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Web-based E-learning in Elementary School: A Systematic Literature Review

Herwulan Irine Purnama [a,*], Insih Wilujeng [a], Cepi Safrudin Abdul Jabar [a]

[a] *Department of Doctoral Program of Basic Education, Faculty of Education, Yogyakarta State University, Yogyakarta, Indonesia*

Corresponding author: [*]herwulanirine.2021@student.uny.ac.id

***Abstract*—This article presents a literature review on web-based e-learning in elementary schools in the latest literature. SLR method and PRISMA protocol with the stages of identification, screening, eligibility, inclusion, and abstraction, data analysis assisted by the *Publish or Perish 7* application, *VOSviewer*, and *NVIVO 12 Plus*. The results of searching for articles on Scopus through the Publish or Perish 7 application are 507. Then the articles were filtered according to compatible themes into 50 articles. The topic findings are *web-based e-learning, elementary school, the impact of web-based e-learning* and *web-based e-learning concept, academic performance, teaching/learning strategies, online learning, Covid-19, HPC database, web-based applications, distance learning, 3D visualization, automation, strategic learning, semantic web, technology, education, linguistic content, big data architecture, learning setting, e-readiness, linguistic content, STEM,* etc., that are directly or indirectly connected. The 50 articles were analyzed according to the specified topics through the *NVIVO 12 Plus* application, and the results were described according to the research questions. The findings in this article explain that web-based e-learning integrates pedagogy and technology and becomes part of digital multimedia implemented in e-learning, blended learning, and face-to-face that impacts elementary school students and teachers directly or indirectly. Future research needs to explore web-based e-learning in schools that is current, safe, and needed by students and teachers.**

***Keywords*— Web-based e-learning; e-learning; digital learning; elementary school; systematic literature review.**

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I. INTRODUCTION

Several studies have examined e-learning, digital learning, or cyber learning based on websites, website pages, and website applications in elementary schools. [1]–[5], but there are still few who study it with a systematic literature review (SLR) [6], [7]. There is still little current research with SLR on the theme of web-based e-learning in elementary schools, as it still focuses on the theme of mobile learning and digital learning [8], game-based learning pedagogy [4], [9], [10], augmented reality, digital storytelling in learning [11], [12], blended learning, and online learning [13], learning management system [14], Moodle e-learning [15] [16], gamified project-based learning [17], [18], internet-based learning [19], web-based nutrition education [20], [21], dan web-based e-learning in nursing education [22], [23]. These studies with systematic literature reviews have not focused on web-based e-learning in elementary schools. Web-based e-learning is a combination of education, teaching, and websites to help students understand the subject matter [24]–[26], integrating asynchronous learning, portfolios, assignment documentation, sharing student learning experiences, etc. [27] [28]. Web-based e-learning in elementary school is an integrated learning model between website, pedagogy, content for elementary school subjects, systemized, electronic-based, and web use [29]–[31]. The concept and features of web-based e-learning generally use the MySQL database storage [32], Hypertext Preprocessor (PHP)[33], and other development. It works through programs that are planned, analyzed, evaluated, and maintained [34], [35]. It has system navigation, systemized, visual design [36], information quality, instructional assessment, system interactivity, provision of quality content, instructional assessment, and is safe to implement in elementary schools [37]–[39].

The development and implementation of web-based e-learning are increasingly varied, such as WebQuest (WQ) for question-based web learning [40], content management systems (Joomla and Moodle), website e-learning [41], [42], semantic website technology [43], WebMO for natural science, and chemistry learning [44], web and video [45], Semantic Web technology, version 3.0 [46], web-based

application of synchronous and asynchronous learning [47], clinical supervision [48], webinar, and web conference learning in elementary schools [49], [50]. Several countries have incorporated web-based e-learning into their curriculum, Learning Management systems (LMS) [51], [52], models, and media for remote-controlled learning systems, online discussion rooms, and student assessment control tools [53]–[56]. These features allow elementary school teachers to choose web-based e-learning that suits their school's condition and readiness. Therefore, teachers need to know the concept, implementation, and impact of web-based e-learning for elementary schools [57], [58].

