



The effectiveness of biology learning media in improving high school students' linguistic intelligence towards biology learning outcomes: A literature review

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Abstract. Linguistic intelligence is important in helping students interpret and communicate biological concepts; however, biology learning in schools is still teacher-centered and provides limited verbal stimulation. This study analyzes the effectiveness of biology learning media in enhancing the linguistic intelligence of senior high school students through a Systematic Literature Review (SLR). From 11,000 initial findings in Google Scholar, the screening process resulted in 10 studies that met the criteria because they explicitly measured indicators of linguistic intelligence. The synthesis shows that differentiated modules, MI-based worksheets, e-learning, Quipper School, videos, 3D animations, and flipbooks consistently produce moderate to high effects. Compared with non-digital media such as printed modules and worksheets, digital media (e-learning modules, Quipper School, 3D animated videos, and flipbooks) show more consistent improvements in linguistic indicators related to verbal reasoning and summarization skills. Overall, media aligned with linguistic aspects effectively enhance conceptual understanding, scientific communication, and biology learning outcomes, while also providing practical guidance for designing language-rich biology instruction.

Abstrak. Kecerdasan linguistik penting untuk membantu siswa menafsirkan dan mengkomunikasikan konsep biologi, namun pembelajaran biologi di sekolah masih berpusat pada guru dan kurang memberikan stimulasi verbal. Penelitian ini menganalisis efektivitas media pembelajaran biologi dalam meningkatkan kecerdasan linguistik siswa SMA melalui Systematic Literature Review (SLR). Dari 11.000 temuan awal di Google Scholar, proses penyaringan menghasilkan 10 studi yang memenuhi kriteria karena secara eksplisit mengukur indikator kecerdasan linguistik. Sintesis menunjukkan bahwa modul diferensiasi, LKS berbasis MI, e-learning, Quipper School, video, animasi 3D, dan flipbook konsisten memberikan efek sedang hingga tinggi. Dibandingkan dengan media non-digital seperti modul cetak dan lembar kerja, media digital (modul e-learning, Quipper School, video animasi 3D, dan flipbook) menunjukkan peningkatan yang lebih konsisten dalam indikator linguistik yang terkait dengan kemampuan penalaran verbal dan ringkasan. Secara keseluruhan, media yang selaras dengan aspek linguistik efektif meningkatkan pemahaman konsep, komunikasi ilmiah, dan hasil belajar biologi, serta memberikan panduan praktis untuk merancang pembelajaran biologi yang kaya bahasa.

Received date: 21/11/2025
Accepted date: 31/12/2025
Published date: 06/05/2026

Keyword: learning media; learning outcomes; biology; linguistic intelligence; literature review

Introduction

Education is a fundamental activity for developing students' potential according to their interests and talents, both through formal and non-formal channels (Jufri, 2017). It plays a crucial role in advancing the nation's future generations and is a determining factor in human achievement and productivity in various fields (Yanto, 2022; Anwar, 2015). In learning activities, students not only interact with teachers but also with various learning resources used to achieve learning objectives (Muchtar & Suryani, 2019). Learning is also defined as the interaction between educators and students, which can take place directly (face-to-face) or indirectly through the use of various learning media (Marhamah, 2023).

Every individual possesses intelligence that can be honed and enhanced through education in various environments, including schools, families, and communities (Daswananda & Fathoni, 2024). According to Gardner (in Kelelufna et al., 2021), verbal-linguistic intelligence refers to a person's sensitivity to spoken and written language, the ability to learn languages, and the skill to use language to achieve specific goals. This intelligence includes the effective use of words, both orally (verbal) and in writing.

The advantage of this intelligence is its position as a primary focus that can influence students' learning abilities. This is reinforced by the research of Dewi & Wilany (2019), which states that verbal-linguistic intelligence has been recognized for a long time, even before the existence of other classifications of intelligence.

