

Using Web 3.0 in Education: A Systematic Review

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Introduction

The internet, which has become an indispensable part of our lives, is rapidly developing and changing with each passing day. In parallel with the development of the Internet, the expected development in the Web is also observed. The first web technologies that entered our lives along with the emergence of the Internet consist of simple, plain, read-only content and are called Web 1.0 (Parsa, 2009; Dominic, Francis & Pilomenraj, 2014). In Web 1.0 technologies, there are websites where the flow of information is unidirectional, the content is limited and created by a content provider,



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and users can only access the provided subject (Park, 2013; Thomas & Li, 2008). Due to the limited use of Web 1.0, Odabaşı et al. (2012) named Web 1.0 users as content-dependent passive readers.

After the simple-read form of Web 1.0, web 2.0 Technologies integrated readers into the system and provided them with the opportunity to write like a writer. With Web 2.0 technologies, users can be content producers as well as information consumers (Cormode & Krishnamurthy, 2008). In this process, the web 1.0 layer forms the basis and is included in all technologies described. Unlike Web 1.0, Web 2.0 includes social communication and interaction between users, and the social use of the web and cooperation among participants comes to the forefront (Park, 2013). Furthermore, with this technology, even users without programming knowledge can produce, edit and share content (Yükseltürk & Top, 2020).

Along with the advantages provided to users by Web 2.0, information redundancy occurs and it is needed to interpret and make sense of the large amount of data obtained through computers and software (Jersen, 2019). Web 3.0 technologies emerging for this purpose are also called "semantic web". The biggest reason why Web 3.0 is called as "semantic web" is that new meaningful information can be created from the available data (Fırat & Fırat, 2021). Through Web 3.0 technology, searches that produce content-based personalized results can be made on websites (Gyamfi, 2014). The function of presenting the meaning of data with the semantic web or Web 3.0 is also added to the machines that involve understanding and processing the data (Presti & Nicolosi, 2012). As the improved-extended new version of the web we use today, Web 3.0 is a system in which computers better understand what information and what its meaning is (Yağcı, 2009; Kapan & Üncel, 2020).

With the evolution of the web and the widespread use of web technologies, new opportunities have started to emerge in the field of education, as in many other fields. With the rise of the web, traditional educational venues were replaced with digital environments, and the idea of e-learning was born (Miranda et al, 2014). E-learning is a web-based education system and is used on the internet, intranet or a computer network (Aytaç, 2003). According to Lee, Tsai and Wang (2008), e-learning has

become popular and realistic with the web pages becoming interactive. The concept of e-learning continues to evolve with the development of the internet or the World Wide Web. Dominik et al. (2014) and Rajiv and Lal (2011) summarized the e-learning 3.0 applications that offer individual settings and various options for the use of Web 3.0 in education in Figure 1.