As a digital tool incorporated into learning, web-based e-learning has both positive and negative impacts. An elementary school in Taiwan implemented web-based e-learning with game integration, positively impacting digital reading skills, comprehension, collaboration skills, and annotation behavior [59]. The positive impact can be presented as follows:

- The improvement of critical thinking skills and learning outcomes of elementary school students in Indonesia [60], [61].
- Learning interest [62].
- Good human-computer interaction (HCI) relations among students in Turkey [63].
- Understanding skills, scientific processes, and applying scientific reasoning skills [64].
- Easy, convenient, practical, and accessible anywhere to students in Malaysia [65].
- Improving the quality of school accreditation in Jordan [66].
- Optimistic attitudes toward digital, web, computer, and internet development among students in Turkey are facing the era of industrial revolution 4.0 [67], [68].

The negative impact of web-based e-learning is found in the use of Facebook [69], [70]. Research on 1,323 elementary and middle school students in the USA found that Facebook had a negative impact because students did not focus on lessons but played more dominantly and were addicted to it [71]–[73]. If not managed well, web-based learning can lead to physical distress, fatigue, academic stress, and mental, emotional, and social health risks for children [74]–[76]. The weaknesses of web-based e-learning so far are not all tailored to the characteristics, objectives, tasks, learning styles, and interests of students [77], [78], so it is not optimal [79]. Web-based e-learning does not run optimally when teachers do not guide elementary school students [80]. A solution is needed so web-based e-learning can maximally support elementary school learning [81], [82].

It is important to learn more systematically about the topic of web-based e-learning in elementary schools because teachers are required to understand the concepts of online learning, synchronous and asynchronous modes [83], [84], blended learning, the use of models, strategies, and media across subjects [85], [86], how to improve digital age skills [87]–[89], think critically, competitively, collaboratively [90]–[92], and make students information literate [93]–[95]. In general, this background explores the description of web-based e-learning in elementary school, which is reviewed and analyzed using the SLR method. The results of this research are expected to provide an overview of web-based e-learning in elementary schools as a whole. This research has a novelty in web-based e-learning that can be applied to several subjects in elementary schools. This article also contributes to strengthening teachers' knowledge about the concept, implementation, and impact of web-based e-learning in elementary schools. The researchers propose three research questions as follows:

- What is the concept of web-based e-learning in elementary school?
- What is the implementation of web-based e-learning in elementary school?
- What is the impact of web-based e-learning in elementary school?

II. Materials and Method

A. Research Design

This research uses the SLR method, which presents a description and analysis of the concept, implementation, and impact of web-based e-learning in elementary schools [96]–[98]. The research flow is by identifying the literature compatible with web-based e-learning in elementary schools on the Scopus database. SLR, in this study, applies the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) technique to identify, filter, test feasibility, include data for analysis, and present it in the narrative form [99], [100]. The stages carried out are identification, screening, eligibility, and inclusion objectively according to the results of the data reviewed in contemporary articles [101]–[103].

B. Inclusion and Exclusion Criteria for Selection of Publications

Several criteria have determined the inclusion and exclusion stage [104] [105]. First, the articles were published in 2018-2022. Second, the studied articles were only scientific articles, not dissertations, theses, papers, conference proceedings, or book chapters. Third, the Scopus database indexed articles. Fourth, the articles searched were on the topic of web-based e-learning in elementary school. Fifth, the search for articles used the *Publish or Perish 7* application by entering the API Key [106], [107]. Sixth, they were English articles.

C. Screening and eligibility assessment for data analysis

At this stage, screening of literature findings from Scopus was carried out on July 5, 2022. The screening literature was on aspects of title, abstract, and keywords from articles published in 2018 to 2022. From the findings, there are 507 articles from Scopus. The details can be seen in Table 1.