The concept of linguistic-verbal intelligence is closely related to speaking ability, which is defined as the process of expressing ideas through the use of words and phrases to convey information effectively (Efendi et al., 2023). This intelligence is considered the most fundamental form of intelligence, because through linguistic intelligence, individuals can express feelings effectively, communicate clearly, and are able to remember and relay information that has been heard or observed (Ulwiyah, 2022). In addition, this intelligence also plays a role in developing critical and creative thinking skills, which are very important in facing various challenges in the modern era (Novita et al., 2022).

Based on the description above, it is known that most previous research has focused more on learning outcomes or scientific literacy. In contrast, this study specifically examines the comparative contribution of various learning media to the development of linguistic intelligence in biology learning. Each individual can hone their intelligence through education, including verbal linguistic intelligence, which is characterized by sensitivity to language and the ability to use words effectively. This intelligence has long been recognized as a primary intelligence that influences learning ability, especially because it relates to speaking skills, expressing ideas, remembering information, and supporting the development of critical and creative thinking skills in facing modern challenges.

Therefore, this study aims to systematically review the potential of biology learning media in enhancing linguistic intelligence, to create contextual, meaningful, and relevant biology learning for students. Specifically, this research answers the following questions:

- 1) What are the research and evaluation trends regarding the use of learning media in biology learning that focuses on improving the linguistic intelligence of high school students in the last 10 years?
- 2) To what extent is the use of various types of learning media relevant, and which media are more effective in improving the linguistic intelligence of high school students in the last 10 years, supporting the achievement of biology learning objectives?
- 3) What are the scientific impacts resulting from research on the effectiveness of learning media on linguistic intelligence in biology learning, particularly in enriching the theoretical basis, learning models, and future biology education practices?

The results of this study are expected to provide a theoretical contribution to the development of more innovative Biology learning models and serve as a practical reference for educators in designing effective and meaningful learning.

Research Methods

Methods can be divided into several parts, including:

- 1) Type

This research method uses the Systematic Literature Review (SLR) type, which is a systematic review of a number of scientific articles that discuss a specific topic. This approach utilizes secondary data collected from various recent academic literatures. The focus of the study is directed at which type of linguistic intelligence-based biology teaching media is more influential in improving the learning outcomes of high school students. Data was searched starting from September through the Google Scholar page. The strategy used is a comparative synthesis strategy, namely descriptive research that aims to deeply understand the causal relationship by examining the factors behind the emergence of a

particular phenomenon. This strategy compares two or more groups of a particular variable (Nazir, 2005 in Zayu et al, 2023).

2) Data source and time

The data source in this study was obtained through a search of scientific articles available online using the Google Scholar database as the primary source. Google Scholar can be used as a primary source in SLR because it has broad literature coverage, is easily accessible, and is able to identify various types of publications. The search process was carried out by entering predetermined keywords, resulting in a number of relevant literatures, and limiting the article range to the last 10 years so as not to lose the focus of the study. The article search was conducted in the period from September 25 to September 27, 2025, taking into account the recency and relevance of the article content to the topic of Linguistic Intelligence in the context of improving students' linguistic intelligence towards biology learning outcomes.

3) Data Collection Technique

The data collection technique was carried out by searching for and downloading scientific articles through the Google Scholar page using the keyword "Biology Learning Teaching Media on the Linguistic Intelligence of High School Students". The search process was limited to articles published in the range of 2015 to 2024. The data collection technique continued by collecting key information from each article based on research findings. Furthermore, the data analysis technique used was descriptive analysis. The search process was limited to articles published in the range of 2015 to 2024; this time range was used because of the rapid development of educational technology and digital learning. Selection was carried out based on a number of inclusion and exclusion criteria which included publication in original research form, in Indonesian or English, open access, relevance to the field of biology education, and direct relevance to the topic of Linguistic Intelligence and learning outcomes, as formulated in Table 1 adapted from (Fajeriadi et al., 2024).

Table 1 Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
Electronic database search using Google Scholar	Electronic database searches do not use Google Scholar.
Publications in the last 10 years	Articles from the last 10 years.
Original articles	Review articles.
Articles in English and Indonesian	Publications not in English or Indonesian.
Full access to articles	Open access to all necessary information.
Biology Education	Other fields of study.
Search based on data relevance to the topic discussed	Only articles relevant to the topic.

