

Exploring the Use of Social Media in Science Learning Environments: A Systematic Literature Review

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ABSTRACT Social media is one of the platforms that is popular and familiar to various circles. This technology has penetrated multiple fields, especially education. Many studies have shown the use of social media in the learning process. This study aims to explore the use of social media in science learning environments and their impacts. The method used is a Systematic Literature Review with several stages: Identification, Screening, and Inclusion. This systematic literature review used several databases, including Springer, Wiley, and ERIC. The study was limited to the last eight years, from 2016 to 2023. After screening using the PRISMA method, 30 articles were obtained and used as literature material. The study results show that social media can be one of the media used in learning science. Social media, which are often used in learning, include Facebook, Instagram, YouTube, Twitter, and WhatsApp. Science learning that requires visualization is suitable if learned using social media. The use of social media in this learning also needs to be adjusted to the characteristics and features owned. The findings in the article report that social media positively affects collaboration skills, knowledge, motivation, and student-centered learning. However, there are negative impacts of using social media that disrupt privacy. In addition, there is a need for training at each institution so that the use of social media is more optimal.

Keywords: Social media, Science learning, Technology

1. INTRODUCTION

Electronic and digital communication technology has revolutionized learning by increasing technological and social connectivity, including the development of Web 2.0. The use of Web 2.0 makes it easier for users to share information. One of the main features of the second-generation Internet is sharing so that users can interact with each other (Szeto et al., 2016). This technological advancement has shifted the world of education, changing the perception of e-learning and mobile learning. Mobile learning has become a significant need in education, and many applications have been developed to support the learning process (Zhao et al., 2021). One of the mobile learning and e-learning that has been developed is social media-based learning. This learning is more flexible in distributing information, thus causing academic effectiveness (Hanif & Imran, 2022).

Social media-based learning is constructive in delivering learning materials. Social media is an internet-based technology that is easily accessible, so it proliferates among adolescents and young adults (Demir, 2018). Some surveys also show that social media is widespread even though most of its use has yet to be focused on education. Around

67% of the world's population uses social media or blog sites, and 10% of total internet usage time is spent on social media (Rahman et al., 2021). Social media consists of several activities such as interacting with friends, posting pictures and videos, engaging in conversations with public topics, watching news, real-time web chat, and elements that enable networking, communication, and collaboration. Material with much visualization requires technology's role in delivering information (Motzko & Dennis, 2023).

One of the learnings that requires visualization is in the science learning environment. The learning environment is the physical and social context in which learning occurs, which can be in the form of classroom interaction between teachers and students (Ibragimov et al., 2023). The learning environment influences student achievement and involvement, especially in science education. Science is an understanding of the universe and living things through observation using structured procedures with scientific methods in making decisions (Stevi & Haryanto, 2020).

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Most science materials are abstract, conceptual, and complex, requiring visualization. Educators must convey concepts with concrete visualizations so they are easy to understand and no misconceptions occur. Conventional learning makes students feel bored because the material is difficult to understand. Using adequate media can build students' understanding and interest, especially in conceptual and abstract material (Nurhayati et al., 2020). Audiovisual media with visual and audio combination features will incredibly help mastery of concepts and avoid misconceptions (Stevi & Haryanto, 2020). In addition, students will prefer flexible and easy-to-use learning media. This is very much in line with the characteristics of social media. Social media is a dynamic platform that can visually represent abstract science concepts (Rap & Blonder, 2016).

The characteristics of various social media platforms create opportunities to choose applications that best suit the character of the learning material (Miller et al., 2019). Every social media has features to like and comment on each other for interaction between users. Some popular social media platforms include WhatsApp, Facebook, Twitter, Instagram, and YouTube. Instagram is among the most popular because it can connect users through visual media through images, feeds, reels, and short captions. Based on these characteristics, Instagram is suitable for learning histological studies that require visualization (Essig et al., 2020). The uniqueness of Facebook is its social aspect and the use of hashtags that distinguish it from other learning media and are in line with digital connectivity. Facebook can be used as a platform for peer-to-peer learning in medical schools during the pandemic (Chambers et al., 2023). Like Facebook, Twitter-based learning can also use the hashtag feature to reach various groups, facilitating interaction in learning science (Lundgren et al., 2022). YouTube is also widely used to utilize interactive science content but still one-way interaction (Salih et al., 2022).

