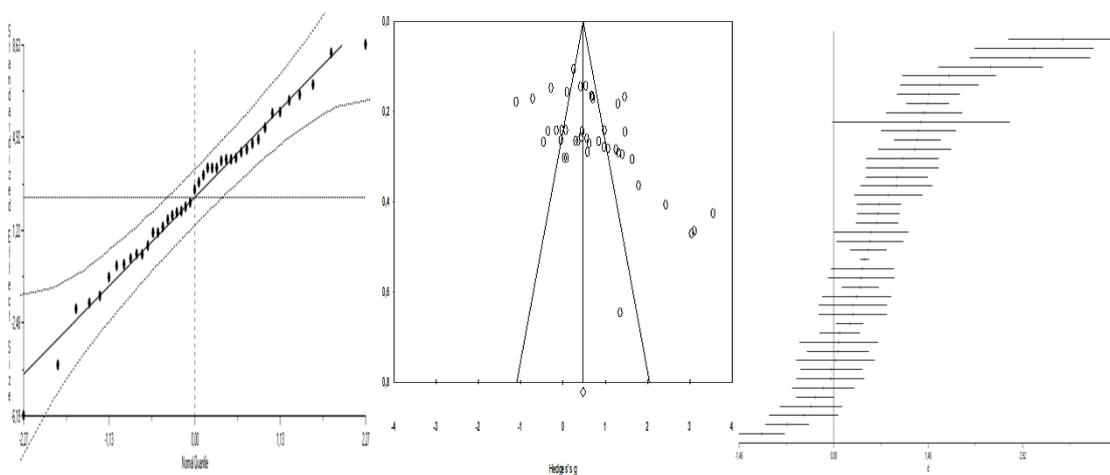
Type of Test	Models	n	g	95% CI		Heterogeneity		
				Lower	Upper	Q	p	I <sup>2</sup>
AAT	FEM	43	0.47	0.41	0.54	491.2	0.0	91.45
	REM	43	0.71	0.47	0.94	7	0	
Attitude	FEM	20	0.25	0.17	0.34	334.0	0.0	94.31
	REM	20	0.70	0.32	1.08	8	0	
<b>Moderator Effects (AAT)</b>		<b>n</b>	<b>g</b>	<b>Lower</b>	<b>Upper</b>	<b>Q<sub>B</sub></b>	<b>df</b>	<b>p</b>
Teaching Levels	Primary	2	0.97	0.61	1.33	28.24	3	0.00
	Secondary	20	1.06	0.64	1.49			
	High	16	0.49	0.23	0.76			
	University	5	-0.01	-0.27	0.25			
	Tot. Betw.	43	0.48	0.33	0.63			
	Overall							
Application Process	1-4	10	1.78	1.20	2.36	26.48	4	0.00
	5-6	14	0.60	0.33	0.88			
	7-8	9	0.01	-0.53	0.56			
	9+	2	0.05	-0.37	0.47			
	Unspecified	8	0.60	0.18	1.02			
	Tot. Betw.	43	0.55	0.37	0.73			
Overall								
Subject Areas	Science	7	0.28	0.04	0.53	31.19	2	0.00
	Social Sciences	9	2.00	1.44	2.55			
	Foreign Langs.	27	0.42	0.15	0.68			
	Tot. Betw.	43	0.50	0.33	0.68			
Overall								
Sample Sizes	Large	12	0.33	-0.05	0.71	6.44	2	0.04
	Medium	23	0.69	0.39	0.98			
	Small	8	1.51	0.65	2.38			
	Tot. Betw.	43	0.62	0.39	0.85			
Overall								

The test of homogeneity indicated that the Q statistical value for academic achievement was calculated at 491.27. And this value meant that the effect sizes were heterogeneously distributed ( $Q=491.27$ ;  $p < .05$ ). At this point, the  $I^2$  value (91.45%) reflected that the observed 91% value is due to the true variance among studies. The  $I^2$  value with a 25% value, on the other hand, shows low heterogeneity, while 50% shows medium and 75% and above high heterogeneity (Cooper, Hedges, & Valentine, 2009). It can be seen herein that the  $I^2$  value analyzed in this study is found to be 91.45, which means high heterogeneity. (Higgins, Thompson, Deek, & Altman, 2003). As a result, a high heterogeneity level indicates the presence of

moderator variables. In other words, it can be said that the moderator analysis of the test should be carried out because the  $I^2$  result shows heterogeneity (Borenstein et al., 2009). Thus, the teaching levels, application processes, subject areas, and sample sizes were selected as moderator analyses. According to the moderator analysis results, it is seen that there are significant differences in terms of the teaching levels ( $Q_B=28.24$ ;  $p<.05$ ), the application processes ( $Q_B=26.48$ ;  $p<.05$ ), subject areas ( $Q_B=31.19$ ;  $p<.05$ ) and sample sizes ( $Q_B=6.44$ ;  $p<.05$ ). The results of the analysis set forth that the applications based on educational comics have a similar large effect on all four groups.

### The Reliability Process of the Meta-Analysis

Figure 2 shows the Funnel Plot, which is also considered a visual sum of the data in the meta-analysis process (Cooper et al., 2009), and shows the probability of publication bias. Meta-analysis calculated with the CMA analysis program can sometimes lead to bias in the calculated effect size (Borenstein & Higgins, 2013; Field & Gillett, 2010). In addition, the Normal Quantile Plot and Classic Fail-Safe test results were examined to examine the bias in the study. In the meta-analytic analysis process, publication bias was calculated, and the fail-safe number (FSN) that would minimize bias was used (Rosenthal, 1979). Following the analysis, it was understood that if a number of 4353 studies were added to the analysis regarding the effect of educational comics on achievement scores, the significance would decrease to null. When it was seen that these values were quite high and considering that it requires an inaccessible amount of work, it was understood that the bias did not have any effect (Cheung & Slavin, 2011). Thus, the analyses were seen to be reliable.