4) Data analysis techniques

This data was analyzed using *Content Analysis* techniques. Content analysis is a method that combines quantitative and qualitative approaches, reflecting a blend of positivistic and interpretive paradigms. The analysis process began with the use of qualitative data in the form of text, which was then examined based on assumptions or reasoning developed by the researcher. After that, a *coding* process is carried out to systematically group the data, followed by an interpretation stage to produce meaningful descriptions or explanations (Liamputtong, 2005 in Rozali, 2022).

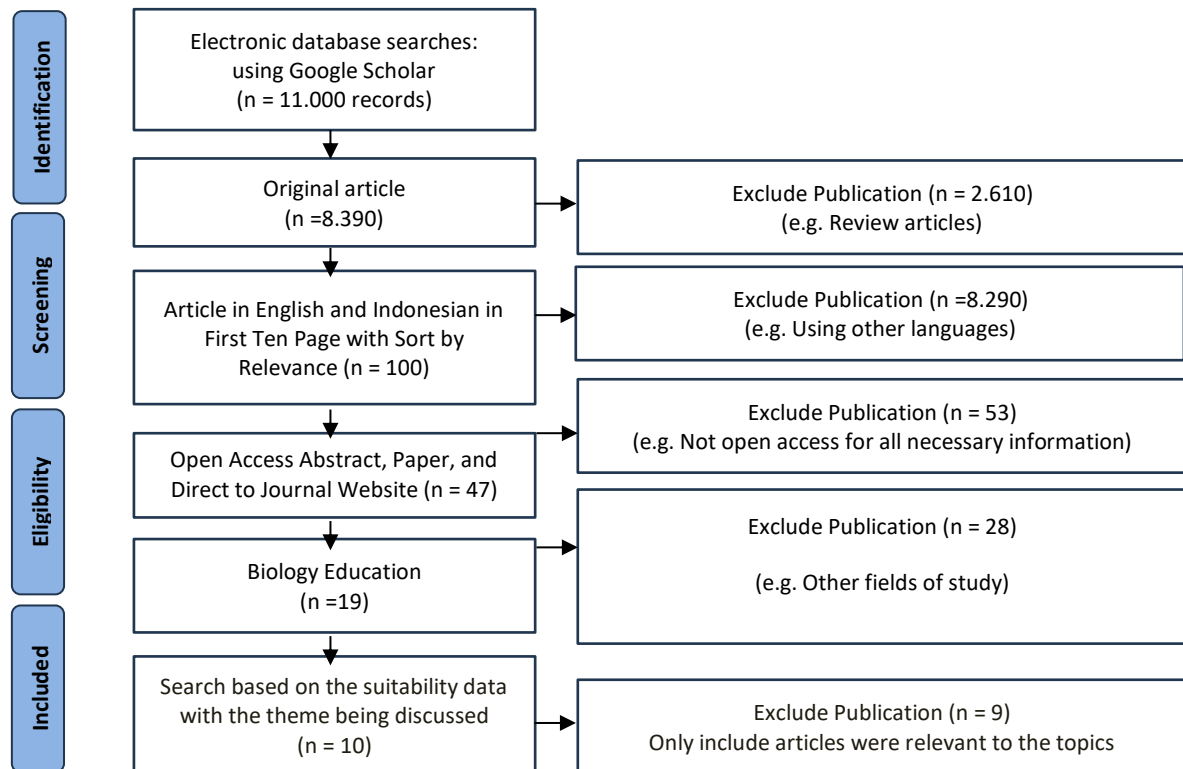


Figure 1 Selection of articles used in SLR using the PRISMA model

Results and Discussion

Based on the data collected, the trend of relevant research publications from 2015 to 2024 shows a rapid increase. In 2015, there were 198 articles, increasing to 294 articles in 2016 and 343 articles in 2017. In 2018, the number increased to 450 articles, then 636 articles in 2019. There was another increase in 2020 with 798 articles, then decreased to 735 articles in 2021. However, this number continued to increase sharply, reaching 1,110 articles in 2022, but then decreased again to 913 articles in 2023. In 2024, it increased again to 1,070. Cumulatively, over the last ten years, the number of articles published reached 6,547 articles.

