



# New Technology for Teaching and Learning Science for Educators and Students as Support for the Independent Curriculum: Systematic Literature Review

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**Abstract:** This research aims to determine new technology used in science teaching and learning to support the implementation of the independent curriculum. The research method used is systematic literature review (SLR), namely researchers reviewing various journal articles that have been published from 2020-2023 via Google Scholar. From the research results, by following established research procedures, 7 journal articles were reviewed. From the results of the review, it was found that the technology that can be utilized in science teaching and learning is multimedia/video assisted learning; Learning with the help of digital games; Learning assisted by computer simulation; Comic-assisted learning; Learning using the Google Classroom platform; and Learning using Web 2.0. Meanwhile, the appropriate devices used in science teaching and learning to achieve predetermined learning objectives are Cell Phones/Android, PDAs, Tablets, Laptops, e-books, and iPods. To optimize the use of technology in science classes, teachers should use collaborative learning approaches, inquiry learning, project-based learning, problem-based learning, game-based learning, and flipped classroom learning. For game-assisted learning, teachers must create good learning scenarios and choose the right games according to learning objectives.

**Keywords:** Gamification; Google classroom; New technology; Teaching and learning

## Introduction

The implementation of the independent curriculum is a major breakthrough for Indonesian education as well as a challenge that must be welcomed with maximum readiness (Vhalery et al., 2022). If not, of course this breakthrough will only have a negative impact which will actually further reduce the quality of education and learning. The implementation of a new curriculum is a reflection of preparation to face growing future challenges (Amalia, 2022; Marisa, 2021). The implementation of the independent curriculum is a form of preparatory effort to improve education in accordance with the challenges of the times that continue to develop

(Kusumawati, 2022; Nadhiroh & Anshori, 2023; Suharli et al., 2023).

Elementary school has its own special features, because it is at this level that basic concepts will be developed and instilled in students (Rachmadyanti & Wicaksono, 2017; Robani et al., 2022; Sahnan, 2019; Salirawati, 2022). Learning in elementary school must be in accordance with the child's actual character, so that learning concepts can be digested and understood well by children (Etivali & Kurnia, 2019; Habibi, 2014; Santika et al., 2022). Students in elementary schools nowadays prefer learning that is directly linked to tools or facilities such as learning media (Hidayatullah et al., 2022; Astuti et al., 2022). So that children gain understanding

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independently, are not dictated to, and remember the material they understand well and for longer.

Science learning in elementary schools plays an important role in educational development (Amali et al., 2019; Asmoro & Mukti, 2019; Nurashiah et al., 2022; Rohmah et al., 2018). As explained by Fadilla et al. (2023), science learning has a very urgent role in the development of technology and science. Science learning is learning that prioritizes process skills, meaning that students gain understanding independently through the learning process carried out directly or through experience (FH et al., 2022). However, science learning is still a learning content that is avoided by students because it requires persistence, seriousness, and a lot of practice or experimentation (Cahyaningsih et al., 2020; Herfinayanti et al., 2017; Maharuli & Zulherman, 2021; Ningrum et al., 2023; Pustikayasa, 2019; Tarisna et al., 2023).

One of the causes of this problem can be overcome by using interactive learning media, which can provide learning according to the child's world and of course can provide meaningful learning to students (Humaida & Suyadi, 2021; Prabowo & Mulyo, 2021; Taupik et al., 2023; Setyawan et al., 2021; Valentina & Sujana, 2021). The science learning process in elementary schools really requires facilities and infrastructure, one of which is using learning media technology (Adiputra & Heryadi, 2021; Agustina & Apko, 2021; Laksono et al., 2021; Megasari, 2020; Wicaksono et al., 2020). Good quality learning must of course be supported by good facilities and infrastructure, and one of these efforts is the use of interactive learning media (Azhari & Sahputri, 2021; Nadzif et al., 2022; Syamsuar & Reflianto, 2019).