In addition to conveying information that requires visuals, social media can also increase student engagement (Carman et al., 2021). Most students consider social media a convenient and inexpensive tool for getting relevant information (Ansari & Khan, 2020). Social media can create social connections and educational goals and attract academic interest. Facebook social media benefits learners because it efficiently asks questions and various information and interacts with peers (Muls et al., 2020). However, using social media to deliver information is still a challenge for educators in integrating these platforms with the material's content (Zablith, 2022). Although social media tends to be easy to use, there are still obstacles to accessing it, including internet limitations and a ban on using some social media (Gilavand et al., 2023). The use in the learning process is sometimes also abused by students, requiring stricter guidance and guidance by teachers (Chambers et al., 2023). In addition, a challenge that has

received attention is datafication, a trend that causes human interactions to be monitored, analyzed, and modified (Marín et al., 2022). Some social media users sometimes feel annoyed by the presence of notifications.

Based on previous research shows that social media can be a student-centered medium and create independent learning (Cathala et al., 2022). A survey from (Salih et al., 2022) shows that social media increases learning in urgent situations. However, there is an assumption that its use may cause privacy disruptions and several other negative impacts (Lundgren et al., 2022). Therefore, it is necessary to conduct further literature studies on the use of social media in science learning and the impact obtained for educators and students. This research focused on the distribution of research methods and years, the application of social media in science learning, and the impact of using social media seen from user experience and perception. This literature study can be used to provide recommendations for future research on the use of social media and as a guide for researchers in the appropriate field.

1.1 Research Questions

1. How is social media applied in science learning?
2. How does the use of social media impact science learning?

2. METHOD

This research was conducted to explore the use of social media in the learning process. This type of literature study uses a Systematic Literature Review (SLR) approach. A Systematic literature review adheres to a set of scientific methods that follow standard rules in identifying and synthesizing articles. This aims to limit systematic error (bias) in identifying, assessing, and synthesizing all relevant studies to answer a particular question (Patticrew & Roberts, 2006). This literature study is guided by the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guideline. The PRISMA principle consists of 27 checklists and four flow chart steps to make compiling a quality systematic review and meta-analysis easier. A systematic review is a scientific process governed by explicit rules demonstrating the completeness, immunity from bias, transparency, and accountability of inclusion and exclusion techniques. The source of the data can be accounted for and retrieved based on articles published by Springer, Wiley, and ERIC over the past eight years. The review over the last eight years through these three publishers aims to show the pattern of using social media as a learning medium from year to year in a more accurate and accountable way. The keywords used in the source search are "Social Media Learning" and "Social Media in Science." The stages carried out in the research can be explained in Figure 1.