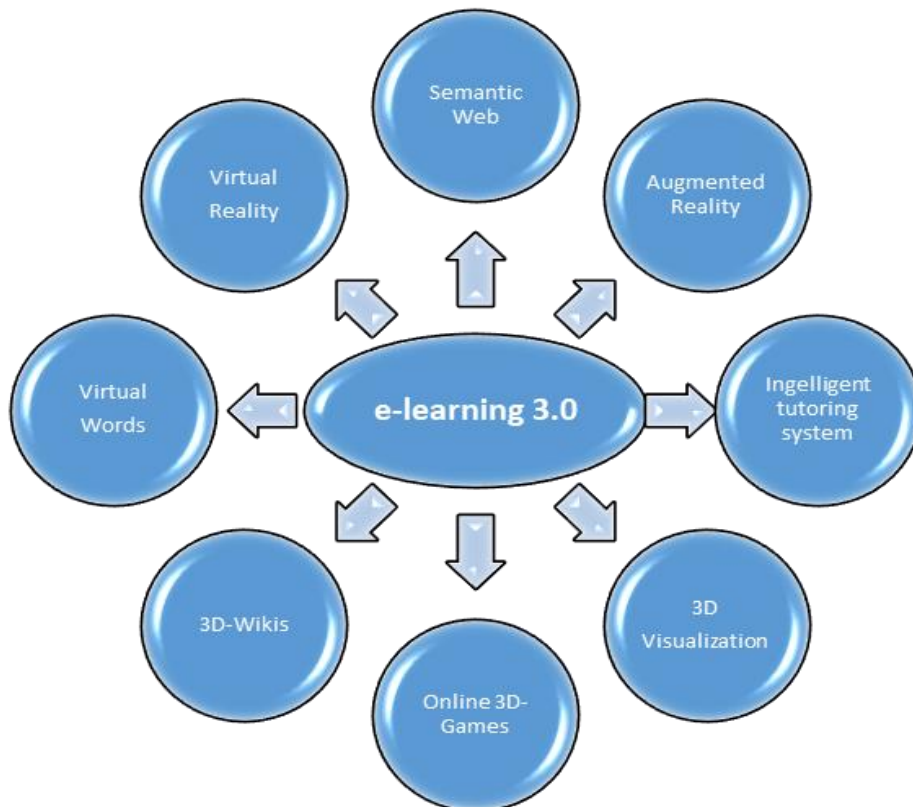


Figure 1. Web 3.0 tools in e-learning (Dominic et al. 2014; Rajiv & Lal, 2011).

While Web 2.0 provides opportunities such as social networking and cooperation between designer and user, according to Figure 1, Web 3.0, also called the semantic web, includes technologies such as big data, connected data, 3D visualization, virtual reality, 3D wikis and games, and augmented reality. These techniques, including augmented reality and mobile learning, are thought to be the future of information access and hold promise for the Web 3.0 teaching approach (Dominik et al., 2014).

Literature

Web 3.0 and Education

Along with the fact that Web 3.0 offers tools and features such as personal assistants, smart agents, 3D games, virtual worlds, and open educational resources, far beyond the opportunities offered by Web 2.0, it is envisaged that the interaction of individuals with the machine will be at the forefront rather than the interaction of individuals with each other, and accordingly, the expectations and interactions of individuals regarding the Internet will differ (Chisega-Negrila, 2016). Collaborative, three-dimensional virtual learning environments are supported with Web 3.0 technologies, and students can be provided with learning environments at anytime, anywhere and as they wish with the enrichment of e-learning environments (Hussia, 2012). Furthermore, with the semantic web technologies in web 3.0 environments, the focus is on enabling students to manage their learning and make their own decisions about their learning (Chisega-Negrilă, 2013; Wadhwa, 2015).

The widespread use of web 3.0 in e-learning also brings along some questions. One of these questions is which theories should be used for the realization of digital learning. Learning theories provide a point of view that helps us to understand how and why learning occurs (Smith, 1999). The learning theories are divided into four as behaviorism, cognitivism, constructivism and connectivism. According to Hussian (2012), while knowledge is transmitted directly from teacher to student in behaviorism (may be related to e-Learning 1.0), cognitivism considers the student as a data processor, and constructivism suggests that students acquire knowledge after the process of structuring knowledge. According to Siemens (2004), one of the pioneers of connectivism theory, connectivism is regarded as the learning theory of the digital age and is described as the successor of other learning theories. In his study, Hussain (2012) summarizes the relationship of technological changes with the principles of connectivist learning theory in e-learning 3.0 as follows:

- Learning and knowledge are based on diversity of ideas. Social semantic networks support this diversity by providing openness and interoperability.

- Learning is the process of connecting specialized nodes or sources of knowledge. Accordingly, big data or global data storage, connected data, cloud computing, extended smart mobile technologies are used.
- Learning can be found in non-human devices. Machine learning, artificial intelligence, personal avatars, 3D visualization and interaction are used in relation to that.
- According to the connectivist learning theory, the capacity to know more is more important than what is currently known, in this context, the function of providing information control of the semantic web is used.
- The ability to see the connections between fields, ideas and concepts requires a basic skill. Nurturing and maintaining connections is needed to facilitate continual learning. Semantic web and collaborative intelligent filtering technologies are used to develop such skills.

As it can be seen above, many technologies used in e-learning supported by the learning theories of the digital age have been developed. Furthermore, in the studies on the use of Web 3.0 in education, the positive aspects of the use of these technologies in education were emphasized by showing that the use of Web 3.0 tools in education provides suitable conditions for institutions, teachers and students to reveal their potential and social and strategic skills (Atabekova et al., 2015). The number of studies on the use of Web 3.0 in education is increasing day by day (Bahadir, 2019; Greener, 2015; Halimi & Seridi-Bouchelaghem; 2021; Wu et al., 2020). However, it is observed that studies that include systematic reviews in this field are not sufficient (Fırat & Fırat, 2021; Jensen, 2019).