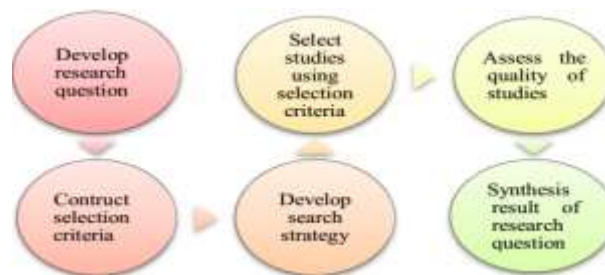
The implementation of an independent curriculum accompanied by the industrial revolution 4.0 towards Society 5.0 requires teachers to be more responsive, creative and innovative in implementing learning (Jannah et al., 2023; Maghfiroh & Sholeh, 2022; Rokhyani, 2022; Thahery & Riau, 2023). Industrial revolution 4.0 is an era marked by the presence of sophisticated technology and the widespread distribution of information (Gazali, 2018; Faeflulloh et al., 2020; Nabilah et al., 2021; Nursalim, 2020; Sawitri, 2019; Verawardina & Jama, 2019). So with this, it will be easier for teachers to meet students' needs effectively (Farid et al., 2022; Novitasari et al., 2021; Siringoringo et al., 2023; Sodik et al., 2021). Because learning is basically an activity that involves three elements, namely educators, students, and infrastructure (Ahmadi & Syahrani, 2022; Dwi et al., 2020; Fajra et al., 2020; Rahman & Wassalwa, 2019). So, to create effective facilities and infrastructure that meet the needs of students in accordance with current developments, of

course teachers must have the ability to utilize this technology in learning.

Based on the description above, researchers are interested in conducting a further literature review regarding new teaching and learning technology in science subjects for educators and independent curriculum elementary school students. The aim of this research is to find out and describe the results of research on the use of new teaching and learning technology in science subjects for educators and elementary school students in the independent curriculum from year to year.

**Method**

Study this use systematic literature review, then in the collection data must be in accordance with research procedures Systematic Literature Reviews. The design procedure study Systematic Literature Reviews as following:



**Figure 1.** Systematic procedure diagram literature review (Zawacki-richter et al., 2020)

As for the explanation in a manner detail as following.

*Develop Research Questions*

Research questions that developed in this research, as following:

- RQ1. How are science learning objectives achieved in elementary schools based on the results of a review of research articles by applying new technology in the classroom?

*Selection Criteria*

The criteria selection on this research is shown in Table 1.

**Table 1.** Criteria inclusions and exclusion

Criteria inclusions (acceptance)	Criteria exclusion (rejection)
Article in accordance with research topic on the New Technology for Science Classroom.	Journal study or work scientific in outside topic research. Publication before year 2019. Unfull text.
Publication (2020-2023). Full text.	

*Developing the Search Strategy*

The search process is carried out using *search engine* (using *google chrome*) with the site address <https://scholar.google.com/>. Strings search needed for search Which more Specific And avoid filtering in that amount too big.

Strings search of this research: ("Teknologi Baru untuk Pembelajaran IPA\*" or "New Technology for Science Classroom/Learning"\*)

*The Study Selection Process*

In the selection process studies namely process Where title and abstract article checked especially formerly for determine is study the relevant or No (Zawacki-Richter et al., 2020).

*Appraising the Quality of Studies*

In study SLRs, data which found will evaluated based on question of quality assessment criteria as following:

- QA1. Is article journal has indexed?
- QA2. Would the article write down the problemstudy Which relevant with this research?
- QA3. Is on article use method study Which relevant fordevelop *new technology for science learning or science classroom*?

From each article journal, will give mark answer for each question in on with Y (Yes) or Q (No).

**Result and Discussion**

Article search results can be seen in Figure 2. Based on figure 2, the results of the findings explained as following.

*Developing the Search Strategy*

Based on Figure 2, results findings in strategy search on site <https://scholar.google.com/> with strings. In this research search, there are 293 articles found, but in these findings there are articles that are the same (duplicate) judging from the title and author.