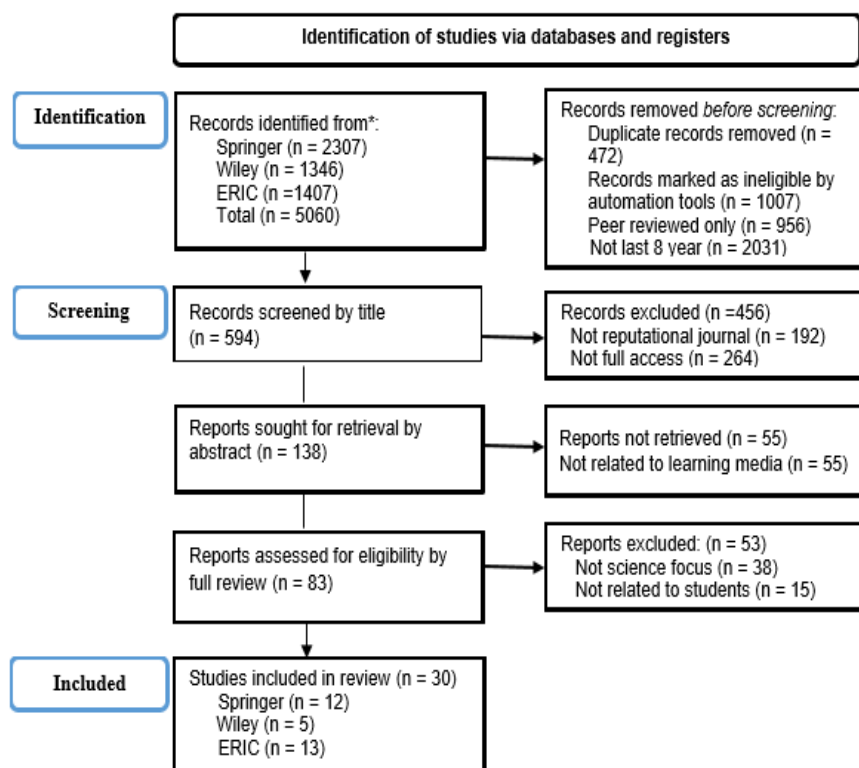


Figure 1 PRISMA flow diagram for systematic reviews

2.1 Identification

This study uses narrative synthesis to review and synthesize findings from articles according to inclusion criteria. The systematic review starts with inclusion criteria and filters relevant sources, then maps and analyzes based on research objectives. Inclusion criteria for identification in this systematic review include (1) no duplication of articles from each database, (2) records marked as eligible by automation tools, (3) peer-reviewed only, and (4) studies that must be published in the last eight years. The data

extraction results are presented in a matrix for evaluation and consideration to produce a conclusion. After obtaining more than 5000 articles, a screening stage for title, abstract, and full paper is carried out.

2.2 Screening

The screening stage consists of several stages: screening by title, abstract, and then full paper. Title screening has criteria such as reputable journals and full access. This is done so that the goods used are of trustworthy quality. Furthermore, it is filtered through an abstract based on research criteria that utilize social media as a learning medium. The last stage is to filter the entire paper with study criteria that focus on science and are related to students. In the screening process, based on the PRISMA guidelines and according to the requirements set, 30 quality articles were obtained that represented the use of social media in science learning.

2.3 Data Analysis

The review process is carried out based on the formulation of the problem and research objectives: i) Explaining the application of social media in science learning and (ii) Knowing the impact of using social media in science learning in terms of user perception and experience. The matrix describes findings regularly, thus facilitating the synthesis of findings. The synthesis of the findings of the literature study provides research conclusions and recommendations. The results of the article selection can be seen in Table 1.

Table 1 Selected articles

No.	Author	Journal Name	Database
1.	Chambers et al.	BMC Medical Education	Springer
2.	Atallah et al.	BMC Medical Education	Springer
3.	Dash et al.	BMC Medical Education	Springer
4.	Cole et al.	BMC Medical Education	Springer
5.	Nti et al.	Journal of Computers in Education	Springer
6.	Rap and Blonder	Journal of Science Education and Technology	Springer
7.	Hasiloglu, et al.	Journal of Science Education and Technology	Springer
8.	Lundgren et al.	Research in Science Education	Springer
9.	Motzko et al.	Medical Science Educator	Springer
10.	Carman et al.	Medical Science Educator	Springer
11.	Essig et al.	Medical Science Educator	Springer
12.	Douglas et al.	Medical Science Educator	Springer
13.	Serpagli, et al.	School Science and Mathematics	Wiley
14.	Ortadeveci et al.	Clinical Anatomy	Wiley
15.	Cathala et al.	Journal of Advanced Nursing	Wiley
16.	Faraji et al.	Nursing Open	Wiley

Table 1 Selected articles (*Continued*)

No.	Author	Journal Name	Database
17	Gilavand, et al.	Health Science Reports	Wiley
18	Salih et al.	Turkish Online Journal of Distance Education	ERIC
19	Rohr et al.	E-learning and Digital Media	ERIC
20	Santaoja	On the Horizon	ERIC
21	Adnan et al.	Asian Journal of University Education	ERIC
22	Kasuma	International Journal of Virtual and Personal Learning Environments	ERIC
23	Setiawan et al.	Journal of Science Learning	ERIC
24	Güler and Hasiloglu	Shanlax International Journal of Education	ERIC
25	Amangeldinovna, et al.	World Journal on Educational Technology: Current Issues	ERIC
26	Mpungose	International Journal of Higher Education	ERIC
27	Kara, Geçer, and Şahin	Athens Journal of Mass Media and Communications	ERIC
28	Stevi and Haryanto	International Technology and Education Journal	ERIC
29	Aydoğmuş, Tut, and Karadağ	International Journal of Psychology and Educational Studies	ERIC
30	Nurhayati, Suryani, and Suharno	Journal of Educational Technology & Online Learning	ERIC