The compilation of studies that have been systematically reviewed is considered important in terms of determining the gaps in the literature about Web 3.0 and providing a conceptual framework for researchers who will conduct studies on the use of Web 3.0 in education. When the systematic review studies on the use of Web 3.0 in education in the literature were examined, two systematic studies were found. Among them, Jensen (2019) aimed more specifically to investigate the relationship between technology and pedagogy in the field of Semantic Web in formal education from a

practical educational perspective. Fırat and Fırat (2021) conducted a systematic review study of the use of Web 3.0 tools in learning environments. In that study, Fırat and Fırat analyzed 81 English articles on the use of Web 3.0 in education, registered in Scopus and Science Direct databases, which include web 3.0 and lower technologies, from 2005 to 2020. Unlike the study of Fırat and Fırat (2021), this study examines English and Turkish articles in the Web of Science, Eric and TR Index, which include the use of Web 3.0 in education, for the years 2012-2022. The study can be considered important in terms of providing an up-to-date and holistic view of the place of Web 3.0 in education in the last ten years, with the keywords used in the search criteria. In this context, the relevant studies were systematically examined in order to determine the place of Web 3.0 technologies in education, and answers to the following research questions were sought:

1. What is the distribution of the studies on the use of Web 3.0 in education by years?
2. What are the types of studies reviewed, in which direction is the trend?
3. What are the number of citations of the studies reviewed?
4. What are the keywords used in the studies reviewed?

Methodology

The objective of this study was to comprehensively review the research on the application of Web 3.0 technologies in education. "Identifying, analyzing, and interpreting all available research on a given research issue, topic area, or phenomenon of interest" is the definition of a systematic review of the literature (Kitchenham, 2004). Although there are different definitions and stages of systematic review, Newman and Gough's (2020) systematic review stages were used in terms of basing educational research in this study.

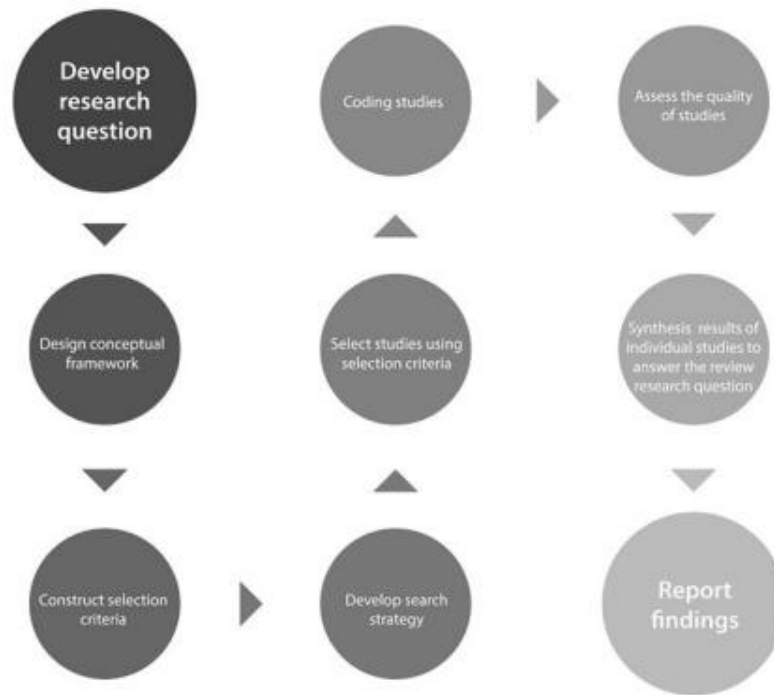


Figure 2. Systematic Review Process of Newman and Gough (2020)

According to Figure 2, Newman and Gough (2020) indicated the review stages as follows. 1) Developing the research question, 2) Designing the conceptual framework, 3) Constructing the selection criteria, 4) Developing the search strategy, 5) Selecting the studies using the selection criteria, 6) Coding studies, 7) Assessing the quality of studies, 8) Analyzing the synthesis results of individual studies to answer the review research question, and 9) reporting the findings. Accordingly, the stages of this study are presented under the following subheadings.