TABLE I
FINDINGS OF ARTICLES FROM THE SCOPUS DATABASE

	Keyword	Quantity
1	Web-based e-learning	200 articles
2	Web-based e-learning in elementary school	27 articles
3	Web-based learning	200 articles
4	Web-based learning in elementary school	80 articles
	Total	507 articles

The same 507 articles were discarded, and then 50 articles were selected and entered into *Mendeley*, then saved in RIS

format. The RIS file was then entered into the *VOSviewer* application to map the initial network of theme relevance [108], [109]. The procedure for entering into *VOSviewer* states (1) creating a map based on bibliographic data; (2) reading data from the reference manager file, (3) selecting a file from the folder, (4) choosing the type of analysis and count method, namely the type of analysis: co-occurrence, unit of analysis: keywords, and counting method: full counting, (5) verifying selected keywords and (6) finish [110]–[112].

The results of the initial analysis of thematic associations show that web-based e-learning in elementary school has a very complex association pattern in Fig. 1 in the *VOSviewer* application.

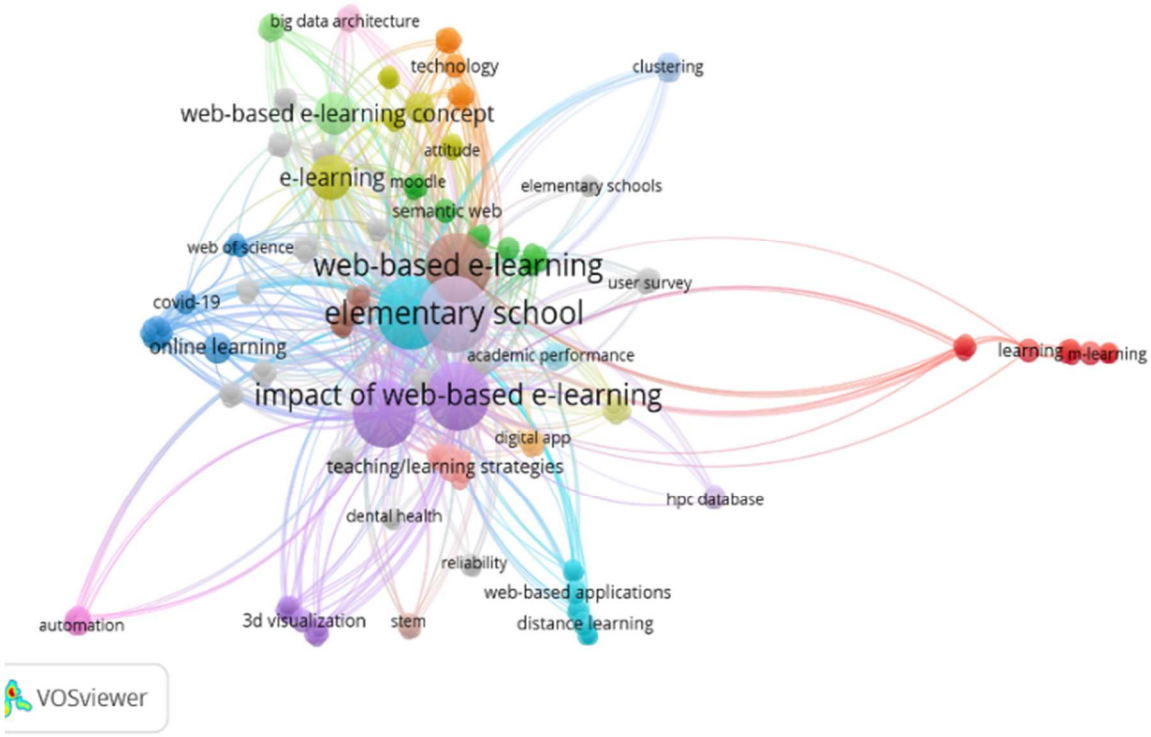

Fig. 1 Initial network visualization.

Fig. 1 shows that discussions and studies related to web-based e-learning in elementary school are very close to several other study themes as follows:

- Web-based e-learning, elementary school
- Impact of web-based e-learning.
- Web-based e-learning concept.