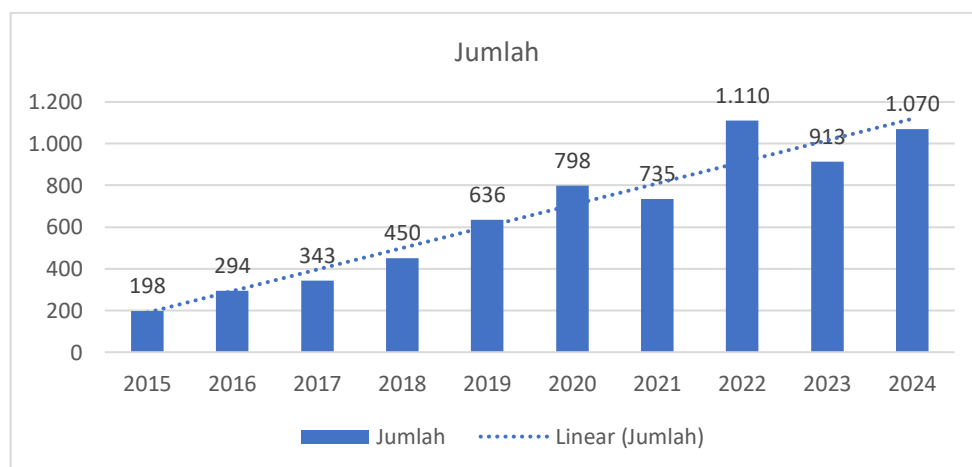


Figure 2 Trend graph for 2015-2024

When analyzed in depth, research publications on linguistic intelligence in biology learning during the period 2015 to 2024 show a fluctuating development pattern but generally show an upward trend. The number of publications was calculated through a selection process consisting of keyword-based searches, manual screening, and meta analytic filtering. The first stage involved entering the keywords learning media, learning outcomes, biology, and linguistic

intelligence into Google Scholar. The second stage involved manual screening, which consisted of reviewing the titles, abstracts, and texts. The final stage was meta analytic filtering, which involved further screening to assess the validity of the article data. Based on the data in Table 2, there were no publications recorded in 2015, then increased to 5 publications in 2016, 9 publications in 2017 and 2018, and continued to increase to 12 publications in 2020. This upward trend reflects the growing interest of researchers in integrating linguistic aspects, particularly verbal skills, scientific argumentation, and science literacy in the Biology learning process.

Table 2 Total of publications on linguistic intelligence research in Biology education from 2015 to 2024

Year	Total
2015	0
2016	5
2017	9
2018	9
2019	11
2020	12
2021	6
2022	10
2023	5
2024	13
Total	80

The trend of increasing publications on linguistic intelligence in biology education shows a fairly dynamic pattern of development, despite experiencing a decline in certain years. However, 2024 saw a significant surge with 13 publications, the highest number during the observation period. This increase can be interpreted as a renewed interest among the scientific community in the role of language in biology education, especially after more and more studies have emphasized that linguistic ability is strongly related to mastery of scientific concepts. Research by Aini *et al.*, (2017) explains that linguistic intelligence has a positive relationship with science learning outcomes. This relationship, although moderate, proves that both oral and written language skills act as key determinants of student success in understanding scientific concepts, which are highly dependent on students' ability to absorb, process, and communicate scientific terminology and principles. Based on the results of a search on Google Scholar using the keywords Linguistic intelligence in biology learning, ten articles published in national journals were selected. The findings from these ten articles are detailed in Table 3.