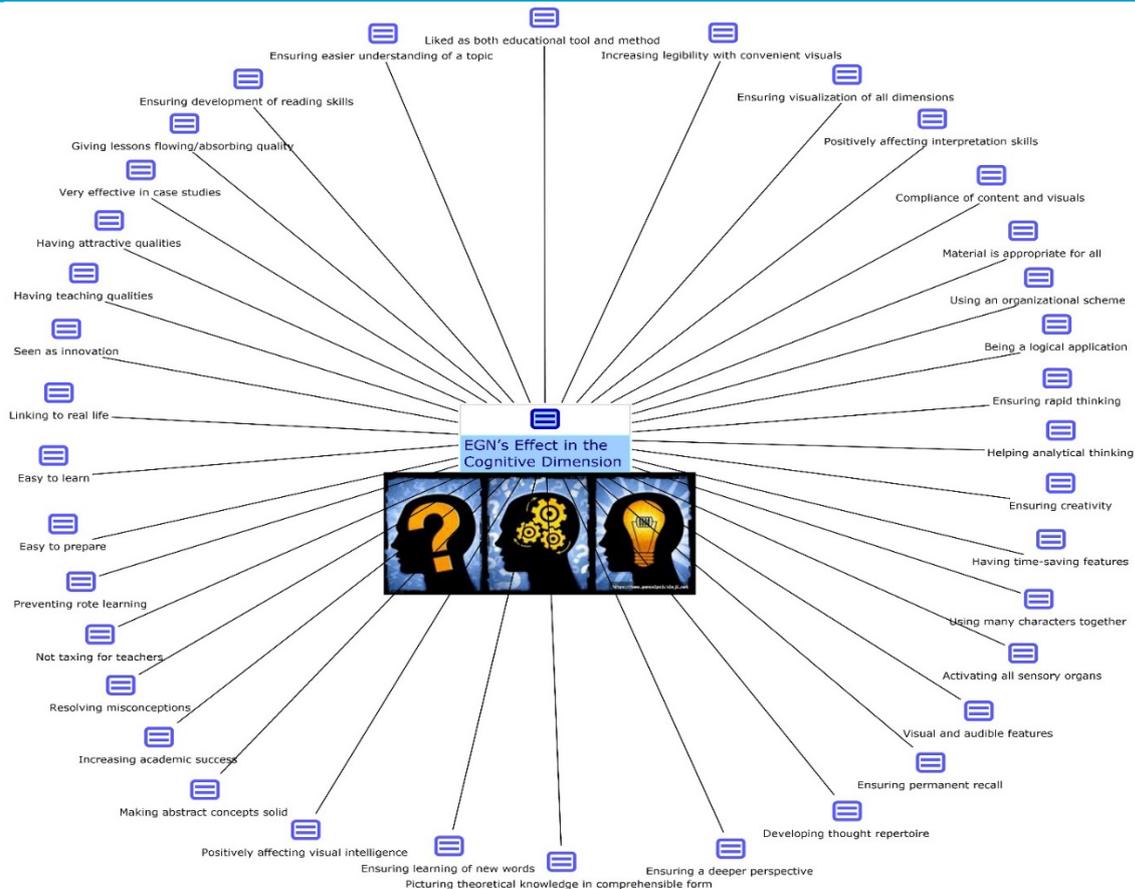


**Figure 2.** Normal Quantile Plot, Funnel Plot and Effect Size CI Plot

Moreover, when the Normal quantile plot, which is reached by MetaWin analysis program, is examined in Figure 2, it is recognized that the studies involved in the analysis are between two lines, meaning the effect size distribution of the studies means reliable interval (Rosenberg, Adams, & Gurevitch, 2000). The studies between two lines can be explained that the effect size values do not indicate outliers, and the data are appropriate for calculating the effect size. At the same time, examining Figure 2 shows that the effect size CI plot values are harmonious with the study data. In this case, it can be recorded that included studies related to the educational comics are in the reliable range.

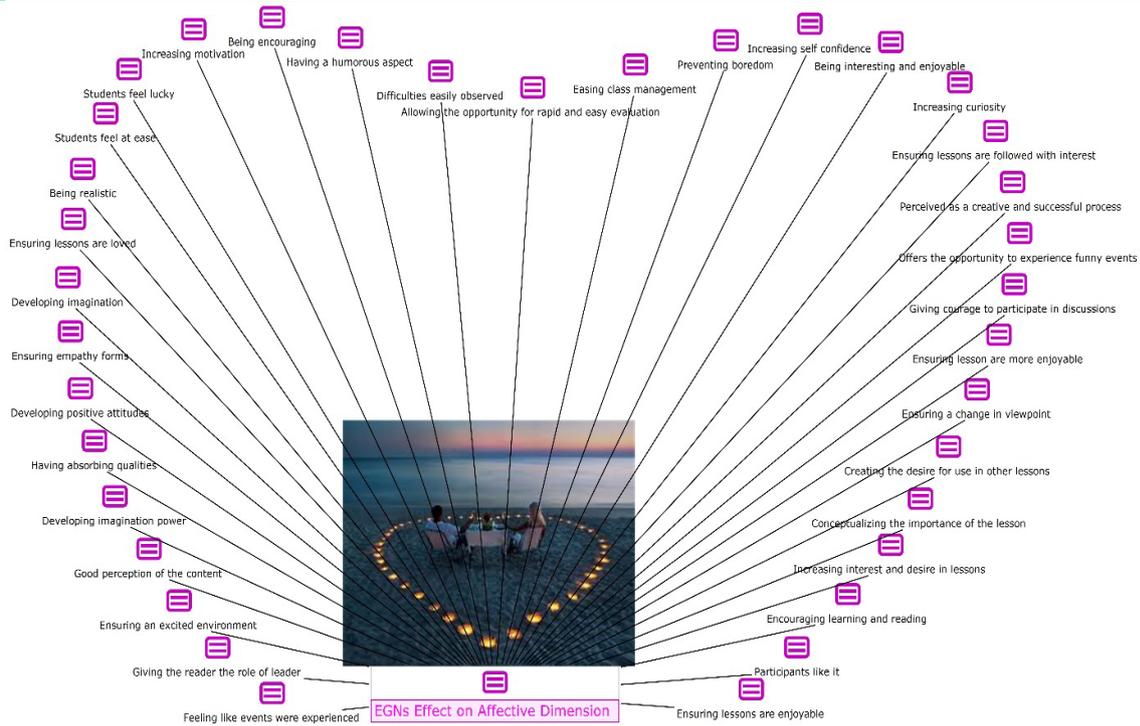
### Results Related to Efficacy of Educational Comics within the Scope of Meta-thematic Analysis