Some keywords with a distant connection to the theme of the study are as follows:

- Academic performance.
- Teaching/learning strategies
- Online learning
- Covid-19.
- HPC database
- web-based applications.
- Distance learning.
- 3D visualization.
- Automation.
- Strategic learning.
- Semantic web.
- Technology.
- Education.
- Linguistic content.
- Big data architecture.
- Learning setting.
- e-readiness.
- Linguistic content.
- STEM, etc.

D. PRISMA Flow Diagram

The search process with the PRISMA flowchart can be seen in Fig. 2 below.

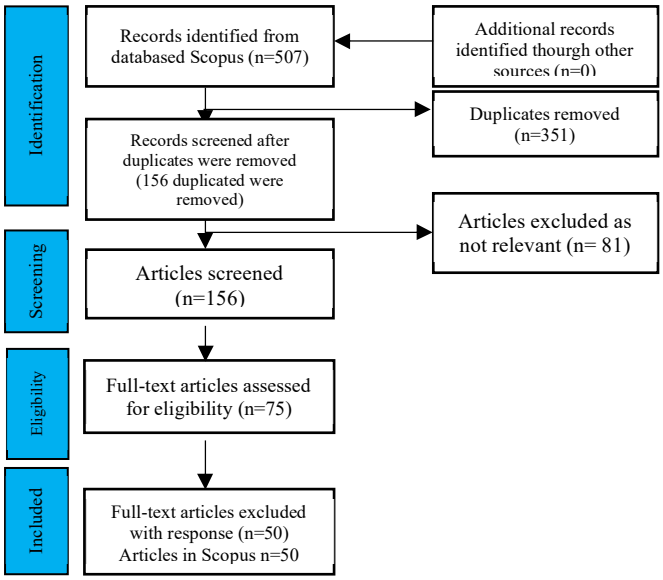

Fig. 2 PRISMA Flow Diagram for Systematic Review [113] [114]

The article findings on the Scopus database amounted to 507 and then checked the same based on keywords, and there

were 156 articles. The similarity of articles is not based on databases because this study is only the Scopus database, but the similarity is seen from the keywords used. The same article is 351. Of the 156 articles, 81 irrelevant articles were discarded, then 75 full-text articles were selected again. Finally, 50 articles were selected according to the research question in terms of title, abstract, keywords, and comprehensive article substance. The next step is to enter the RIS file from *Mendeley* [115], into the *NVIVO 12 Plus* application to be analyzed, reviewed, and the results are presented according to the three research questions [116], [117].

III. Results and Discussion

Before presenting the findings according to the research questions, the article findings based on journal (name, volume, edition, year, author), country, method, relevance to the research question (RQ) 3.1 about the concept, 3.2 about implementation, and 3.3 about the impact of web-based e-learning in elementary school are presented below.