*Selection Criteria*

In Figure 2, the findings of the criteria acceptance selection (inclusion) and rejection (exclusion) from 267 article, article which fulfil criteria reception namely 63 articles with acceptance criteria: Topic new technology for teaching and learning science, Publication (2020-2023), and Full text. Article which selected or rejected 204 articles, as for criteria exclusion, namely: Outside topic new technology for teaching and learning science, that is there were 229 articles that were rejected, and Unfull text, there is 17 that article only provide the abstract only , so that article the rejected.

*The Study Process*

On this stage, article which fulfil criteria selection reception, furthermore be read title and the abstract for determine relevant nope with topicthis research. From the findings at the stage here, there are 7 articles which relevant with this research and there were 14 articles that were rejected because the article was incomplete, it only consisted of an abstract, the full text could not be found or could not be accessed other than that the article Which considered no relevant because writer no include level education on title article while in the abstract it states level education, however no level elementary school, so the article is not relevant with study this.

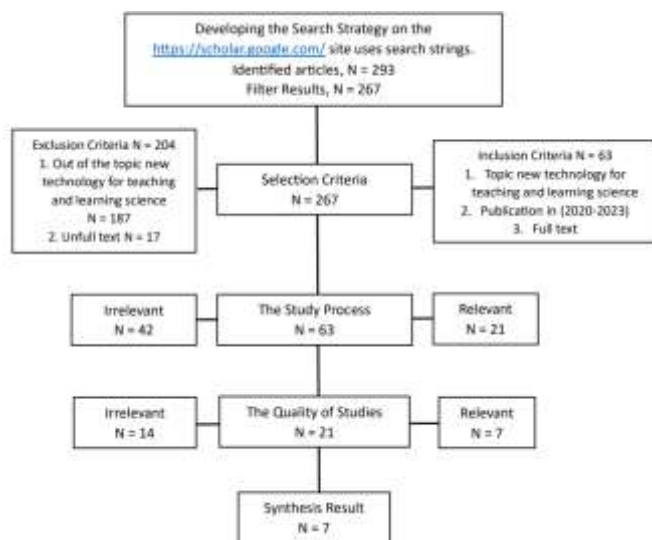
*The Quality of Studies*

Result of quality studies that is there are 7 journals article fulfil criteria quality studies, proved with answer yes from all questions (QA1, QA2, QA3). This means that the journal articles in the table are indexed by Scopus or included in international scientific journals, write research problems related to new technology for science learning in elementary schools as well as journal articles writing research methods used to develop new technology for science learning in elementary schools.

*Synthesis Results*

Then carry out the data synthesis stage. The purpose of data synthesis is to collect evidence from selected studies to answer research questions (Latifah & Ritonga, 2020). As for the question research (question research) and answers study as following:

RQ1. How are science learning objectives achieved in elementary schools based on the results of a review of



**Figure 2.** Article search results of literature

research articles by applying new technology in the classroom?

Based on the results of a review of 7 journal articles regarding new technology for learning and teaching, it is proven that it can achieve science learning objectives in elementary schools, as evidenced by an increase in the initial value or percentage (before using) compared to the final value or percentage (after using). In detail it is explained as follows.

First article by Kwangmuang et al. (2021) with the title "The development of learning innovation to enhance higher order thinking skills for students in Thailand junior high schools". The result study showing that the design of content is in line with students' knowledge levels, easy to understand, and enable to connect science contents to their daily life. However, some contents cannot fully cover into all classroom lessons; Multimedia. A navigation design is easy for students to find information and direct to their needs. The icon symbols could hint the meaning of various information sources and have links to these sources. Also, multimedia could considerably explain scientific processes and help students understand better; the design of problem scenarios supports easier connection to the daily life. In addition, using videos as a learning resource could suitably illustrate scientific process, and improve communicative and collaborative skills in problem solving.

Second article by Safitri et al. (2022) with the title "Improvement of Student Learning Motivation through Word-Wall-based Digital Game Media". The result study showing that the use of digital games has a positive effect on students' learning motivation due to the presentation of attractive media, and also supported by the way the teacher builds a pleasant learning atmosphere. This digital game is also relatively easy for all people, including elementary school students. Furthermore, most importantly, digital games provide new experiences in the student learning process. In its application, this digital game only acts as a medium that can help increase student learning motivation. This media cannot significantly increase students' learning motivation if not applied with the exemplary learning scenario. Other than that, selecting the type of game with the material also needs to be considered so that the learning objectives can still be achieved. With this, student learning motivation can be realized to the fullest.