Table 3 Details of findings from ten articles relevant to the topic

Code	Researcher (Year)	Problem	Media	Findings
A1	Rini <i>et al.</i> , (2024)	Learning tools are not suited to the intelligence characteristics of students	Biology teaching module	Learning completeness increased by 27.3% → 75.8%; improving cognitive, affective, and psychomotor skills
A2	Lestari & Nisa (2018)	LKS has not yet trained student independence & MI	Multiple Intelligences based LKS	Media validation 96.43%, material 84.21%, readability 65.33%
A3	Rahmah <i>et al.</i> , (2024)	Low critical thinking	Differentiated MI Module	N-Gain 0.76; student response 86.85%
A4	Toyyibah & Rachmadiarti (2019)	Learning is still based on memorization	A Biology Textbook based on Multiple Intelligences (environmental changes & waste recycling topics).	Validity score of 3.78; effective in training divergent thinking and linguistic intelligence
A5	Fuadiyah <i>et al.</i> , (2022)	There has been no MI analysis of cell material yet	Biology Learning based on MI	Improving student activity and conceptual understanding (without specifying percentages)

Code	Researcher (Year)	Problem	Media	Findings
A6	Andayani (2017)	Low learning interest & learning outcomes	E-Learning Module based on MI	The e-learning module increases students' interest in optimizing multiple intelligences. The results of the t-test show that $t_{\text{calculated}} = 16.3 > t_{\text{table}} = 1.98$, indicating a significant difference in learning interest between the class using the e-learning module and the class using the textbook.
A7	Handayanti <i>et al.</i> , (2020)	Low learning outcomes	Quipper School	Learning mastery of 81.13%; implementation level of 85.66%; moderate N-gain
A8	Khairani <i>et al.</i> , (2019)	The learning process is less engaging	Educational video	Learning outcomes of 85.30%; student response score of 121; teacher support score of 191
A9	Ferry <i>et al.</i> , (2019)	Low learning outcomes	3D animated video	Learning mastery increased from 55.5% to 88.8%, while the average score rose from 74.94 to 81.27
A10	Wijayanti & Trimulyono (2019)	Genetics is considered an abstract topic	Flipbook MI	Validity of 93.53%; student response of 81.85%; learning mastery of 100%; Multiple Intelligences achievement of 83.33%

An analysis of 10 relevant articles examining the effectiveness of teaching media in biology learning, particularly those focusing on the multiple intelligence approach, shows that the use of integrated media has been proven effective in facilitating the development of students' linguistic intelligence while improving their learning outcomes. The teaching media developed is not only oriented towards knowledge transfer, but also designed to accommodate the diversity of characteristics and intelligence potential of students, which is a major challenge in biology learning. This trend is also in line with the growing interest in research on the integration of learning media that is in harmony with the characteristics of multiple intelligences, especially linguistic, intrapersonal, and interpersonal intelligence, which are the foundation in the process of understanding, interpreting, and conveying information effectively.

Based on the findings, it shows that learning devices based on printed teaching modules (A1, A4, A5) and digital teaching modules (A3, A6) have good results in improving linguistic intelligence in learning. However, digital teaching modules show more consistent improvement in verbal explanation and summarization skills, as reflected in higher N-Gain scores and statistically significant t-values. The selection of appropriate learning media can increase the effectiveness of classroom learning in achieving learning objectives (Kusumawati, 2016 in Anggreani & Satrio, 2022).

In learning based on printed worksheets (A2) and digital teaching media (A7, 10) it was found that digital teaching media, such as Flipbook MI, had a 100% completion rate, 93.53% validity, 81.85% response rate, and 83.33% MI. This can strengthen linguistic abilities and conceptual understanding. The study by Lena & Nurkholis (2024) confirms that digital media such as educational videos, interactive applications, and language based games are able to enrich vocabulary, improve reading skills, and facilitate engaging speaking practice. These findings are reinforced by the study of Vania & Hidayat (2024), which shows that the use of flipbooks enhances students' early reading abilities by fostering enthusiasm and learning motivation.

In learning using instructional videos (A8) and 3D animated videos (A9), both are equally effective in improving students' linguistic intelligence. However, when compared to 3D animated videos (A9), 3D animation shows a stronger impact because it not only improves understanding but also results in a higher learning completion rate, from 55.5% to 88.8%, and strengthens students' ability to explain biological processes in a coherent manner. Thus, 3D animated videos can be considered more effective in developing linguistic intelligence, particularly in terms of structured conceptual explanation.