TABLE II
Finding 50 articles from the Scopus database

No	Journals	Country	Method	RQ
1	EURASIA Journal of Mathematics, Science and Technology Education 14 (1) 2018 [118]	Taiwan	Analysis	3.2
2	Turkish Online Journal of Distance Education-TOJDE 19 2018 [119]	Nigeria	Field survey & questionnaires	3.1
3	World Journal on Educational Technology: Current Issues Vol 10 (1) 2018 [120]	Indonesia	Research and development	3.2
4	International Journal of Learning, Teaching, and Educational Research Vol. 17 (8) 2018 [121]	Italy	Analysis	3.2
5	International Journal of Technology and Design Education 2018 [122]	Taiwan	Quasi-experimental	3.3
6	International Journal of Engineering & Technology 7 (4.10) 2018 [123]	India	Experimental	3.1
7	J. Parallel Distrib. Comput. 118 2018 [124]	India	Analysis & Case Study	3.1
8	International Journal of Geo-Information 7 2018 [125]	Kenya	Investigative research	3.1
9	Journal of Psychoeducational Assessment 37 (4) 2018 [126]	USA	Evaluation Research	3.1
10	International Journal of Web-Based Learning and Teaching Technologies Vol. 13 (2) 2018 [127]	India	Experimental	3.2
11	International Journal of Web-Based Learning and Teaching Technologies Vol. 13 (4) 2018 [128]	Saudi Arabia	Quantitative an d qualitative	3.1
12	Journal of Interactive Media in Education 1 (7) 2018 [129]	Washington	Qualitative	3.1
13	Journal American Water Works Association 110 11 2018 [130]	Ohio	Quantitative	3.1
14	Journal of Theoretical and Applied Information Technology 96 (23) 2018 [131]	Indonesia	Research and Development	3.3
15	Information Security Journal: A Global Perspective 28 (3) 2019 [132]	Greece	Research and Development	3.2
16	International Journal of Electrical and Computer Engineering 9 (6) 2019 [133]	Kufa	Qualitative descriptive	3.2
17	EURASIA Journal of Mathematics, Science and Technology Education 15 (11) 2019 [134]	Several countries	Literature Review	3.2
18	International Journal of Emerging Technologies in Learning 14 (11) 2019 [135]	Morocco	Qualitative descriptive	3.3
19	Journal of Cleaner Production 2019 [136]	Spain	GIS-MCDA and F-DEMATEL	3.3
20	International Journal of Engineering Pedagogy (iJEP) 9 (5) 2019 [137]	Morocco	Element Oriented Method	3.1
21	Hindawi: Journal of Healthcare Engineering 2019 [138]	Spain	Experimental	3.2
22	International Journal of Artificial Intelligence in Education 29 (2) 2019 [139]	Hong Kong	Comparison	3.3
23	Journal of Intelligent and Fuzzy Systems 37 (3) 2019 [140]	India	Rough-Fuzzy Clustering	3.3
24	Universal Journal of Educational Research 7(1) 2019 [141]	USA	Phenomenologi cal qualitative	3.2
25	Education and Information Technologies 24 (4) 2019 [142]	Turkey	Experimental	3.3
26	Turkish Online Journal of Distance Education 19 (1) 2019 [143]	Turkey	Correlational study	3.3
27	Journal of Pediatric Nursing 45 2019 [144]	Taiwan	Evaluation	3.1

No	Journals	Country	Method	RQ
28	International Journal of Engineering Pedagogy 10 (2) 2020 [145]	Indonesia	Evaluation	3.2
29	Computers & Education 144 2020 [146]	Taiwan	Qualitative Analysis	3.3
30	International Journal of Emerging Technologies in Learning 15 2020 [147]	Indonesia	Qualitative	3.3
31	Journal of Network and Computer Applications 157 2020 [148]	Poland	Experimental	3.1
32	Journal of Internet Technology 21 (4) 2020 [149]	China	Experimental	3.1
33	Journal of Medical Internet Research 22 (8) 2020 [150]	Switzerland	Randomized, controlled, quadruple-blind closed web-based trial	3.1
34	Journal of Digital Imaging 33 (3) 2020 [151]	USA	Content Analysis	3.1
35	World Journal on Educational Technology: Current Issues 12 (2) 2020 [152]	Turkey	Experimental	3.1
36	International Journal of Science Education 43 (8) 2021 [153]	USA	Case Study	3.3
37	Journal of Special Education Technology 36 (2) 2021 [154]	USA	Research-based practices	3.2
38	International Journal of Evaluation and Research in Education (IJERE) 10 (4) 2021 [155]	Malaysia	Qualitative research	3.3
39	International Journal of Interactive Mobile Technologies 15 (21) 2021	Indonesia	Experimental and control groups	3.3
40	International Journal of Evaluation and Research in Education 10 (1) 2021 [156]	Malaysia	Quantitative	3.3
41	Journal of Multilingual and Multicultural Development 2021 [157]	Canada	Mixed-method	3.1
42	International Journal of Interactive Mobile Technologies 15 (11) 2021 [158]	Indonesia	Mixed method	3.1
43	International Journal of Evaluation and Research in Education 10 (2) 2021 [159]	Ukraine	Comparative analysis	3.3
44	Psychometrika 87 (2) 2022 [160]	USA	Empirical research	3.1
45	JOI: Int. J. Inform. Visualization 6 (2) 2022 [161]	Malaysia	Action research	3.1
46	International Journal of Interactive Mobile Technologies 16 (03) 2022 [162]	Ukraine	Quantitative	3.1
47	Computers & Education 179 2022 [163]	Taiwan	Quasi-experimental	3.1
48	International Journal of Interactive Mobile Technologies 2022 [164]	Several countries	Systematic review	3.3.
49	Hindawi Mobile Information Systems 2022 [165]	Saudi Arabia	Quantitative research	3.1
50	Heliyon 8 2022 [166]	Several countries	Bibliometric analysis	3.1