Constructing the Selection Criteria

According to Yılmaz (2021), this stage is one of the important stages in which the research route is determined and the road map is designed according to this route, which acts as a sort of filter for the research. The criteria to be included or excluded from the study are determined in this stage. The selection criteria in systematic reviews

are shaped by the research question and conceptual framework. The most commonly used selection criteria can be listed as the characteristics of the study participants, the country where the study is conducted, the language in which the study is reported, and the research methods (Newman & Gough, 2020). Accordingly, in this study, the year of the study, research type, the number of citations and keywords were determined as the criteria for inclusion in the research.

Developing the Search Strategy

The search strategy is the plan for how to identify relevant research studies and serves to detail the resources to be sought and the manner in which resources are sought (Newman & Gough, 2020). Accordingly, The year of the studies to be included in the research, the area to be researched, the keywords to be used, the types of studies, the resources to be searched, the field to be searched and the language to be searched were determined in the stage of determining the search strategy. The criteria determined and used in the study are presented in the table below.

Table 1. Search Criteria

Year	2012-2022
Area to be researched	Title
Keywords	“web 3.0”, “semantic web”
Research Type	Research Article
Databases	Eric, Web of Science, Tr Index
Search Area	Educational research
Language	English and Turkish

As it is indicated in Table 1, with this systematic research, the research articles published in ERIC, Web Of Science and TR Index databases between 2012-2022, in

English or Turkish, in the field of education, with the keywords "Web 3.0" and "semantic web" in the study title were included in the study.

Since the use of Web 3.0 technologies in education has gained popularity in the last ten years, the studies conducted between 2012 and 2022 were included in the study, and studies outside this year range were excluded. Some studies were published in books, although they were research articles. Therefore, the studies in the category of research articles and published in books were also included in the study.

Selecting Studies Using the Selection Criteria

The search was performed between 01 April and 15 April 2022 in accordance with the criteria indicated above. Two researchers searched different databases in the study. While the first researcher conducted research in the Eric database, the second researcher continued searches in the Web of Science and Tr Index. The articles were downloaded from the databases specified by the researchers and saved in the public folder created with the year of study, author and name.

Coding Studies

The studies selected within the scope of the search were processed in the table, which was prepared by the researchers and created using E-tables from Google Documents in order to allow researchers to work together, by taking into account the year of the study, author, research purpose, research type, data collection tools, participants and number of citations.

Rourke and Anderson (2004) argued that the use of a coding scheme proven by many researchers would help increase the validity of content analysis. Therefore, the classification scheme developed by Dick and Dick (1989) was used in classifying the studies according to their types. According to this scheme, the classification of studies is divided as in Table 2.

Table 2. Classification of Studies According to their Types (Dick & Dick, 1989)

Literature Review	Presentation of a summary of the literature as a critique or an expression of the latest technology.
Methodological article	Study including a new model or procedure for carrying out a technical activity
Theoretical Article	Article that primarily benefits from and contributes to the theoretical literature of the field
Empirical and Experimental Studies	All studies, except assessments, that use data to draw conclusions
Descriptive study	Presentation of information about a specific program or event using little or no data.
Evaluation study	Presentation of data and information to explain the effectiveness of a particular program or method, usually in an applied setting.
Professional article	A description of the issues related to the instructional technology profession, such as the determination of qualifications or definitions of internship programs.

Assessing the Quality of Studies

The assessment of the quality of studies is an indication of the strength of the evidence provided by the systematic review and gives information on the standards required for future research. A number of standards with a similar effect in determining how compilations are made or what a compilation should contain and report was established in order to maintain accuracy and quality in systematic reviews (Gough & Thomas, 2016). The study entitled PRISMA-Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA, 2020) is one of the important sources about systematic reviews. While the PRISMA Reporting is used to assist authors in improving the presentation of systematic review and meta-analysis research, it can also be used for

critical evaluation of the presentation (Karaçam, 2013; Moher, et al., 2009). The PRISMA diagram of the research process is presented in Figure 3.

