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Integrating vlogs into case-based learning: A literature review of innovative biology education for environmental literacy and numeracy

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ABSTRACT

The rapid development of digital technology in the Industrial Revolution 4.0 era has encouraged educational transformation to strengthen 21st-century competencies, particularly environmental literacy and numeracy literacy. However, OECD PISA results indicate that Indonesian students' basic literacy skills remain relatively low. This study aims to systematically review research on the implementation of vlog-based Case-Based Learning (CBL) in biology education and to examine its potential contribution to enhancing environmental and numeracy literacy. This study employed a Systematic Literature Review (SLR) approach combined with qualitative narrative synthesis. Literature was collected from national and international databases, including Google Scholar, Garuda, and Scopus-indexed journals, covering publications from 2019 to 2024. The review process followed sequential stages of identification, duplicate removal, title and abstract screening, and full-text eligibility assessment. From an initial pool of 120 articles, 16 studies met the inclusion criteria and were included in the final analysis. The selected articles were analysed thematically, focusing on five aspects: vlogs as learning media, the implementation of Case-Based Learning, environmental literacy, numeracy, and implementation challenges. The findings indicate that vlog-assisted CBL shows consistent potential to support authentic learning experiences, encourage data-driven discussions, and facilitate students' understanding of environmental issues and numerical information through visual representations such as graphs and tables. This review recommends the development of vlog-based Case-Based Learning designs aligned with the Merdeka Curriculum as a promising instructional approach in biology education and as a foundation for further empirical research.

INTRODUCTION

Indonesia has entered the Industrial Revolution 4.0 era, which has a significant impact on the current development of education. Putriani (2021) States that the relationship between education and the industrial revolution 4.0 requires following rapid technological developments and being able to utilize information and communication technology. However, the rapid development of technology presents new challenges, such as the phenomenon of "clickbait" and the spread of fake information (hoax), which has the potential to reduce literacy skills in society, both in evaluating content and verifying information sources. The government, through the Ministry of Education and Culture, has launched six basic literacies since 2017, including environmental literacy and numeracy literacy, to improve the competence of the younger generation in facing the digital era. However, Rizki (2022) states that based on PISA (2018), Indonesia's numeracy ability was ranked 73rd out of 79 countries with a score of 379, below Thailand (ranked 58th) and Singapore, which was ranked second. Low numeracy literacy is seen in daily life, such as experiencing difficulty calculating change, understanding discounts, or understanding how to read bills with taxes. Even in understanding news information, there are still difficulties, such as income, inflation, and also in personal financial management, so as not to be trapped by online loans, pay later services, and even risks such as online gambling. Yulianti (2021) adds that the environmental literacy level of elementary school students in Indonesia is also relatively low. This is evident from daily behaviors, such as littering, damaging plants, and a lack of awareness regarding organic and inorganic waste management. Therefore, strengthening environmental literacy and numeracy literacy is urgent in the context of science education, especially biology.

Environmental change material in biology learning is considered relevant to building both literacies. The selection of environmental change as a means to improve both literacies is due to its inherent difficulty, as it contains numerical data that needs to be analysed and complex ecological concepts. According to Miterianifa (2024), Environmental literacy can increase students' awareness of environmental issues and enable them to make sustainable decisions. Meanwhile, Haloho (2023) states that numeracy literacy can help individuals understand and process related data, improve critical thinking skills, and support the understanding of complex biological concepts, but in reality, students often have difficulty understanding numerical concepts if they only rely on explanations from the teacher.

The results of the researcher's observations during teaching internships at SMAN 08 Bengkulu City (2019) and during preliminary studies at Lubuk Linggau Nature School (2022) show that teachers have not fully developed digital learning media in biology learning, even though learning has been conducted in a blended online and offline format. The learning media used by teachers are still dominated by textbook sources and the internet, making them less relevant to students' learning needs. During the Covid-19 pandemic, the learning process tended to rely on one side without verifying the accuracy of information and other adequate sources. Access to various online forums widely allows students to get information freely, and sometimes makes the learning discussion process deviate from the main topic.

Therefore, an approach is needed to support the improvement of environmental literacy and numeracy literacy through the use of the case-based learning (CBL) model. This statement is in line with Widyasari (2023), who found that the CBL model helps students solve cases by connecting prior knowledge with various real-life situations, and Dayu (2022) who states that CBL facilitates discussion and cooperation among students in forming a deep understanding. Biology, as a discipline, inherently integrates empirical investigation of living systems with quantitative interpretation of ecological and physiological data, making it particularly relevant for environmental and numeracy literacies because understanding topics such as population dynamics, nutrient cycling, and ecosystem change requires interpreting graphs, tables, and statistical trends. Systematic studies have shown that biology curricula that embed data analysis

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tasks improve students' competence in both interpreting biological phenomena and applying quantitative reasoning in real-world environmental contexts (Husamah et al., 2024; Fauzi & Fadilah, 2024).