A. The Concept of Web-based e-learning in Elementary School

Web-based e-learning is a learning concept with an Open and Distance Learning (ODL) system by implementing distance learning through server, design, integrated system, text, video, and voice [119]. Forms of web-based learning are integrated with the Internet of Things (IoT), cloud computing, machine learning, digital learning [123], and the adoption of web-based ICT in learning that facilitates students and teachers [137]. Web-based e-learning is a form of digital multimedia that becomes an effective learning instrument, attracting learners' interest through varied and interactive content [144]. The world-renowned concept of web-based e-learning is web-based learning utilizing several platforms, such as Zoom, Webex, Google Classroom, Microsoft, etc. [166].

There are several web-based e-learning platforms in the world as follows:

- High-Performance Computing (HPC), Parallel & Distributed Computing (PDC) in India [124].
- 3D Web-Based City Models in Kenya [125].
- Web-Based Assessment of Children's Social-Emotional Comprehension in the USA [126].
- Web Quest Strategy in Saudi Arabia [128].
- Web-Based Applications in Chemistry learning in Washington [130].
- Chose mobile web-based in China [149].
- e-module based website in Switzerland [150].
- 3D-based website, gaming, and virtual reality in the USA [151].
- Web-based Mentimeter and Kahoot applications in Turkey [152].
- Web-Based Animation Video in Indonesian elementary schools [158].
- Web-based computer with Math Garden in the USA [160].
- Interactive Gamification E-Learning Web-Based Application in Malaysia [161].
- Web and AI-Enabled Mobile Applications in Saudi Arabia [165], etc.

Web-based inquiry design in elementary schools is integrated with reading annotation systems, digital collaboration, and information literacy for learning [163]. Web-based e-learning must have high traffic and be developed through artificial agents (web bots) for security,

performance, and maintaining privacy [148], integrated into the local curriculum, using multilingualism, and aligned with primary school materials [157]. Web-based e-learning concepts, such as Web-Quizzing, contain formative tests, diagnostic tests, summative quizzes, and benchmarks with three streams: familiarization, shaping, and assessment [162].

B. The Implementation of Web-based e-Learning in Elementary School

Implementation of web-based e-learning is designed through curriculum, content, materials, and curricular activities with planning to evaluate either e-learning, blended learning, or face-to-face [118], [127]. Implementation of web-based e-learning in Indonesia is through a web-based game of snakes and ladders for elementary school students to make it easier for them to understand the material [120], in Kufa, through e-learning, Windows, student information systems, network servers, and applications instead of traditional learning [133]. The application of web-based e-learning is used as multimedia integrated between computer technology, cellular, and games in education in the form of ICT, CBI, web games, video games, microgames, serious games, tablets, mobile phones, PDAs, and others. The goal is that learning is comprehensive, collaborative, active, inductive, and problem-solving-based [134].