3. result and Discussion

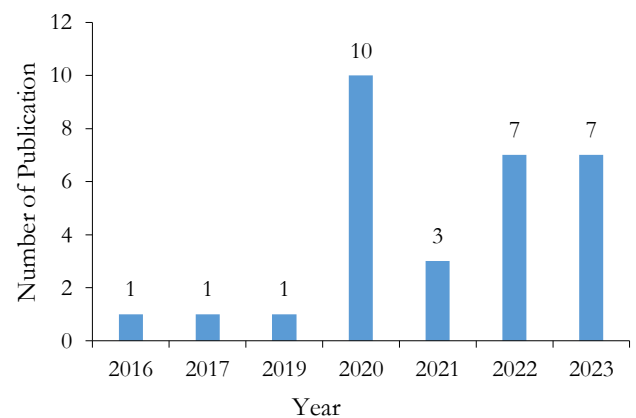
This review literature study obtained 30 eligible articles. This study analyzes and synthesizes articles to find out (i) the application of social media in science learning and (ii) the impact of social media on science learning.

3.1 Implementation of Social Media in Science Learning

This literature review is systematically and comprehensively reviewed to show the application of social media in science learning. This research aims to summarize various latest and relevant research related to the use of social media so that it can provide perspectives for researchers, teachers, and other parties to see the study from various angles. The data analysis carried out is expected to give a new perspective for other researchers to develop research based on the distribution of research that has been analyzed. Furthermore, teachers can use social media to learn more effectively and avoid the negative impact of social media on learning. Research on the use of social media in the world of education is increasingly widespread in various disciplines. The use of social media has begun to grow since the COVID-19 pandemic and has become one of the effective ways to convey information (Sahni & Sharma, 2020). Social media use effectively reaches the public audience and learning (Bardus et al., 2020). Therefore, various studies on the use of social media in the world of education have begun to develop widely.

Research on the use of social media in the world of education begins to develop from year to year. The distribution of this article's publication year can provide an overview of the need for social media in the science learning process every year. More and more articles published show that the use of social media is increasingly recognized for its benefits in the world of education. The findings show that the highest number of publications in 2020 was ten articles, then in 2022 and 2023; research obtained as many as seven articles, in 2021 as many as three

articles, while the lowest number of publications in 2016, 2017, and 2019 was 1 article. A significant increase from 2019 to 2020 shows that social media is widely used in learning. This increase is predicted to be caused by the COVID-19 pandemic, so flexible learning media is needed and can be used in remote learning. Based on the article's year of publication, the research distribution can be shown in Figure 2.

**Figure 2** Statistical data based on year of publication

The COVID-19 pandemic has forced the face-to-face learning system to become online distance learning. At the time of the implementation of lockdowns during the COVID-19 pandemic in 2020, the use of the internet and social media reached an unprecedented peak (Marzouki et al., 2021). Most people get information through digital media (social media) during the lockdown period, so the media strongly influences decision-making (Kaya, 2020). Based on research that has been conducted (Bernadetha, 2020), it has been shown that learning using social media, such as Facebook, Instagram, and YouTube, during the COVID-19 pandemic is effective in conveying theoretical material. Distance learning during the lockdown due to the COVID-19 pandemic utilizes social media through video

conferencing to overcome boredom and stress due to learning at home (Batubara et al., 2021).

The rapid development of technology has caused a shift in learning based on e-learning and m-learning. One of them is the use of social media in science learning. This literature study is focused on the field of science, which has many abstract concepts, so it requires media that can visualize concepts to be more concrete. The field of science is broadly divided into several fields. Most studies show that social media is widely used in general science and health science, with as many as 13 articles. General science is a science that broadly discusses nature. Social media allows many people to learn about nature (Santaoja, 2022). Health science covers all fields of health and medicine. In medicine, many require visualization, as in anatomy, which is more accessible if conveyed through social media (Ortadeveci & Ozden, 2023). Furthermore, in the field of biology, there are as many as two articles, and in chemistry and technology, 1 article each. Distribution data from fields of science that utilize social media as a learning medium can be seen in Figure 3.