Learning media in the 4.0 revolution era are increasingly directed towards digital formats to support the sophistication of technology today. Video learning media can be a choice that supports case-based learning (CBL). As stated by Tasyari et al. (2021), Audiovisual media have great potential in biology learning, but their implementation is still limited. The latest video learning media efforts, such as Video Blog (Vlog), are expected to improve the learning process. Afriyadi et al. (2023) state that vlogs are familiar media for teachers and students and are effective in the learning process.

Research on the application of case-based learning in the context of science, especially with the help of learning videos, is still relatively limited compared to other learning methods. However, some studies have shown that case-based learning has the potential to increase creativity, collaboration, innovation, and critical thinking skills, especially in the field of science. This study recommends the development of vlogs and CBL media in improving environmental literacy and numeracy as a form of 21st-century learning innovation.

METHODS

This study employed a Systematic Literature Review (SLR) approach to identify, screen, and synthesize relevant literature in a structured and transparent manner. To enhance methodological rigor and validity, the article selection process followed a step-by-step procedure adapted from the PRISMA framework, including literature identification, duplicate removal, title and abstract screening, and full-text eligibility assessment. Each stage of the selection process was documented to ensure transparency and traceability, and the overall procedure is summarized using a PRISMA flow diagram. According to Kertamuda (2024), the SLR method allows researchers to conduct a planned literature review to gain a deeper understanding of the research topic. Kitchenham (2004) explains that the SLR procedure involves several stages: (1) Identifying articles through searches in various academic databases, (2) Removing duplicates, (3) Screening titles and abstracts to assess relevance, (4) Reviewing the full text to determine eligibility, and (5) Final inclusion for analysis. Hijriyah (2024) explains that to enhance validity, the article selection process in this study is presented following the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) framework. The PRISMA diagram is used to illustrate the number of articles at each selection stage, from the initial search results to the final number analyzed, thereby ensuring transparency and traceability of the selection process. The process is visualized in the following PRISMA diagram (Figure 1).

Literature Identification

Literature was searched through online academic databases, such as Google Scholar, Garuda, ResearchGate, and Sage Journals. The articles used consist of reputable journals accredited by Sinta or Scopus, seminar proceedings, and published research reports. The keywords used in the literature search were "vlog pembelajaran" (learning vlog), "case-based learning", "literasi lingkungan" (environmental literacy), and "literasi numerasi" (numeracy literacy). Sources included reputable journals accredited by Sinta or indexed in Scopus, seminar proceedings, and published research reports.The initial identification stage yielded n = 120 articles, consisting of: sinta-accredited journals: 45 articles; scopus-indexed journals: 30 articles; seminar proceedings: 25 articles, and research reports/other publications: 20 articles.

Full-text Eligibility Assessment

The eligibility criteria for inclusion were national and international journal articles published between 2019 and 2024, written in Indonesian or English. While for exclusion criteria was articles

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that are not available in full-text, are not relevant to the focus of the review, or are non-journal papers, such as opinions and summaries without data. After removing n= 20 duplicates, n= 100 unique articles remained. Titles and abstracts were screened to ensure relevance to the review's focus on vlog case-based learning (CBL) in biology education and its relation to environmental literacy and numeracy literacy. A total of n = 60 articles were excluded at this stage. At this stage, 60 articles were excluded due to irrelevance, lack of connection to biology education, or absence of environmental/ numeracy content, leaving 40 articles. The remaining n= 40 articles underwent full-text review. For n= 24 were excluded for the following reasons: (1) no description of CBL or vlog implementation, (2) literacy focus aligned with environmental/ numeracy literacy, or (3) opinion/ commentary pieces without empirical data. A total of n= 16 articles met all inclusion criteria and were included in the qualitative synthesis. The analysis focused on five main themes: vlog as a learning medium, CBL model, environmental literacy, numeracy literacy, and challenges in implementing CBL in biology learning.