Based on the media used, most studies used interactive digital teaching media, while the rest used teaching media such as Student Worksheets (LKS) and teaching modules. Digital media offers various advantages, such as the ability to present material in a more interesting and interactive way, which can increase student motivation and engagement in the learning process (Yulianti *et al.*, 2024). This is in line with the findings of a study conducted by Ningrum *et al.*, (2024), which states that the use of technology-based learning media can improve students' conceptual understanding and literacy skills, as students find it easier to understand material that is presented in a more visual and engaging way.

Overall, module-based media, LKS MI, e-learning, videos, 3D animations, and flipbooks have been proven to improve students' abilities in reading, writing, explaining, and discussing, which are indicators of linguistic intelligence development. Thus, learning media not only serve as tools but also as means of systematically and continuously building students' scientific literacy skills. Learning media that can improve students' linguistic intelligence are very much in line with the learning needs of the 21st century, as linguistic intelligence is an important foundation for the ability to interpret scientific information, collaborate through discussion, and convey ideas effectively. Therefore, the application of learning media designed to facilitate verbal linguistic abilities through print modules, MI worksheets, e-learning,

animated videos, and flipbooks can be a sustainable strategy to improve the quality of Biology learning and prepare students to face increasingly complex academic demands and real-world contexts.

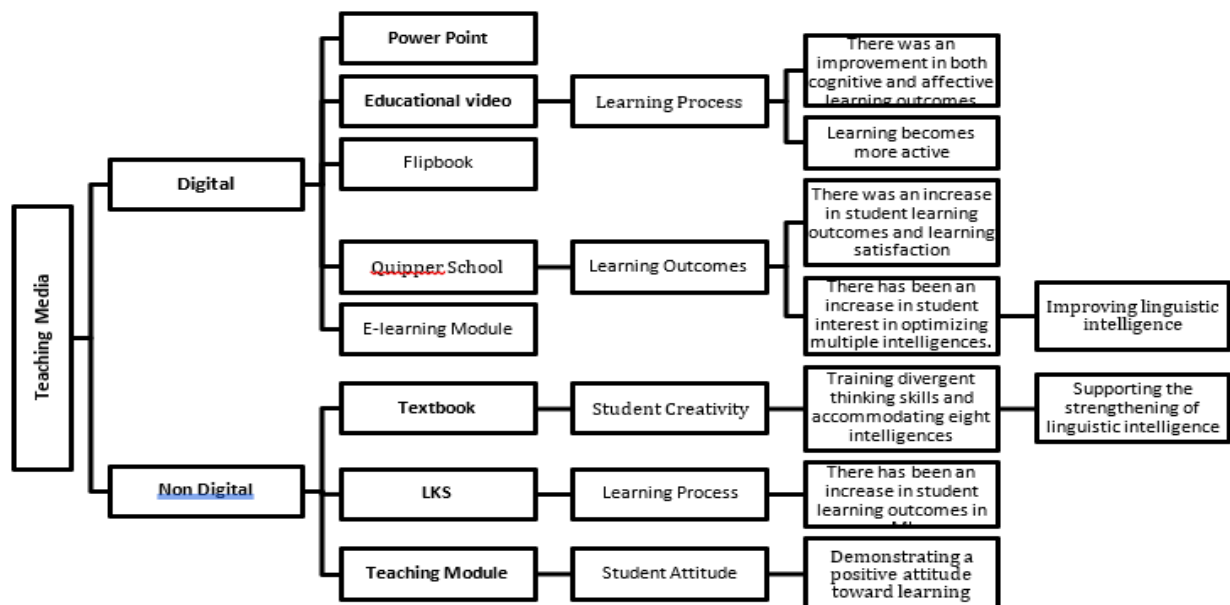


Figure 3 Research Pattern Scheme for linguistic intelligence in biology learning based on analysis of 10 articles

Based on the synthesis of ten articles analyzed and conceptual mapping of the effectiveness of biology teaching media in improving students' linguistic intelligence in learning outcomes, it was found that several biology learning media consistently had a positive impact on optimizing and improving students' linguistic intelligence. Findings from both digital and non-digital teaching media noted an increase in student learning outcomes and creativity. Digital teaching media help improve the learning process because they are able to present material in more attractive visual and audio forms, making it easier for students to understand abstract concepts. Teaching media in non-digital forms also help train divergent thinking skills and accommodate eight intelligences. Recent research on multimedia learning confirms that digital media can improve cognitive learning outcomes as well as affective aspects when designed according to modern learning principles (Mayer, 2024).