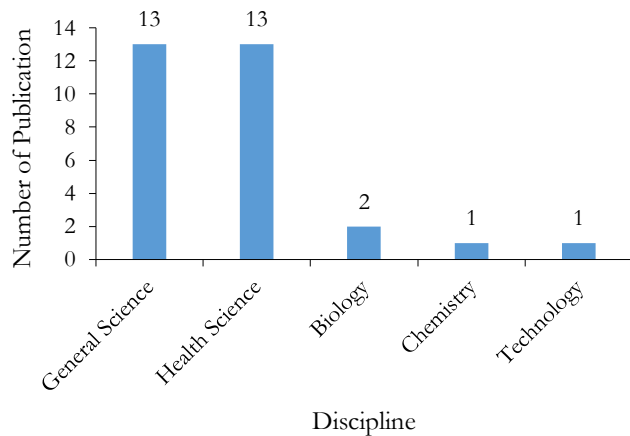


Figure 3 Statistical data based on discipline

In addition to various disciplines, social media is used at different institute levels. Social media is most widely used at the university level, with as many as 20 articles. There were five articles at the senior high school level, then two at vocational high school and elementary school. Studies at the junior high school level only have 1 article. Most studies show that social media is used in learning at the upper level. This is because most social media users are teenagers and young adults. Significant age differences exist in social media use (Güler & Hasiloglu, 2022). In addition, the higher the level of education, the more abstract and conceptual the subject matter is, so it requires media that supports the delivery of concrete information. Learning using social media is one of the alternatives to learning via distance learning since 2020 during the COVID-19 pandemic. In this new learning process, there is a need for in-depth planning, organization, implementation, and

evaluation by both educators and students in order to increase the effectiveness of the teaching and learning process (Batubara et al., 2021). Therefore, using social media as a learning medium is mainly applied at the university level, as shown in Table 2.

Table 2 Statistical data based on level of institute

Level of Education	Number of Publications
Elementary School	2
Junior High School	1
Senior High School	5
Vocational High School	2
University/College	20
Total	30

Social media can be used in the learning process at various levels of education. However, most studies show that the application of social media at the higher education level, especially at the university level, has become a trend over the past few years. The use of social media at lower levels of education is quite effective, but it does not have an optimal impact (Nurhayati et al., 2020; Stevi & Haryanto, 2020). In addition to increasing the effectiveness of the learning process, using social media is also a distraction for students, especially for students at the lower education level. According to Pearson's opinion (Moran et al., 2011), students at the higher education level's ability to utilize social media will further encourage professional development, expand the reach of institutions, and optimize student success. Online learning has become an essential and influential part of delivering learning materials and interacting socially to build an online community. This will make it easier for academics in higher education to share and collaborate without distance and time limitations (Lahiri & Moseley, 2015).

Many social media platforms have developed along with increasingly sophisticated technological developments. Data media is used for academic tasks, socialization, and entertainment (Nti et al., 2022). Some social media platforms widely used by the general public include Instagram, Facebook, YouTube, WhatsApp, and Twitter. Each social media platform has different characteristics and features, so the selection of social media for learning depends on the material presented. In most studies using more than one social media, either studies to compare or collaborate on the use of multiple social media. Figure 3 shows that most studies used more than one social media platform, as many as 16 articles. The use of more than one social media in this study aims to compare the characteristics of social media and the most preferred respondents (Dash et al., 2022). In addition, collaborating on more than one social media is more effective in improving learning outcomes (Carman et al., 2021). The use of social media in learning about antimicrobials can be through quizzes to reduce antibiotic errors, thus impacting behavior and practice (Atallah et al., 2023). Research

(Ortadeveci & Ozden, 2023) shows that the delivery of anatomical content can be conveyed through social media with academic training and management through a team of media experts.

Facebook is a social media widely used as a learning medium because it supports peer-to-peer learning (Chambers et al., 2023); some use Facebook Grub to interact with chemistry learning (Rap & Blonder, 2016). A total of 7 articles showed using Facebook as a learning medium, followed by Instagram with four articles. Instagram's characteristics focus on photos and videos in favor of visual learning for two-way active learning (Douglas et al., 2019). They can show the necessary visuals on dental and anatomical material (Motzko & Dennis, 2023). Instagram can also convey science materials that require histological images (Essig et al., 2020). Instagram Live can also make delivering biology content easier and bring science into everyday life (Serpagli & Mensah, 2021). In addition, they are based on the results of a literature review of WhatsApp, YouTube, and Twitter use in learning 1 article each. WhatsApp is the most popular social media platform. It has the advantage of ease of interaction, allowing study groups to be formed, discussions to be made, and photos and videos to be sent (Gilavand et al., 2023). The findings also show that many students use one-way YouTube channels to acquire new media literacy (Kara et al., 2020). Twitter and Facebook can use the hashtag feature to reach further interactions (Lundgren et al., 2022). Statistical data on the distribution of the type of social media used can be seen in Figure 4.