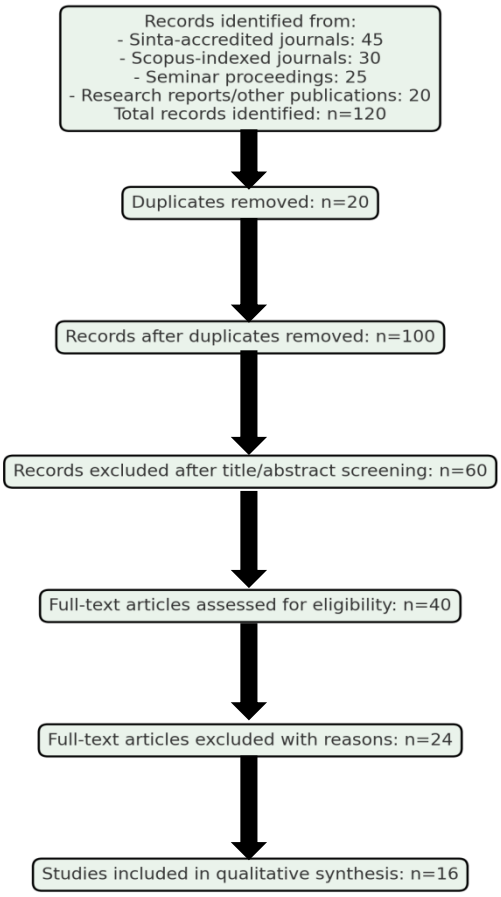

Figure 1. Literature selection process using PRISMA

Comprehensive Qualitative Synthesis

The subsequent stage involved a comprehensive qualitative synthesis of the sixteen articles that met all inclusion criteria. A thematic analysis was conducted to examine the integration of vlogs within CBL and its specific impact on environmental and numeracy literacy. Data extraction focused on identifying patterns and correlations between digital media use and the overall effectiveness of biology instruction. These findings were ultimately synthesized to provide a robust evidence-based recommendations for future biology education research.

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RESULTS AND DISCUSSION

Table 1. Summary of Reviewed Articles

No	Author (Year)	Journal Title	Study Focus	Method	Main Findings
1	Agustin (2022)	*Pengembangan Media Pembelajaran Video menggunakan Vlog pada Materi Pelestarian Lingkungan dan Pembangunan Berkelanjutan.*	Vlog in Biology Learning	Quantitative	Vlogs are effective for increasing student motivation and understanding
2	Cahyo (2023)	*Pengembangan Media Pembelajaran Video Interaktif IPA untuk Meningkatkan Literasi Lingkungan Siswa Sekolah Dasar*	Video Learning in Science Learning	R&D	Video learning is effective in improving environmental literacy skills.
3	Kasmini (2023)	*Pengembagan Media Video Animasi Berbasis Kearifan Lokal untuk Meningkatkan Literasi Lingkungan pada Pembelajaran IPA*	Video Learning to Improve Environmental Literacy	R&D	Video learning development is suitable for improving students' environmental literacy
4	Dhiyazzahra (2023)	Analysis of Case-Based Learning Assisted by Math Song Media on Students' Mathematical Literacy	Case-based learning based on math songs	Experiment	The combination of creative media strengthens case-based learning in improving numeracy literacy
5	Setiawan (2021)	*Efektivitas Penggunaan Video Based Learning pada Pembelajaran Jarak Jauh Pendidikan Anak Usia Dini*	Video for Science learning	Qualitative Study	Video builds environmental awareness in fostering attitudes and skills
6	Winarni (2021)	*Efektivitas Video Pembelajaran Matematika untuk Mendukung Kemampuan Literasi Numerasi dan Digital Siswa*	Video learning for Mathematics learning	Quasi Experiment	Video learning in Mathematics classes is effective in terms of students' numeracy literacy and digital skills

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No	Author (Year)	Journal Title	Study Focus	Method	Main Findings
7	Imawati (2022)	*Pengembangan Video Pembelajaran pada Materi Sistem Organ Pencernaan Manusia untuk Meningkatkan Literasi Sains Siswa Sekolah Dasar*	Learning Videos in Biology learning	R&D	The development of scientific literacy modules based on the digestive system has relevance and internal consistency for developing students' scientific literacy
8	Asmiyunda (2024)	*Integrasi Strategi Belajar Konflik Kognitif pada Bahan Ajar* Digital Case Based Learning *berbantu Video untuk Pembelajaran Mikro*	Video with conflict learning strategies in case-based learning for students	R&D	Digital video teaching materials are valid and suitable for use in micro-lecture processes
9	Alkhotiyah (2024)	The Use of Video-Based Learning with Interactive Quizzes to Foster the Acquisition of English Vocabulary: A Case Study at an English Course in Indonesia	Video with interactive quizzes in English learning	Qualitative Study	Video-based learning with interactive quizzes successfully increased student engagement and motivation in the learning process
10	Marenden (2021)	*Analisis Pengembangan Sumber Belajar Digital Media Video untuk Meningkatkan Mutu SDM Guru melalui Pemanfaatan Teknologi pada Pembelajaran Tatap Muka di Era New Normal*	Creation of digital video media learning resources by teachers in the new normal era	Descriptive	Quite good as a means for teachers to develop themselves and skills in utilizing digital video media learning resources, and improve the quality of teacher human resources in face-to-face learning
11	Wijaya (2024)	*Model Case Based Learning berbantuan Video Kontekstual terhadap Kemampuan Literasi Sains dan Keterampilan Berpikir Kreatif dalam Pembelajaran Fisika*	Contextual video-assisted case-based learning in physics learning subjects	Experiment	Contextual video-assisted case-based learning is effective in improving students' science literacy and critical thinking in physics
12	Utami (2020)	*Perbedaan Hasil Belajar Biologi Siswa pada Penggunaan Media Video dengan Media* Powerpoint *melalui Pembelajaran*	Use of media in online learning	Quasi Experiment	Student learning outcomes taught using audiovisual media are greater than student learning outcomes taught using