Studies in the last decade show that digital platform-assisted learning improves conceptual understanding, facilitates access to learning, and strengthens student interest (Pertiwi *et al.*, 2024). Improvements in student learning outcomes can be aided by utilizing digital-based learning media (Alifah *et al.*, 2023). Student activity during learning can also be measured through the digital media used (Maisarah & Prasetya, 2023). With exposure to varied texts, visuals, and interactions, students are able to discuss and debate issues, as well as express their ideas and thoughts in discussion activities (Priyambodo, 2020).

Non-digital teaching media have an influence on improving learning outcomes, student creativity, and student attitudes. Learning using non-digital teaching media is considered capable of improving linguistic intelligence because it can foster interaction in the form of communication between teachers and students, as well as strengthen students comprehension (Ginting & Harfiani, 2025). In addition to generating student engagement through social interaction, teaching media that does not use digital engagement also generates direct discussion and the formation of a strong learning community (Maghrobi & Hafidz, 2025).

The combination of all these digital and non-digital media effects leads to the strengthening of linguistic intelligence, where students experience improvements in understanding texts, writing coherent answers, and expressing ideas orally and in writing. This strengthening occurs because all media, both digital and non-digital, create a learning environment that demands interpretation, understanding, communication, and language representation, as confirmed by modern science literacy research that the variety of teaching media significantly improves linguistic skills, especially in biology subjects that are full of scientific terms and narratives. Thus, the scheme illustrates that the combination of digital and non-digital media consistently encourages improvements in the learning process, learning outcomes, creativity, and positive attitudes among students. All of these aspects ultimately contribute to the strengthening of linguistic intelligence, a fundamental skill in the successful learning of biology and other subjects.

Conclusion

Based on the synthesis of ten articles analyzed, the use of teaching media in biology learning, both digital and non-digital, has been consistently proven to be effective in improving linguistic intelligence and learning outcomes of high school students. Digital media such as educational videos, 3D animations, Quipper School, e-learning modules, and flipbooks help strengthen conceptual understanding through visualization, narration, and engaging interactions. Meanwhile, non-digital media such as teaching modules, textbooks, and worksheets based on multiple intelligences also stimulate students reading comprehension, scientific writing, argumentation, and communication skills. Among the media reviewed, flipbooks and digital modules demonstrated more comprehensive linguistic benefits than single media such as videos, as they simultaneously supported reading, writing, and verbal pronunciation activities. These findings also have practical implications for teachers and policymakers, namely the need to consciously select teaching media designed to develop linguistic abilities, diversify media use according to student characteristics, and provide facilities and training to encourage linguistic intelligence-based learning innovation so that learning innovation in schools can take place systematically and sustainably. In addition, the use of media that is aligned with linguistic intelligence characteristics has been proven to improve students' verbal abilities in explaining biological concepts, interpreting scientific phenomena, and producing structured scientific language. To strengthen empirical evidence, further research needs to use experimental designs with media variable controls, expand database sources, and examine the long-term impact of media use on linguistic intelligence and biology learning outcomes. Given that this study has limitations related to potential publication bias and variations in literature quality, future research needs to use more diverse methodologies and coverage in order to produce more comprehensive and representative findings.

Acknowledgement

The author would like to express their gratitude to the research funding agency, or research partner if the research was conducted outside the institution, or the research permit issuer. Other than that, it is not necessary to write it in the acknowledgments, or for further explanation, please contact the editor. For students, it is not permitted to acknowledge thesis/dissertation advisors whose names are listed as authors on the first page of the article.

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