Within the context of educational comics, meta-thematic studies completed with the aim of adding to data reached by document analysis apart from meta-analysis are presented as models with different themes and codes. The theme headings obtained in the meta-thematic dimension were the cognitive dimension effect of educational comics (Figure 3), affective dimension effect (Figure 4) and criticisms (Figure 5).



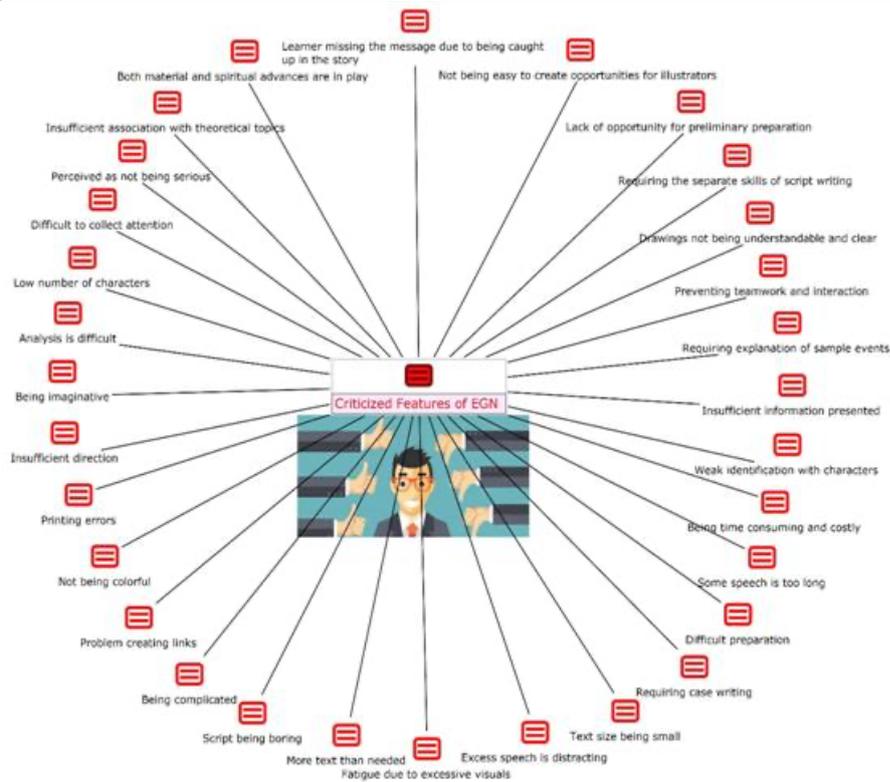
**Figure 3.** Educational Comics' Effect in the Cognitive Dimension

The themes and codes modeled in the context of participant opinions related to the effect of educational comics on the *cognitive dimension* are presented in Figure 3. Noteworthy codes can be stated as “involving all sensory organs, liked as both educational tool and method, ensuring permanent recall, increasing legibility with convenient visuals, providing flowing/absorbing quality to the lesson, ensuring new words are learnt, resolving misconceptions, being a logical application, picturing theoretical knowledge in understandable form, and positively affecting visual intelligence”. Some statements that can be referenced about these codes include “*an event activating all of our sense organs. Both reading, seeing, feeling. Remaining in the mind by being both visual, audible, controversial, and participatory (303683-s.153)*”, “*I was caught by the magic and absorbed in the comic. (447716-s.97)*”. These direct quotes presented as examples mean that educational comics positively affect the cognitive dimensions in many ways and as a result, similarly, affect the learning level.



**Figure 4.** Educational Comics’ Effect on Affective Dimension

An examination of Figure 4 reveals the codes for how educational comics should be effective in the area of *affective dimension*. In this context, it appears codes in the form of “ensures the topic is followed with interest, has a humorous aspect, increases self-confidence, ensures lessons are liked, and encourages learning and reading.” If examples are to be given about following the topic with interest, the study coded 303683-s.153 stated “*When we look at the discussion, previously maybe only one case was done. But when they get their hands on this book, first it attracts their interest more because it’s a very different method, a method they haven’t seen before today.* In terms of ensuring lessons are liked, it was stated that “*I don’t normally like the social science lessons, but I liked this much better. I liked lessons with the comic much more*” (447716-s.90).