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No	Author (Year)	Journal Title	Study Focus	Method	Main Findings
		dalam Jaringan (Daring) di SMAN 3 Mataram tahun ajaran 2020/2021			PowerPoint media. This statement is also supported by previous studies
13	Hidayati (2023)	*Pengaruh Pembelajaran Berbasis Kasus (Case Based Learning) dalam Meningkatkan Kreativitas dan Kemampuan Berpikir Mahasiswa*	Application of CBL in student learning for Public Health Department at Jambi University	Quasi Experiment	The application of the CBL model can improve creativity, thinking skills, and communication skills in the learning process for students
14	Umami (2019)	*Video Blog (VLOG) Sistem Reproduksi sebagai Media Pembelajaran Biologi*	Application of Vlogs on reproductive system material, sub-material dangers, and prevention of free association	R&D	Video (audiovisual) blogs can be played using electronic media to understand free association and analyse the impact of free association from a case
15	Widyasari (2023)	*Analisis Keterlaksanaan dan Aktivitas Siswa Menggunakan Model* Case-Based Learning *pada Materi Pencemaran Lingkungan*	Use of the Case-Based Learning Model on environmental change material	Observation research	The CBL model has a positive impact on student implementation and activities. Students are actively involved in discussion, practice, exercise, and assignment activities during learning
16	Lisa (2023)	Case-based Learning Video and Learning Motivation among Midwifery Students	Case-based learning video on learning motivation among midwifery students	Quasi Experiment	The use of case-based learning videos effectively increased motivation among students

The results of the reviewed articles show that the integration of vlogs in the Case-Based Learning model has a positive impact on increasing environmental literacy and numeracy literacy in biology learning. The findings from 16 articles were analyzed and synthesized into the following five main themes:

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Vlog as Biology Learning Media

Marenden (2021) stated that video is an electronic medium that can combine visual and audio technology. Umami (2019) states that since the appearance of YouTube in 2005, many vlog creators have emerged, especially vlogs that can be used in learning. Thus, teachers need such learning media. Vlogs as digital media are able to increase students' cognitive and affective engagement. Video content that is communicative and contextual helps visualize abstract and complex biological concepts. This is in line with Nunohara (2020), who states that to explore learning based on previous studies, students tend to prefer case-based videos because they consider video modality to be authentic, engaging, and stimulating. Evidence from the reviewed studies demonstrates concrete examples of successful implementation. For instance, Widyasari (2023) reported the use of a vlog presenting a real case of river pollution in environmental pollution topics, where students were required to analyze water quality indicators displayed in the video and discuss their ecological implications. Similarly, Agustin (2022) implemented vlog-based learning on environmental conservation and sustainable development, in which students interpreted visual data related to ecosystem degradation and proposed solution strategies. These studies indicate that vlog-assisted learning can facilitate students' ability to connect biological concepts with real-world environmental data, particularly through the interpretation of graphs, tables, and visual evidence embedded in the videos.