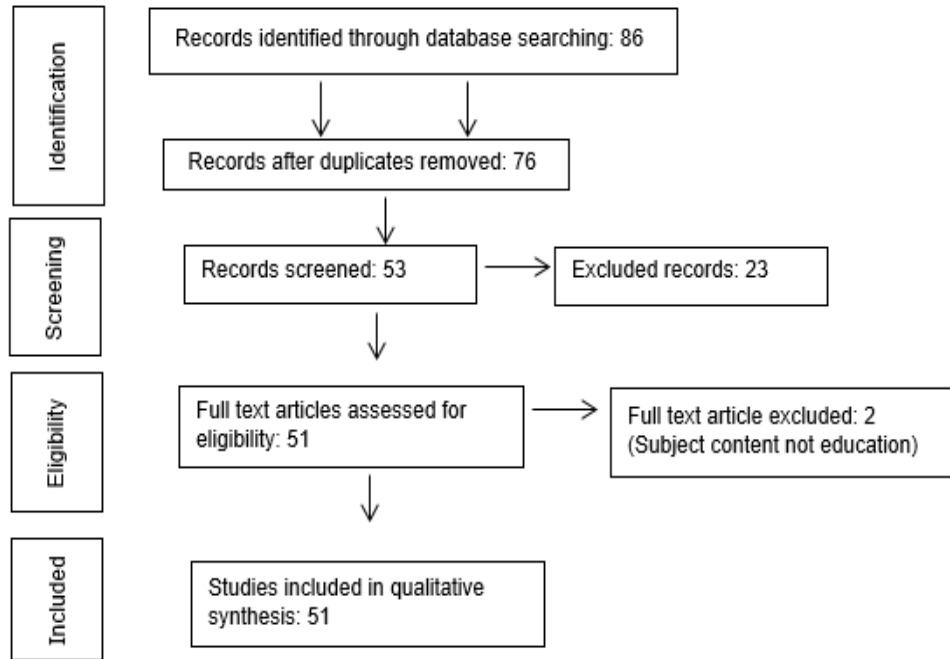


Figure 3. Systematic review PRISMA flow chart (Brunton et al., 2012, slightly changes after p.86; Moher et al., 2009, s. 8).

According to the Prisma chart above, 86 studies were found in the first search of the databases. After the reviews, it was determined that 10 studies were repeated in the databases and the repetitions were excluded from the research. With regard to the inclusion criteria, two researchers analyzed 76 articles in detail. From the titles of the articles, 23 studies that did not meet the search criteria were excluded from the research. As a result of examining the contents of 53 articles obtained after exclusion, two studies that were not related to education were excluded from the research. Finally, the study was conducted with 51 articles. Regarding consensus and disagreement among researchers, the reliability was determined by using Miles and Huberman's (1994) $\text{Reliability} = \frac{\text{consensus}}{\text{consensus} + \text{disagreement}}$ formula. Two researchers

scanned 86 articles and reached an agreement of 92% on inclusion/exclusion. Then, the researchers discussed inconsistencies and agreed on the remaining 8%.

Limitations

Research articles were included in the study. Theses and conference proceedings were not included in the study. In future systematic analyses, the study can be expanded by differentiating the databases and adding different types of studies. Different databases can be used or all of them can be examined as a whole. Furthermore, variables such as data collection tools and the number of participants were not examined in the study since the studies in this study included a small number of experimental studies. When the scope of the study is extended, such data can be examined from the data to be obtained. Moreover, researchers are recommended to use the concept of semantic web along with the concept of Web 3.0 in their studies.

Findings and Discussions

The findings section corresponds to the “analyzing the synthesis results of individual studies to answer the review research question”, one of the systematic review steps of Newman and Gough (2020). The findings obtained in this context are presented by dividing them into sub-headings as follows.

Findings on the First Sub-Problem

The first sub-problem of the study includes determining the distribution of studies on the use of Web 3.0 in education by years. The findings obtained as a result of the reviews are presented in figure 4.