**Figure 5.** *Criticized Features of Educational Comics*

Examining Figure 5, it is clear that certain codes highlighted *criticized features* with using educational comics in the classroom. Some of the related codes include “some speeches are too long, learners may miss the message and be absorbed by the story, weak identification with characters, preventing teamwork and interaction, drawings not being understandable and clear, and not being appropriate for every topic”. Statements which are referenced in these codes include “*the excess of speech distracted in some panels, some panels were very nice, with one or two speech bubbles, but some panels were too long*” (303683-s.156) and “*I found the text size very small. As a result, I think it negatively affected the students’ approach to the book.*” (M-17-s.60). Additionally, some other criticized aspects were also mentioned like “material and spiritual advances, analysis being difficult, difficult to associate with theoretical topics, few numbers of characters, deficient directions, printing mistakes, and lack of color, etc”. A statement mentioning the difficulty in preparing educational comics emphasizing different skills and forming the basis for some codes was given by 303683-s.156; “*Writing a script requires a separate skill, determining the characters in the scenario requires a separate skill.*”

**DISCUSSION, CONCLUSION AND RECOMMENDATIONS**

In this research, a process operating with meta-analysis and meta-thematic analysis ensured a comprehensive and overall quality assessment of educational comics. The research, in this context, first performed a meta-analytic investigation of educational comics, reviewing the status of the comics in the field.

The meta-analysis dimension of the research calculated the effect size of the research about educational comics in relation to academic achievement and attitude. The effect size of educational comics studies on academic achievement was medium ( $g=0.71$ ), and on attitudes, it was also medium ( $g=0.70$ ), with educational comics in favor of academic achievement and attitude points, meaning it positively affected these types of points. Similarly, this finding may be interpreted as showing that educational comics increase academic achievement and are effective on attitude and behavior. Within this scope, different studies about

the efficacy of educational comics support the research results. Cihan (2014) made recommendations that educational comics be used as an educational tool and studied as a form of lesson material; the doctoral study by İlhan (2016) concluded that educational comics possessed a positive influence on achievement and learners' attitudes toward lessons in the Social Sciences course, showing similar and consistent results to the present research. Research suggests that educational comics have a positive impact on academic achievement due to their visual richness. (Williams, 1995), increased motivation at high levels (Haugaard, 1973), and feelings of desire and curiosity (Hoover, 2012; Yıldırım, 2016).

In addition, moderator analyses were carried out to clarify whether the efficiency of educational comics changed in terms of teaching levels, application processes, subject areas, and sample sizes. Upon reviewing the results, significant differences were observed in terms of teaching levels, application processes, subject areas, and sample sizes. Hence, the analysis reflected that the efficiency of educational comics can change in terms of the related moderators. For instance, using educational comics in a crowded class may not have the same effect compared to a less crowded one. Or it may be true to say that the efficiency of educational comics is different at different lessons, durations of applications, and teaching levels.

Reliability was also assessed, and several techniques were utilized to guarantee the reliability of meta-analysis research. These methods were the values of the FSN, the funnel plot, and the CI plot. It was seen from each reliability method that there were no significant problems with bias in the analysis dimension of the study. Thus, it may be stated that the operations in the meta-analysis process were completed at reliable levels.

In addition to the meta-analytic dimension, meta-thematic analyses were added. Within this scope, considering meta-thematic findings, educational comics were identified as having different dimensions of effect. These dimensions were evaluated in detail by considering themes. In this context, when themes related to the *cognitive and affective* dimensions of educational comics are investigated, themes emerging in the research include educational comics giving lessons a flowing or absorbing quality, making abstract concepts concrete, resolving misconceptions, and increasing academic achievement in the cognitive dimension (Haugaard, 1973; İlhan & Oruç, 2019; Koenke, 1981). When themes related to the affective dimension are investigated, they include educational comics that increase motivation, ensure lessons are operated in an enjoyable fashion, trigger curiosity, and develop imagination (Crawford, 2004; Hutchinson, 1949; Topkaya, 2016b).

Examining criticisms of educational comics, research highlights that these comics have limitations in explaining certain subjects, their drawings may not be clear or understandable, and the text can be small (Topkaya & Yılar, 2015; Yıldırım, 2016). According to the research results, it appears that the number of studies related to educational comics in national and international literature is very limited. As a result, it is recommended that studies be completed with the aim of researching the effect of educational comics on many different variables, such as academic achievement, attitude, motivation, learning environment, desire to learn, creativity, etc. There is a need for model teachers to adopt and apply the process requiring continuous innovation and changes in the education-teaching environment in the technological period of the 21<sup>st</sup> century. As a result, it is very important that the qualities of teachers be redefined based on reforms and changes in education and teaching and that teachers and preservice teachers gain these qualities. From this aspect, it is recommended that a variety of seminars be arranged for employed teachers about the active use of technology in classrooms and that lessons about the use of this technology be included in undergraduate education with the aim of developing these capacities in preservice teachers. Considering remarkably successful schools around the world, it is clear that it is not the schools that are constantly making significant and fundamental changes that are successful, but the schools that keep up and adapt to technological advances. As a result, as educational comics ensure integration with technology, it will ensure students have

more up-to-date and innovative learning opportunities, and teacher training programs and pedagogic education programs should include technology-based teaching methods and techniques (Abell, 2008). Some research has recommended that stories developed with technology will increase children's conception and perception levels of stories (Zucker, Moody & McKenna, 2009). Multimedia materials visualize story events in accordance with explanations, providing nonverbal information that may aid in understanding the story (Verhallen, Bus, & Jong, 2006). Similarly, stories with interactive features may increase the development of literacy skills or effective listening (Takacs, Swart, & Bus, 2015). At this point, technology-supported interactive content can be created during the preparation of educational comics, which will address students' interest and attention even further.