Beyond biology learning, the reviewed studies indicate that vlogs also support the development of cross-disciplinary skills, although the nature of these contributions varies across subject areas. In mathematics and physics education, vlog-assisted learning was predominantly associated with improvements in numeracy-related competencies, particularly students' ability to interpret quantitative representations such as graphs, equations, and data trends (Winarni, 2021; Wijaya, 2024). In contrast, studies conducted in English learning contexts reported that vlogs were more effective in enhancing communicative competencies, including listening comprehension and vocabulary acquisition, through contextual and authentic audiovisual exposure (Alkhotiyah, 2024). In health and midwifery education, vlog-based case presentations primarily functioned as tools to increase learning motivation and contextual understanding of professional practices rather than to strengthen quantitative skills (Lisa, 2023). Compared to these disciplines, biology learning occupies a distinctive position because it integrates both qualitative interpretation of environmental phenomena and quantitative analysis of ecological data. This integration enables vlog-assisted Case-Based Learning in biology to simultaneously support environmental literacy and numeracy literacy, a pattern that appears more limited or domain-specific in non-biology contexts. A comparative analysis of the reviewed articles revealed that while nearly all studies reported improvements in students' skills, the focus of these improvements varied across disciplines. For instance, in mathematics and physics, vlogs were more effective in helping students understand numerical data and graphical representations, whereas in English learning, vlogs were particularly impactful in developing listening and speaking skills through authentic scientific contexts. In health education, vlogs proved effective in raising awareness of healthy lifestyle behaviors through real-life case studies.

Case-Based Learning Model in Biology Learning

Kurniawan (2022) states that Case-Based Learning is a constructivist learning approach where problems are presented in case-based learning. The CBL model allows students to develop critical thinking and problem-solving skills through real-case analysis. The situations presented in CBL must be relevant to students' daily experiences, so the connection between CBL learning and its benefits in students' lives becomes clear.

In the context of biology learning, cases related to local environmental issues such as pollution, climate change, and deforestation have proven effective in increasing students' awareness and understanding. Based on the table of reviewed articles, the case-based learning model can improve skills useful in everyday life, such as critical thinking skills, student

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motivation, environmental literacy, numeracy literacy, digital skills, creativity, and student activeness in the learning process.

Strengthening Environmental Literacy and Numeracy in Vlog Case-Based Learning

Environmental literacy is formed through understanding issues, involvement in problem analysis, and solution creation. This is in line with Patrisiana (2020), who states that environmental literacy-based learning is an individual's knowledge and understanding of aspects that build the environment, principles that occur in the environment, and are applied in daily life. Vlog case-based learning can encourage students to explore environmental issues through visual narratives, providing space for reflection and creativity towards environmental concern.

Meanwhile, numeracy literacy, according to Ekowati (2018), is the ability and knowledge to use various types of numbers and symbols related to basic mathematics. This ability is used to analyze information data in the form of tables, graphs, charts, and results of data analysis interpretation, so that the data can be used as an estimation in decision-making. Students are trained to read, interpret, and present numerical data in their vlogs, such as temperature change graphs and population data. Numeracy literacy encourages students to increase their interest or participation with full attention and pleasure to learn subjects, especially Biology. Thus, environmental literacy is strengthened through observation of real cases in vlogs, while numeracy increases through the presentation of data in the form of graphs and numbers.

Challenges and Opportunities for Implementation

Based on the reviewed studies, the implementation of vlog-assisted Case-Based Learning is constrained by several recurring challenges, including unequal technological infrastructure, limited teacher readiness in managing digital and case-based instruction, and insufficient training in vlog production. However, the literature consistently indicates that these constraints can be mitigated through careful instructional planning, collaborative teacher practices, and supportive school policies. Studies conducted in contexts with adequate institutional support report more effective integration of vlog media, particularly when vlog development is aligned with curriculum goals and assessment strategies. Accordingly, vlog-based CBL can be regarded as a promising instructional approach for 21st-century biology education when implemented within a supportive ecosystem that combines infrastructure readiness, teacher capacity building, and policy alignment.

CONCLUSION

Based on the results of the literature review, it can be concluded that the Case-Based Learning model assisted by vlog media demonstrates consistent potential to strengthen students' environmental literacy and numeracy literacy in biology learning. Evidence from the reviewed studies indicates that vlog-assisted CBL has been implemented effectively in contexts such as environmental pollution topics, where students analyzed river water quality indicators, and environmental change topics, where learners interpreted air quality or population data presented through visual representations in videos. These implementations suggest that vlog-based cases can support contextual and problem-oriented learning by linking biological concepts with real environmental data. The use of digital media that is familiar to students further supports active learning, critical discussion, and data-informed reasoning, which are essential components of 21st-century competencies. Therefore, this review recommends the development of vlog-assisted Case-Based Learning designs that are aligned with the Merdeka Curriculum, particularly for biology topics that require field observation, data interpretation, and environmental decision-making. Future research is encouraged to employ experimental or mixed-method approaches to empirically examine the effectiveness of this model across different educational levels and biological contexts, such as ecosystem analysis, biodiversity monitoring, and environmental impact assessment through vlog-based case presentations.

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