A study in the USA mentions that web-based virtual learning for mathematics learning applies a number of free, paid, and premium platforms, namely Zoom (*zoom.us*), Google Meet (*meet.google.com*), Loom (*www.loom.com*), Jamboard (*jamboard.google.com*), Nearpod (*nearpod.com*), Google Classroom (*classroom.google.com/u/0/h*), Seesaw (*web.seesaw.me*), Screencastify (*www.screencastify.com*), Flipgrid (*info.flipgrid.com*), Camtasia (*techsmith.com/videoeditor.html*), Peardeck (*peardeck.com/googleslides*), Brainingcamp (*brainingcamp.com*), NLVM (*nlvm.usu.edu*), MLC (*mathlearningcenter.org/resources/apps*), and Didax (*www.didax.com/math/virtualmanipulatives.html*) [154]. Web-based learning in Spain is implemented through the integration of game-based Virtual Reality Videos for therapy and supports student health programs [138]. The application of web-based e-learning must ensure the safety of students. This research states that web-based learning with the Learning Content Management Systems (LCMS) platform is safe for students and teachers [132]. Research in the USA shows that 75 percent of elementary school principals have a positive role in implementing web-based e-learning based on Forethought, Workshop, Euphoria Aware, and a web-based public education information management system [141]. The web is also implemented in evaluation with e-learning systems based on learning content, structure, and measurable evaluation instruments [145]. The success of web-based e-learning is determined by the synergy between teachers, students, and parents, especially through the media of the digital web, satellite, and cable TV [121].

C. The Impact of Web-based e-learning in Elementary School

In a study of 241 students in Taiwan, web-based e-learning had an impact on STEM problem-solving and collaboration skills [122]. The study of web-based learning in Indonesia has an impact on strengthening the character of discipline, honesty, respect for friends' opinions, courtesy, and improving students' knowledge, attitudes, psychomotor abilities [131], and creative-thinking skills [159]. Web-based e-learning through Moodle impacts the development of e-learning in schools, increasing system interoperability and finding new approaches to learning with semantic web technology [135]. Web-based learning with Multi-Criteria-Spatial Decision Support System (MC-SDSS) student development has a positive impact on STEM education in terms of students' sustainably [136], students' attitudes, interests, and academic achievement in English [142]. Studies in Hong Kong say the use of web-based e-learning facilitates communication and interaction between teachers and students, facilitating synchronous and asynchronous learning modes so that this innovation prevents children from being lazy to learn [139]. Weblog learning positively impacts students' innovation and learning effectiveness, as they learn independently and in groups according to the teacher's instructions [140]. Teachers should be trained in website-based distance learning management. The impact of the training strengthens teachers' abilities to understand the concepts, techniques, and strategies for successful web-based distance learning [143].

Research on 55 elementary school students in Taiwan mentions the application of a web-based collaborative reading annotation system (WCRAS) used for gamification, improving students' reading comprehension and skills [146], and the implementation of the Blended Web Mobile Learning (BWML) model in Indonesia impact on students' higher-order thinking skills [147]. Web-based inquiry science environment (WISE) in USA elementary schools has an impact on improving science learning, building scientific explanations, encouraging students' scientific discourse, and teachers are more helpful in remote teaching [153]. Web-based e-learning applied in blended learning in Malaysia has an impact on improving 21st-century skills [155], students' interests in constructing knowledge through Virtual Learning Environment (VLE) [156], and Mobile Web-Based Character enhancing perseverance and discipline in 192 elementary school students in Indonesia [167]. Quality human (student) and computer relationships impact the success and failure of web-based learning [164].

IV. CONCLUSION

Web-based e-learning started from the concept of learning with the ODL system, using servers, design, text, video, sound, IoT, cloud, machine, and digital learning, and became digital multimedia with various platforms, names, and types developed according to needs of elementary school teachers and students. Web-based e-learning is implemented through curriculum design, content, materials, and curricular activities, from planning to evaluation, in the form of e-learning, blended learning, or face-to-face. Web-based e-learning impacts increasing STEM problem-solving skills, 21st-century thinking skills, students' diligent and disciplined character, making it easier for teachers to teach, etc. Subsequent research needs to explore more deeply related to web-based e-learning that is contemporary, safe, and needed by elementary school students and teachers.

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