The opportunity should be taken to use educational comics more widely in different disciplines such as social sciences, natural sciences, mathematics, and language education. The present research reached a variety of conclusions based on the effect of educational comics on achievement and attitudes. However, the researchers recommend studies be performed investigating the efficacy of educational comics in different dimensions. Finally, in this study, the inclusion of meta-analysis and meta-thematic analysis, following a different path to reach conclusions, interpret data, and determine results in the research, allowed the creation of detailed data with a broad span and consistent and supportive qualities. This method ensures the enrichment of data and may be used by researchers as a basis to investigate different research topics.

### **Limitations**

The main goal of this study is to analyze the effectiveness of educational comics using a meta-analysis approach. However, for the future researchers, it is suggested that they can evaluate how educational comics will have an effect among the variables such as application times, courses, grades, and sample sizes. On the other hand, the inclusion criteria of the research can be modified (i.e., semi-experimental researches may also be included); the studies might be grouped according to the types of publications and the measurement tools they use; or aside from the academic achievement and attitude, examining the effect of educational comics on factors such as motivation, awareness and reading comprehension might be executed to provide different contributions to the literature. In this sense, Karagöz (2018) examined the effect of educational comics on reading comprehension; Pereira, Paula and Lopes (2019) used educational comics as a motivational tool in physics education. It might, therefore, be appropriate to suggest other researchers to carry out their future studies considering the related factors.

### **Conclusion and Implications**

In the digital age we are in, visual elements affect every point of life and have permanent and significant effects in the field of education. From an educational perspective, the diversification of learning environments to accommodate individual differences has demonstrated the need for a range of educational materials and training. At this point, it has been tried to determine how effective the use of educational comics is, which combine pictures and texts and present them to the readers in harmony as learning material, by examining the other studies in the literature. Herein, the basic aim is to reach a general judgment with the results obtained by evaluating both quantitative and qualitative research. The common result of the studies analyzed through meta-analysis in a quantitative context revealed that educational comics have an incredibly positive effect in terms of academic achievement and attitude. On the other hand, common results of qualitative studies carried out in the context of educational comics were reflected by meta-thematic analysis, which is complementary and supportive of these results. Findings showed that educational comics materials provide improvement in learners' cognitive and affective levels. However, the limitations determined, depending on the experience of some problems in the implementation dimension of the educational comics, are also reported. The fact that the visual drawings are not understandable, that it is not easy to draw, and that it may be problematic to find visuals suitable for each subject are the remarkable ones. Removing the limitations of this application, which involves the learner in the process by having fun, drawing attention,

and not getting bored, can increase its effectiveness. At this point, it is believed that the existing prosperity of educational comics will increase by considering suggestions such as ensuring visual and text harmony, preliminary preparation, and preparation with short and concise content. Finally, it is thought that educational comics provide original contributions to the literature by producing meaningful, positive, and effective results in terms of the learning process in general and at the expected level.

## REFERENCES

References marked with an asterisk (\*) indicate studies included in the meta-analysis and meta-thematic analysis.

- \*Alaba, S. O. (2007). The use of educational cartoons and comics in enhancing creativity in primary school pupils in Ile-ife, Osun State, Nigeria. *Journal of Applied Sciences Research*, 3(10), 913-920.
- \*Arini, F. D. & Sunardi, A. S. C. (2017). The use of comic as a learning aid to improve learning interest of slow learner student, *European Journal of Special Education Research*, 2(1), 71-78.
- \*Athanasia-Ioanna, A. (2016) *The use and effect of comic book reading on the reading attitudes and reading habits of Greek (typically developed and dyslexic) EFL learners in a mixed ability EFL classroom.* (Doctoral Thesis), University of Bolton, ma New York College Athens.
- \*Azam, M. M. (2018). *Reading and creating comics in the fully online AFL classroom: students' perceptions.* (Masters' thesis). The American University in Cairo, Egypt.
- \*Blanch, C. L. (2017). *Searching for the comic book scholar: an autoethnographic study of educators' experiences with comic books.* (Doctoral Thesis). Ball State University Muncie, Indiana, ProQuest Number: 10277457.
- \*Çağlar Basol, H. (2011). *Using graphic novels to improve reading comprehension skills at EFL classrooms.* (Master's Thesis). Selçuk University, Konya, TR.
- \*Çiçek Şentürk, Ö. (2020). *The effect of argumentation-supported educational comics on students' environmental interests, motivation, and academic achievements and student experiences.* (Doctoral Thesis). Gazi University, Ankara, TR.
- \*Delgado-Algarra, E. J. (2017). Comics as an educational resource in the teaching of social science: socio-historical commitment and values in Tezuka's manga. *Cultura y Educación*, 29(4), 848-862.
- \*Ekinci Effecioglu, E. (2013). *The role of graphic novels in teaching English as a foreign language.* (Masters Thesis). Hacettepe University, Ankara, TR.
- \*Ertemsir, E. (2011). *Interactive comic book as a new instruction method on executive training in higher education and a research on its usefulness perception.* (Doctoral Thesis). İstanbul University, İstanbul, TR.
- \*Golding, S., & Verrier, D. (2020): Teaching people to read comics: the impact of a visual literacy intervention on comprehension of educational comics, *Journal of Graphic Novels and Comics*.
- \*Herlambang, D. D. (2018). *The effect of using a comic book on students' vocabulary mastery study at second year students'.* University Of Muhammadiyah Sumatera Utara, Medan, Indonesia.
- \*Kerneza, M., & Kosir, K. (2016). Comics as a literary-didactic method and their use for reducing gender differences in reading literacy at the primary level of education. *CEPS Journal*, 6(2), 125-149.
- \*Khoii, R., & Forouzesh, Z. (2010). Using comic strips with reading texts: are we making a mistake? *Literacy Information and Computer Education Journal*, 1(3), 168-177.
- \*Kılıçkaya, F., & Krajka, J. (2012). Can the use of web-based comic strip creation tool facilitate EFL learners' grammar and sentence writing?. *British Journal of Educational Technology*, 43(6), 161-165.
- \*Kim, J. Chung, M. S. Jang, H. G., & Chung, B. S. (2016). The use of educational comics in learning anatomy among multiple student groups. *Anatomical Sciences Education*, 10, 79–86.
- \*Lin, S. F., & Lin, H.-S. (2016) Learning nanotechnology with texts and comics: the impacts on students of different achievement levels, *International Journal of Science Education*, 38(8), 1373-1391.