Third article by Dewi et al. (2022) with the title "The impact of Google Classroom to increase students' information literacy". The result study showing that the information literacy of students improved before and after their learning exposure using Google Classroom based on the descriptive and inferential statistics.

Moreover, the students' attitude towards the online platform shows that they are more willing to learn using Google Classroom than the non-online or conventional learning platforms. Therefore, applying Google Classroom in online learning is effectively boost students' information literacy.

Fourth article by Oladejo (2021) with the title "Teaching Chemistry with Computer Simulation: would Senior School Students Perform Better". The result study showing that a statistically significant difference between the performance of students taught using computer simulation and those taught with the traditional lecture method [ $F(1.80) = 49.34; p < .05$ ]. It was also found that the experimental group showed superiority over the control group in higher-order cognitive achievement. Hence, the study concluded that computer simulation is a useful facility for improving students' performance in chemistry and promoting meaningful learning.

Fifth article by Afikah et al. (2022) with the title "Mobile Learning in Science Education to Improve Higher-Order Thinking Skills (HOTS) and Communication Skills: A Systematic Review". The result study showing that the most appropriate mobile devices used to achieve learning objectives are mobile phones, followed by PDAs, tablets, iPad, laptops, e-books, and iPods; the learning approach used in science learning to improve higher-order thinking skills and communication skills are a collaborative learning approach, inquiry learning, project-based learning, problem-based learning, game-based learning, and flipped classroom learning. It was hoped that this research can be an illustration for other researchers to create innovative learning approaches. Sixth article by Habiddin et al. (2022) with the title "Digital Comic Media for Teaching Secondary School Science". The result study showing that the media has been tested to 20 students during the emerging of the Covid-19 pandemic and showing good acceptance. This implies that digital comic media is of value to be used and applied in online learning.

Seventh article by Azid et al. (2022) with the title "The COVID-19 Pandemic: Web 2.0 Tools as an Alternative Instruction for Science in Secondary Schools". The result showing that the creative approach using web 2.0 tools has not only produced advancement in students' achievement in the science subject but has also motivated them to complete the assessments given during online lessons. The findings also emanated that students' motivation to learn science through online learning was due to the usage of 2.0 tools. Hence, science teachers ought to be better prepared with the skills as well as better-designed learning modules and experiences to incorporate integrated online learning

and face-to-face class with a blended learning approach seamlessly. From the seven journal articles, it is proven that there has been an increase in the achievement of science goals after the application of technology to science learning in the classroom.

## Conclusion

From the description above, it can be concluded that technology-assisted learning can improve learning outcomes, improve high-level thinking skills (HOT), increase learning motivation, increase learning activity, improve performance, improve communicative skills and improve collaboration skills in solving problems. Apart from that, the use of technology can increase students' information literacy. The technology that can be utilized in science teaching and learning is as follows: Multimedia/video assisted learning; Learning with the help of digital games; Learning assisted by computer simulation; Comic-assisted learning; Learning using the Google Classroom platform; and Learning using Web 2.0. Meanwhile, the appropriate devices used in science teaching and learning to achieve predetermined learning objectives are Cell Phones/Android, PDAs, Tablets, Laptops, e-books, and iPods. To optimize the use of technology in science classes, teachers should use collaborative learning approaches, inquiry learning, project-based learning, problem-based learning, game-based learning, and flipped classroom learning. For game-assisted learning, teachers should create good learning scenarios and choose the right games according to the learning objectives.

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## Author Contributions

Conceptualization, A. F., L. A. K., methodology, S.; validation, E. S and R. M. P; formal analysis, A. F.; investigation, E. S., and S; resources, E. S. and. R.M.P; data curation, L. A. K: writing – original draft preparation, L. A. K and A. F.; writing – review and editing, S.: visualization, R. M. P and S. All authors have read and agreed to the published version of the manuscript.

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## Conflicts of Interest

All authors declare no conflict of interest.

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