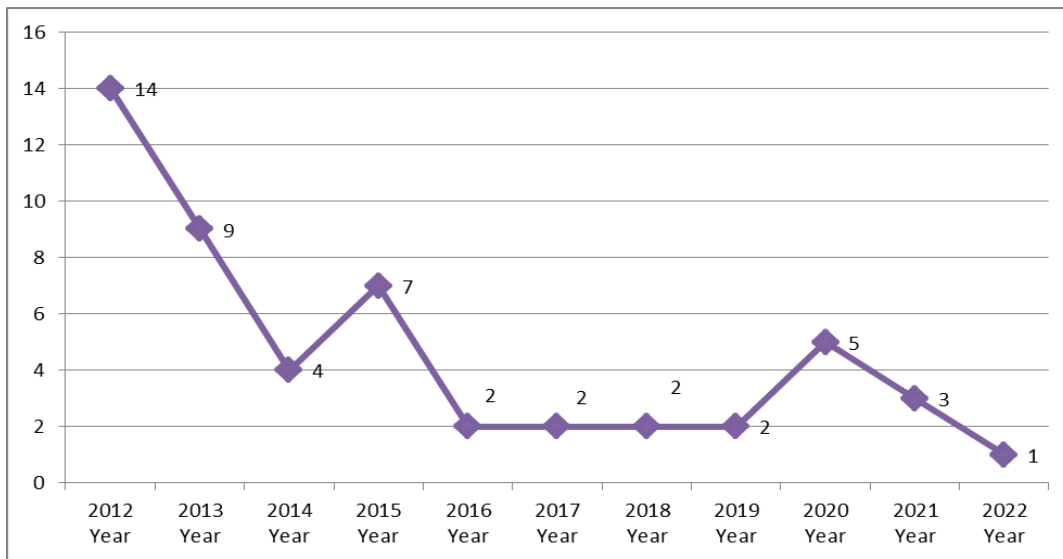


Figure 4. Distribution of the studies reviewed by years

The majority of studies on Web 3.0 in education were conducted in 2012, between 2012 and 2022, according to an analysis of the distribution of studies by years. It was observed that there was a decrease in the number of studies from 2012 until 2015. An increase was observed again in 2015. After this increase, there was a stagnation in the studies between 2016-2019, and it was observed that there was an increase in the number of studies in 2020.

Findings on the Second Sub-Problem

The second sub-problem of the study includes determining the types of studies on the use of Web 3.0 in education. The findings obtained as a result of the reviews are presented in Figure 5.

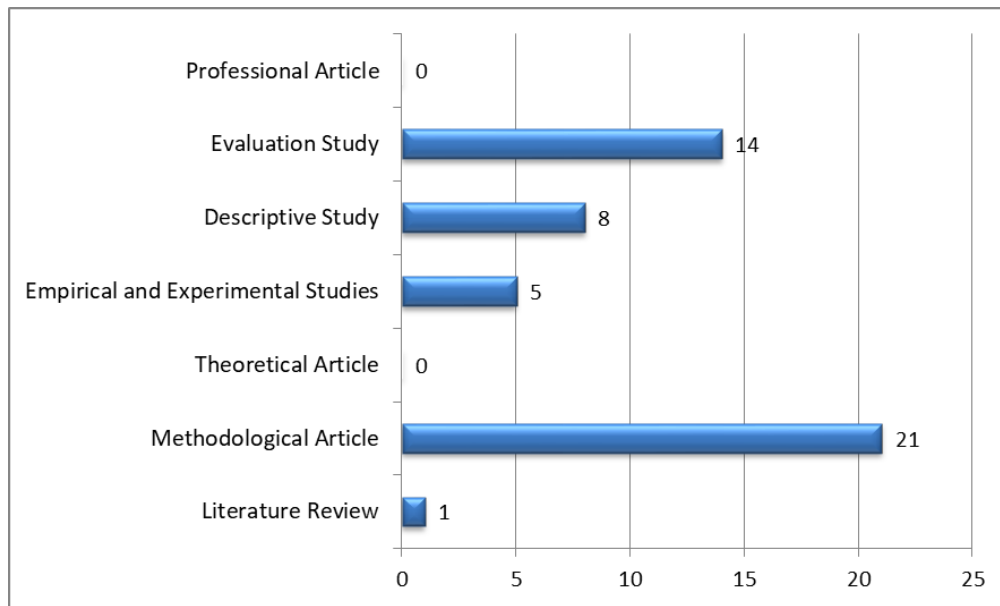


Figure 5. Distribution of the studies reviewed by types

The types of studies reviewed were classified using the classification scheme developed by Dick and Dick (1989). Accordingly, it was observed that the types of the studies reviewed concentrated on methodological (38.8%) and evaluation studies (29.6%). Nevertheless, it was observed descriptive studies (20.3%) and empirical and experimental studies (9.2%) were also conducted. Furthermore, among the studies reviewed, one study included the literature review, and two systematic studies were not included in the table because there was no category. Among the studies reviewed, no professional and theoretical articles were found.