- \*Mamolo, L. A. (2019) Development of digital interactive math comics (DIMaC) for senior high school students in general mathematics. *Cogent Education*, 6(1), 1-13.
- \*McGrail, E., Rieger, A., & Doepker, G. M. (2017). Pre-service teachers' perceptions about the effectiveness of the toon comic books in their guided reading instruction. *Georgia Educational Researcher*, 14(1), 1-39.
- \*McNicol, S. (2016). The potential of educational comics as a health information medium. *Health Information & Libraries Journal*, 34, 20-3.
- \*Orçan, A. (2013). *The effect of science-fiction stories developed by comics technique, on creative thinking skills and physics attitudes of students*. (Master's Thesis). Gazi University, Ankara, TR.
- \*Orçan, A., & Kandil İnceç, Ş. (2016). The effect of science-fiction stories developed by comics technique on creative thinking skills in physics teaching. *Hacettepe University Journal of Education*, 31(4), 628-643.
- \*Özdemir, E. (2010). *The effect of instructional comics on sixth grade students' achievement in heat transfer*. (Doctoral Thesis). Middle East Technical University, Ankara, TR.
- \*Özdemir, E. (2017). Humor in elementary science: Development and evaluation of comic strips about sound. *International Electronic Journal of Elementary Education*, 9(4), 837-850.
- \*Piróg, D., & Rachwał, T. (2019) Comics as a tool for a narrative approach in early career counselling: theory versus empirical evidence. *British Journal of Guidance & Counselling*, 47(4), 498-511.
- \*Sarayeva, T. (2017). *Comics' and graphic novels' effect on the perception of climate change and natural disasters*. Retrieved May 12, 2020 from <http://lup.lub.lu.se/luur/download?func=downloadFile&recordOid=8922347&feOid=8922458>
- \*Şentürk, M. (2020). *The effects of educational comics and educational cartoons in the social studies course on student' attitude, motivation and academic achievement*. (Doctoral Thesis). Erzurum Kazım Karabekir University, Erzurum, TR.
- \*Shaw, P. T. (2017). *What does psychology know and understand about the psychological effects of reading superhero comic books?: An exploration study*. (Doctoral Thesis). Oklahoma State University. ProQuest Number: 10275482.
- \*Silva, A. B. D., Santos, G. T. D., & Araujo Bispo, A. C. K. (2017). The comics as teaching strategy in learning of students in an undergraduate management program. *Mackenzie Management Review*, 18(1), 40-65.
- \*Teis, A., & Wilkie, L. (2014) The science of getting it... wrong: comic principles in induced-error learning, *Comedy Studies*, 5(1), 41-51.
- \*Toh, T. L., Cheng, I. P., Ho, S. Y., Jiang, H., & Lim, K. M. (2017) Use of comics to enhance students' learning for the development of the twenty-first century competencies in the mathematics classroom. *Asia Pacific Journal of Education*, 37 (4), 437-452.
- \*Topkaya, Y. (2016a). Doğal çevreye duyarlılık değerinin aktarılmasında kavram karikatürleri ile eğitici çizgi romanların etkililiğinin karşılaştırılması. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 13(34), 259-272.
- \*Topkaya, Y. (2016b). The impact of instructional comics on the cognitive and affective learning about environmental problems. *Education and Science*, 41(187), 199-219.
- \*Topkaya, Y., & Doğan, Y. (2020). The effect of educational comics on teaching environmental issues and environmental organizations topics in 7th grade social studies course: a mixed research. *Education and Science*, 45(201), 167-188.
- \*Topkaya, Y., & Şimşek, Y. (2016). The effect of educational comics on the academic achievement and attitude towards earthquake. *International Online Journal of Educational Sciences*, 8(3), 46-54.
- \*Ünal, O. (2018). *The effect of using educational comics in social studies course on students' success and attitudes*. (Master's thesis). Akdeniz University, Antalya, TR.