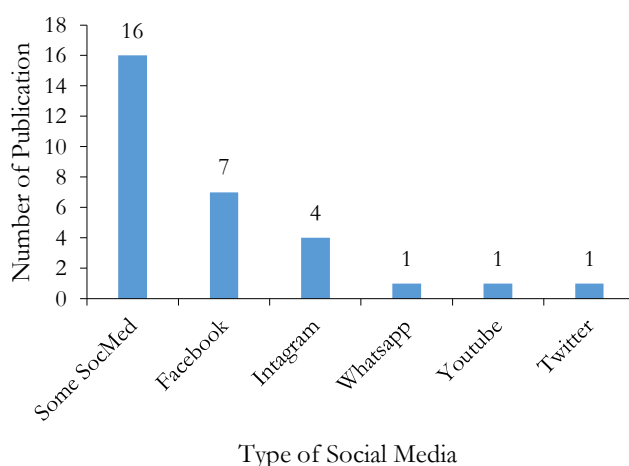


Figure 4 Statistical data based on type of social media

3.2 Impact of Social Media Use in Science Learning

The application of social media in science learning has an impact that can be viewed from respondents' effectiveness, perceptions, and experiences. The impact of using social media can be positive, but some think that social media has a destructive impact on learning. The research results on the use of social media in each study will

differ depending on the research method used. The findings in this study include distribution according to the research method. Based on the 30 articles analyzed, 43% used qualitative research methods, 43% used quantitative research methods, 7% used mixed-method research methods, and 7% used R&D research methods, as shown in Figure 5.

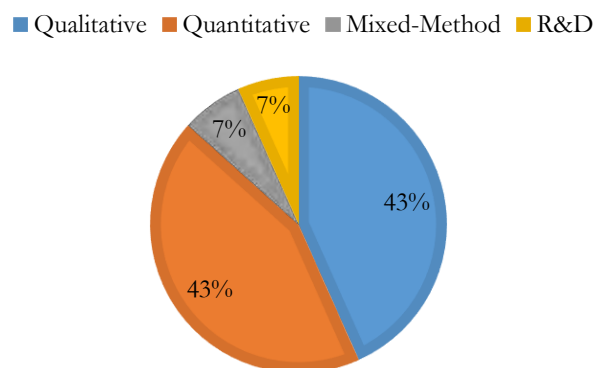


Figure 5 Statistical data based on research method

Most studies use qualitative and quantitative research methods, while only a few use mixed-method and R&D methods. The articles used in this study can use qualitative or quantitative methods because the focus of this study explores the use of social media, which can be seen from the effectiveness and perception of users in the learning process. Based on the analysis of the article, the qualitative and quantitative methods have the same percentage. This study aims to explore respondents' perceptions from qualitative research and determine the effectiveness of social media in learning through quantitative research.

Quantitative research is used to conduct experiential surveys or experiments to determine the effectiveness of social media in science learning. Qualitative research can explore the use of social media based on user perceptions. The R&D research aims to develop a framework for social media applications through a synthesis methodology (Adnan et al., 2020) and develop Instagram media to explain material that requires visualization (Essig et al., 2020). This development research typically requires further testing of effectiveness against the impact of using Instagram. The complete research was carried out with a

Table 3 Quantitative research result: The use of social media

Quantitative Research Result	Number of Publications
Knowledge	5
Literacy	1
Interest and Motivation	5
Communication and Collaboration	2
Student-centered Learning	1
Total	14

mixed method design so that it can find out the use of social media in depth (Motzko & Dennis, 2023) and evaluate in more detail the roles, benefits, and obstacles of each social media (Carman et al., 2021). However, statistical data show that social media positively and effectively improves the quality of learning, as shown in Table 3.