Findings on the Third Sub-Problem

The third sub-problem of the study includes determining the number of citations of studies on the use of Web 3.0 in education. The findings of 51 studies that were cited among the reviewed studies are presented in Figure 6.

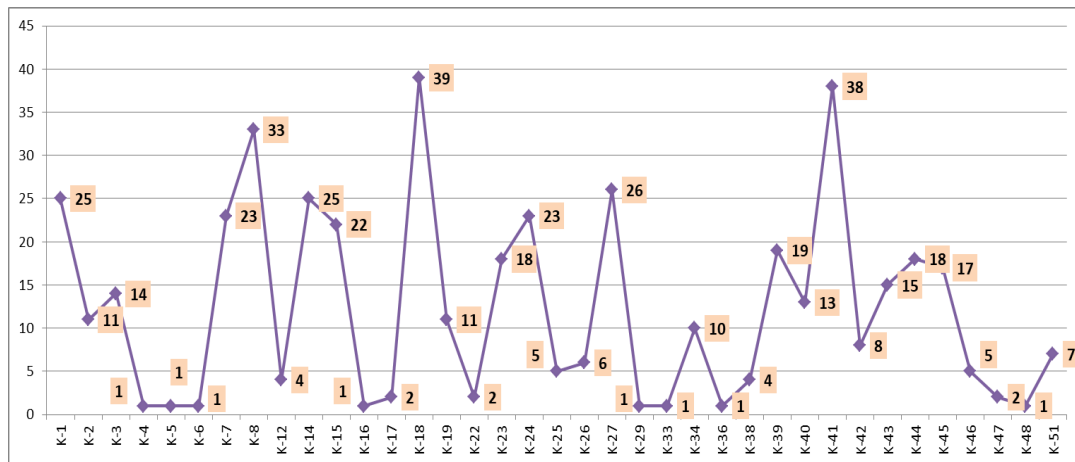


Figure 6. Distribution of the studies reviewed by the number of citations

(K: Indicates the coding number of each study)

When Figure 6 was examined, among the studies reviewed, the study with the highest number of citations of 39 was the study by Isotani et al. (2013) entitled “A Semantic Web-based authoring tool to facilitate the planning of collaborative learning scenarios compliant with learning theories” which was coded as K-18. The second most cited study was “A systematic literature review of the use of Semantic Web technologies in formal education” written by Jensen, coded as K-46 with 38 citations. Immediately after, the most cited study was the study of Siadaty et al. (2012) entitled “Self-regulated Workplace Learning: A Pedagogical Framework and Semantic Web-based Environment” with 33 citations, which was coded as K-8. It was followed by the study of Bhattacharya et al. (2015) entitled “Threshold concepts and the semantic web” with 26 citations. When the frequency distribution of the citation numbers of the studies was examined, it was observed that there was an intensity in the distribution of the studies with more than 20 citations. Therefore, studies with more than 20 citations are presented in tables as follows.

Table 3. Studies with more than 20 citations

Number of Citations	Authors	Name of the Study	Year
39	Isotani, S., Mizoguchi, R., Isotani, S., Capeli, O. M., Isotani, N., De Albuquerque, A. R., Ig. Bittencourt & Jaques, P.	Semantic Web-based authoring tool to facilitate the planning of collaborative learning scenarios compliant with learning theories	2013
38	Jensen, J.	A systematic literature review of the use of Semantic Web technologies in formal education	2019
33	Siadaty, M., Gašević, D., Jovanović, J., Pata, K., Milikić, N., Holocher-Ertl, T., Jeremić, Z., Ali, L., Giljanović, A. & Hatala, M.	Self-regulated Workplace Learning: A Pedagogical Framework and Semantic Web-based Environment	2012
26	Bhattacharya, S., Cohen, M. B., & Cohen, M. B.	Threshold concepts and the semantic web	2015
25	Adorni, G., Coccoli, M., & Torre, I.	Semantic Web and Internet of Things supporting enhanced learning	2012
25	Carmichael, P., & Tscholl, M.	Cases, simulacra, and Semantic Web technologies.	2013
23	Halimi, K., Seridi-Bouchelaghem, H., & Faron-Zucker, C	An enhanced personal learning environment using social semantic web technologies	2014
23	Hsu, I. C.	Intelligent discovery for learning objects using semantic web technologies	2012
22	Vera, M. S., Fernández, J. T., Sánchez, J. S., & Espinosa, M. P.	Practical experiences for the development of educational systems in the semantic web.	2013

Findings on the Fourth Sub-Problem

The fourth sub-problem of the study includes determining the keywords of the studies on the use of Web 3.0 in education. As a result of the reviews, the keywords that are used more than one (1) are presented in tables as follows.