- \*Webber, K. C., Saldanha, T. C. B., Silva, K. K. S. E., Santos, P. M. M., Souza, D. D. D., & Arroio, A. (2013). Introducing comics as an alternative scientific narrative in chemistry teaching. *The Western Anatolia Journal of Educational Sciences (WAJES)*, 4(8), 1-14.
- \*Wiegerová, A., & Navrátilová, H. (2017). Let's not be scared of comics (researching possibilities of using conceptual comics in teaching nature study in kindergarden). *Procedia - Social and Behavioral Sciences* 237, 1576 – 1581.
- \*Yıldırım, E. (2016). Examining opinions of classroom teacher candidates on educational comics. *The Journal of Social Sciences*, 6, 52–70.
- \*Zhang-Kennedy, L, Chiasson, S., & Biddle, R. (2016). The role of instructional design in persuasion: A comics approach for improving cybersecurity. *International Journal of Human-Computer Interaction*, 32(3), 215-257.
- Abell, S. (2008). Twenty years later: Does pedagogical content knowledge remain a useful idea? *International Journal of Science Education*, 30(10), 1405-1416.
- Akkaya, A. (2013). A different activity in grammar learning in Turkish course: Educational comic strips. *International Journal of Academic Research*, 5(5), 118-123.
- Alsaç, Ü. (1994). *Türkiye'de karikatür, çizgi roman ve çizgi film [Caricature, comics and cartoons in Turkey]* (Vol. 144). İletişim Publications.
- Barker, M. (1989). *Comics: Ideology, power and the critics*. Manchester, US: Manchester University Press.
- Batdı, V. (2017). Smart board and academic achievement in terms of the process of integrating technology into instruction: A study on the McA. *Croatian Journal of Education*, 19(3), 763-80.
- Borenstein, M., & Higgins, J. P. (2013). Meta-analysis and subgroups. *Prevention Science*, 14(2), 134-143.
- Borenstein, M., Hedges, L., Higgins, J., & Rothstein, H. (2009). *Introduction to meta-analysis*. Chichester, UK: John Wiley.
- Bose, S., & Singh, P. (2023, June). The potential of digital comics in the classroom. *In AIP Conference Proceedings* (Vol. 2782, No. 1). AIP Publishing.
- Bozkurt, O. (2023). The effect of using educational comics in science class on hidden attitude, motivation and academic achievement. *International Journal of Education Technology and Scientific Researches*, 8(23), 1301-1328.
- Brown, S. A. (1991). Measuring quality of primary studies for meta-analysis: A realistic yet rigorous approach. *Nursing Research*, 40, 352–355.
- Brown, S. A., Upchurch, S. L., & Acton, G. J. (2003). A framework for developing a coding scheme for meta-analysis. *Western Journal of Nursing Research*, 25, 205–222.
- Candrayani, N. M. W., & Sujana, I. W. (2023). Digital Comics: Character Value-Based Learning Media in the Ramayana Puppet Story Content Social Studies Elementary School. *Indonesian Values and Character education Journal*, 6(1), 63-72.
- Cary, S. (2004). *Goinggraphic: Comics at work in the multilingual classroom*. Portsmouth, NH: Heinemann.
- Çelik, K., & İlhan, G. O. (2021). Çocuk haklarına yönelik eğitici çizgi roman: “Sadece Biriyim”. *Türkiye Eğitim Dergisi*, 6(1), 262-279.
- Cheung, A. C. K., & Slavin, R. E. (2011). The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta-analysis. *Educational Research Review*, 9, 88-113.
- Chute, H. (2008). Comics as literature? Reading graphic narrative. *PMLA*, 123(2), 452-465.
- Çiçek Şentürk, Ö., & Selvi, M. (2023). Argumentation-supported educational comics as a teaching tool for environmental education. *Environmental Education Research*, 1-20.
- Cihan, N. (2014). Comics-adaptation of the content for 8th grade Turkish courses as teaching tools. *Journal of Research in Education and Teaching*, 3(3), 313-321.
- Çokluk, Ö., Şekercioğlu, G., & Büyüköztürk, Ş. (2016). *Multivariate statistical SPSS and LISREL applications for social sciences* (4<sup>th</sup> edition). Pegem Akademi.

- Cooper, H., Hedges, L. V., & Valentine, J. C. (2009). *The handbook of research synthesis and meta-analysis* (2<sup>nd</sup> ed.). Russell Sage Publication.
- Crawford, P. (2004). Using graphic novels to attract reluctant readers and promote literacy. *Library Media Connection, 22*(5), 26-28.
- Doğan, Y. (2014). Using marketing brochures in teaching Turkish vocabulary to foreigners. *Journal of Language and Linguistic Studies, 10*(1), 89-98.
- Diegritz, T. (1979). Sind comics schmutz und schund. *Der Evangelische Buchberater, 33*(1), 1-6.
- Durlak, J. A. (2009). How to select, calculate, and interpret effect sizes. *Journal of Pediatric Psychology, 34*, 917-928.
- Eisner, W. (1974). Comic books in the library. *School Library Journal, 21*(2), 75-79.
- Field, A. P., & Gillett, R. (2010). How to do a meta-analysis. *British Journal of Mathematical and Statistical Psychology, 63*(3), 665-694.
- Freeman, D., & Freeman, Y. (2000). *Teaching reading in multilingual classrooms*. Portsmouth, NH: Heinemann.
- Güngör, A. (2020). Evaluation of narrative iconic and visual graphic languages in the context of comics and graphic novels. *The Journal of Academic Social Science, 8*(109), 284-300.
- Hedges, L. V. (1982). Estimation of effect size from a series of independent experiments. *Psychological Bulletin, 92*, 490-499.
- Higgins, J. P., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *BMJ, 327*(7414), 557-560.
- Haugaard, K. (1973). Comic books: Conduits to culture? *The Reading Teacher, 27*, 54-55.
- Hoover, S. (2012). "The case for graphic novels". *Communications in Information Literacy, 5*(2), 174-86.
- Hosler, J., and K. B. Boomer. 2011. "Are Comic Books an Effective Way to Engage Nonmajors in Learning and Appreciating Science?" *CBE Life Sciences Education 10*(3), 309-317.
- İlhan, G. O. (2016). *Comics in social studies teaching*. (Doctoral Thesis). Afyon Kocatepe University,
- İlhan, G. O., & Oruç, Ş. (2019). Comic books use in social studies lesson: Texas history. *Education and Science, 44*, 327-341.
- Inge, M. T. (1997). Comic books. *Sanat Dünyamız [Our world of art], 64*, 70-79.
- Karagöz, B. (2018). Applicability to the strategies of determining and interpreting interdisciplinary content of educational comic novels: the case of "adam olmuş çocuklar ve kahraman kadınlarımız series". *Erzincan University Journal of Education Faculty, 20*(3), 637-661.
- Kirchoff, J. (2017). Using Digital Comics to Develop Digital Literacy: Fostering Functionally, Critically, and Rhetorically Literate Students. *Texas Journal of Literacy Education, 5*(2), 117-129.
- Koenke, K. (1981). The careful use of comic books. *Reading Teacher, 34*, 592-595.
- Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. Thousand Oaks, CA: Sage.
- Liu, J. (2004). Effects of comic strips on L2 learners' reading comprehension, in TESOL. *Quarterly, 38*(2), 225-243.
- Mamun, A. S. (2023). The Effect of Using Digital Comic Book on Students' Reading Comprehension Achievement in Narrative Text. In *Prosiding Seminar Nasional Literasi dan Pedagogi (SRADA)* (pp. 168-178). Fakultas Keguruan dan Ilmu Pendidikan, Universitas Pancasakti Tegal.
- McHugh, M. L. (2012). Interrater reliability: The kappa statistic. *Biochemia Medica, 22*(3), 276-282.
- Megawati, F., & Anugerahwati, M. (2012). Comic strips: A study on the teaching of writing narrative texts to Indonesian EFL students. *TEFLIN Journal, 23*(2), 183-205.
- Meriç, A. (2013). The effect of comic strips on EFL reading comprehension. *International Journal on New Trends in Education and Their Implications, 4*(1), 54-64.
- Metken, G. (1970). *Comics*. Frankfurt: Fischer Bücherei.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Thousand Oaks, California: Sage.

- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & Prisma Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine*, 6 (7), e1000097.
- Muzumdar, J. (2016). An overview of comic books as an educational tool and implications for pharmacy. *Innovations in Pharmacy*, 7(4), 1-10.
- Olson, J. C. (2008). *The comic strip as a medium for promoting science literacy*. Northridge: California State University Press.
- Pereira, H. L., Paula, J. A., & Lopes, S. M. M. C. (2019). The use of comics as a motivational tool for high school physics education. *Revista Amazonica*, 24, 417-445.
- Platin, A. (1985). *Tek resimden dizi resme geçiş*. [Transition from a single image to a series of image]. *Gösteri Sanat-Edebiyat Dergisi*, 61, 64-65.
- Purnell, K. N., & Solman, R. T. (1991). The influence of technical illustrations on students' comprehension in geography. *Reading Research Quarterly*, 26(3), 277-299.
- Richter, T., A. Rendigs, and C. P. Maminirina. 2015. "Conservation Messages in Speech Bubbles—Evaluation of an Environmental Education Comic Distributed in Elementary Schools in Madagascar." *Sustainability* 7(7), 8855–8880.
- Rosenberg, M., Adams, D., & Gurevitch, J. (2000). *Metawin statistical software for meta-analysis version 2.0*. Massachusetts, MA: Sinauer Associates Inc.
- Rosenthal, R. (1979). The file drawer problem and tolerance for null results. *Psychological Bulletin*, 86(3), 638-641.
- Rosenthal, R. (1995). Writing meta-analytic reviews. *Psychological Bulletin*, 118, 183–192.
- Short, J. C., & Reeves, T. C. (2009). The graphic novel: A "cool" format for communicating to generation Y. *Business Communication Quarterly*, 72(4), 414-430.
- Silverman, D. (2001). *Interpreting qualitative data: Methods for analysing talk, text and interaction*. London: SAGE Publication.
- Sones, W. (1944). The comics and instructional method. *Journal of Educational Sociology*, 18, 232-240.
- Symeon, R. (2008). *State of the art comics in education using web comics in education*. Project Deliverable Report.
- Takacs, Z. K., Swart, E. K., & Bus, A. G. (2015). Benefits and pitfalls of multimedia and interactive features in technology-enhanced storybooks: A meta-analysis. *Review of Educational Research*, 85(4), 698–739.
- Thalheimer, W., & Cook, S. (2002). *How to calculate effect sizes from published research articles: A simplified methodology*. Retrieved May 12, 2020 from [http://education.gsu.edu/coshima/EPRS8530/EffectSizes\\_pdf4.pdf](http://education.gsu.edu/coshima/EPRS8530/EffectSizes_pdf4.pdf)
- Topkaya, Y., & Yılar, B. (2015). Analysis student views related to educative comics. *Route Educational and Social Science Journal*, 2(3), 106-117.
- Tuncer, N. (1993). *Çizgi roman ve çocuk* [Comic strips and kid], TR: Kids Foundation Publication.
- Uğureli, G., Küçükaltun, Ç., Çalışkan, M., Avan, B., Evgin, H. G., & Yurtbekler, M. (2023). An Effective Material in Disaster Education: Educational Comics. *Journal of Interdisciplinary Education Research*, 7(15), 231-240.
- Verhallen, M. J. A., Bus, A. G., & de Jong, M. T. (2006). The promise of multimedia stories for kindergarten children at risk. *Journal of Educational Psychology*, 98, 410–419.
- Williams, N. (1995). *The comic book as course book: Why and how*. Paper presented at the annual meeting of the teachers of English to speakers of other languages. Long Beach.
- Wright, G., & Sherman, R. (1994). What is black and white and read all over? *The funnies! Reading Improvement*, 31(1), 37-48.
- Yani, I., Susanto, L. H., Ichsan, I. Z., & Marhento, G. (2023). Develop Comics as Learning Media to Improve Students' Knowledge about Environmental Disaster in Biology Learning. *Jurnal Penelitian Pendidikan IPA*, 9(6), 4124-4129.

- Yıldırım, A., & Şimşek, H. (2013). *Sosyal bilimlerde nitel araştırma yöntemleri [Qualitative research methods in social sciences] (9. Edt.)*. Seçkin Publication.
- Zucker, T. A., Moody, A. K., & McKenna, M. C. (2009). The effects of electronic books on pre-kindergarten-to-grade 5 students' literacy and language outcomes: A research synthesis. *Journal of educational computing research, 40*(1), 47-87.