These data were obtained from quantitative studies examining social media use's effectiveness in learning. A total of 6 articles showed that media can increase knowledge, 1 article increased literacy, five articles grew interest and motivation, two articles improved communication and collaboration, and 1 article supported independent learning. Based on the study's result, it was found that media literacy education is relatively weak, and YouTube can be used as a source of new media literacy (Kara et al., 2020). Social media is also beneficial in increasing knowledge (Setiawan & Phillipson, 2020) by utilizing various features, such as Instagram Live, to advance understanding of biology (Serpagli & Mensah, 2021), increasing knowledge of microbial stewardship that is foreign to ordinary people (Atallah et al., 2023). This social media can also improve the standard of living of people with asthma because they can get information more efficiently and flexibly (Faraji et al., 2020). This ease of obtaining knowledge will positively affect learning outcomes and academic performance (Nti et al., 2022). This increase in learning is due to the ease of accessing various materials and discussions on social media (Gilavand et al., 2023).

Another benefit of using social media is the increase in interest, motivation, and activeness of students, as shown in some literature. One of them is using Instagram to make students actively involved and make it easier to deliver material (Essig et al., 2020), increasing motivation to learn complex and abstract material (Ortadeveci & Ozden, 2023). Increasing student motivation in learning will make students more interested and highly interested in participating in the learning process. Social media can make learning activities more interesting so students are actively involved (Salih et al., 2022). Further, social media development can increase interest (Adnan et al., 2020). Studies also show that social media such as WhatsApp and Facebook can improve communication and collaboration skills (Mpungose, 2020). Other studies have shown that the communication skills of children with intellectual disabilities improve with social media (Amangeldinovna et al., 2021). Flexible and ubiquitous social media supports independent, student-centered learning (Cathala et al., 2022). However, there are differences in the effectiveness of social media use shown in science classes that are more positive than those taught in non-science classes (Kasuma, 2021). In addition to the effectiveness of social media use, studies provide insightful perceptions and experiences.

This literature review also analyzes several qualitative studies exploring respondents' perspectives on using social

media in learning. Teachers consider social media as an alternative mechanism to address resource shortages and make a positive impact (Aydoğmuş et al., 2023). Social media makes it easier to exchange views, materials, and experiences (Hasiloglu et al., 2020) and facilitates interaction (Faraji et al., 2020). All platforms support collaborative learning, developing digital literacy, critical assessment skills, and widespread awareness of health issues (Cole et al., 2017). Respondents think that social media helps gather information, network, and collaborate. Social media can provide visualization of abstract and conceptual material to be more concrete (Douglas et al., 2019; Motzko & Dennis, 2023; Nurhayati et al., 2020; Rap & Blonder, 2016; Stevi & Haryanto, 2020). The choice of social media platform to use depends on the age (Guler, 2022) and the level of education of the learner, as well as the features appropriate for the material's content (Carman et al., 2021). The use of social media does have many benefits in the field of education. However, using this platform also requires adequate training to be more optimal (Cole et al., 2017). Several studies reveal that social media is unsuitable for learning (Salih et al., 2022). While the use of social media can increase engagement and ideas, its use can lead to privacy intrusions, misuse of personal data, and the need for the support of other adequate facilities, such as internet services.

5. CONCLUSION

Based on a study of 30 articles, social media can be used as a medium for learning science. Many science materials require visualization, so they will be suitable if learned using social media. Most studies show that social media is used at higher levels, such as university or senior high school. The use of social media in this learning also needs to be adjusted to the characteristics and features of each media. Several types of social media are popular and familiar among learners. These social media include Facebook, Instagram, YouTube, WhatsApp, and Twitter. Findings in the article on the impact of social media on learning show that this platform is effective for increasing knowledge and literacy, interest and motivation, communication and collaboration skills, and student-centered learning (self-centered). Various positive perceptions and experiences from learners also show that social media is an alternative in overcoming the lack of learning resources. The use of social media has shortcomings in terms of privacy and requires further training to be utilized optimally. This paper ends with implications for every educational institution that conducts basic training on media use, especially the use of social media. This can help educators overcome the challenges of integrating the platform with the material's content. In addition, every educational institution is also advised to provide adequate facilities to access this social media, such as adequate internet access. The researcher also suggested that educators provide stricter guidance and

guidance because not everyone can access it and avoid misuse of social media by students. Every institution must also be careful and aware of data that can be abused, so there needs to be preventive measures if they use social media as a learning medium.

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