Table 4. Keywords Used in Studies and Number of their Uses

Keywords	Frequency
Semantic Web	20
E-Learning	10
Educational Technology	4
Web 3.0	3
Education	3
Semantic Technologies	3
Ontology	3
Workplace Learning	2
Higher Education	2
Online Systems	2
Technology Uses In Education	2
Internet	2
Scorm	2
Semantics	2
Cloud Computing	2
Participatory Design	2
Knowledge Creation	2
Interdisciplinarity	2
Learning Objects	2
Semantic Web Technologies	2

When Table 4 was examined, the most repeated keywords were Semantic web (20), e-learning (10), and educational technology (4). It was observed that the keywords Web 3.0, Education, Semantic Technologies, and Ontology were mentioned in three studies.

Conclusion and Discussion

This study looked at 51 research articles on the use of web 3.0 technologies in education that were published between 2012 and 2022 in the ERIC, Web of Science, and TR Index databases in English or Turkish and had the terms "Web 3.0" and "semantic web" in the study title. In the systematic review, it was observed that studies were intensely conducted in 2012. It was observed that there was an increase again in 2015 and 2020 after 2012. It was also observed that there was a decrease in the number of studies and stagnation from time to time between these years. These findings are consistent with Fırat and Fırat (2020) study. As a result of the systematic review of Fırat and Fırat (2020) on the use of web 3.0 in education, it was observed that the studies increased in 2012 and the highest number of studies was reached in 2013. Along with the decrease after this, an increase was also observed again after 2015.

When the studies were classified according to the types of studies developed by Dick and Dick (1989), it was observed that methodological (38.8%) and evaluation studies (29.6%) were studied more frequently. Nevertheless, it was observed that descriptive studies (20.3%) and empirical and experimental studies, although their number was small (9.2%), were also conducted. Furthermore, two studies, including literature review (Fırat & Fırat, 2021; Jensen, 2019), were also included among the studies reviewed. Among the studies reviewed, there were no theoretical articles. These findings revealed that the studies on the semantic web mainly consisted of studies that included a new proposal for a new model and procedure. Since Web 3.0 technology is a new technology for education, the number of studies on the effectiveness of its use in education can be expected to be high. These findings are partially consistent with the study of Fırat and Fırat (2020). In their systematic review, Fırat and Fırat (2020) indicated that the majority of the studies consisted of experimental studies and studies

on the design or presentation of learning software, which is called "methodological" in this study. It was considered that the number of experimental studies was higher in their studies, unlike this study, since they included the concepts involving the applications such as augmented reality in their systematic reviews.

It was found that the most cited studies were "A Semantic Web-based authoring tool to facilitate the planning of collaborative learning scenarios compliant with learning theories" (Isotani et al., 2013) and "A systematic literature review of the use of Semantic Web technologies in formal education" (Jersen, 2019), respectively, when the distribution of the studies according to the number of citations was examined. Based on these findings, it can be understood from the researchers' interest in the study that digital learning includes a learning process, so the tools developed should be based on learning theory. It can also be said that researchers had a great interest in this systematic study, and therefore, there is a need for such systematic studies. Furthermore, when the articles were reviewed in detail, it can be said that methodological studies involving a new model or procedure for the execution of the technical activity and descriptive studies involving the definition and use of the semantic web using little or no data received more citations. This may suggest that there are still descriptive deficiencies in the studies on web 3.0/semantic web and that experimental studies cannot be conducted because this technology is not fully understood.

When the keywords used in the studies were examined, it was observed that the word semantic web was used more than web 3.0. It is considered that future studies can be conducted on this concept, and the studies can be extended. It was observed in the findings that the keyword e-learning was highly used along with the keyword semantic web (n=10). It was considered that the concept of semantic web, which is a kind of synonym of web 3.0, was used more in the studies as a result of defining it as semantic web in its definitions and reinforcing it with examples in this context for a better understanding of Web 3.0 technologies.

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