



Teachers' Needs Analysis of Video as a Project-Oriented Chemistry Learning Media Integrated with Sustainable Development Issues for Global Warming and Climate Change Topics

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ABSTRACT

Objective: This study aims to analyze the needs of high school chemistry teachers in developing project-oriented instructional videos integrated with Sustainable Development Issues (SDIs), especially in the context of teaching global warming and climate change. These topics are multidisciplinary and require not only conceptual understanding but also contextual application, aligning with the goals of the Merdeka Curriculum and 21st-century education. **Method:** This research employed a qualitative approach using an exploratory survey method. Data were collected through a semi-open questionnaire adapted from Rothwell et al. (2015), distributed to ten high school chemistry teachers in Yogyakarta. The data were analyzed thematically using two-stage coding to identify patterns and key themes from teacher responses. **Results:** The findings indicate that teachers have a strong understanding of the Merdeka Curriculum, learning media, instructional videos, SDGs, and project-based learning. However, challenges persist, especially in integrating SDGs and PjBL due to limited experience, lack of suitable video resources, and time constraints. Teachers expressed the need for chemistry learning videos with attractive visuals, contextual relevance, a duration of 6–10 minutes, and additional features such as quizzes and relatable illustrations. **Novelty:** This research highlights a specific gap in available educational resources by addressing the practical needs of teachers for effective video-based project learning tools integrated with sustainability issues. It provides a foundation for developing relevant, accessible, and pedagogically sound media to support chemistry education aligned with SDGs.

INTRODUCTION

The rapid development of the modern era is a dynamic process that continuously affects various sectors of life, including education (Najib & Maunah, 2022). The 21st-century education landscape presents both new challenges and opportunities for schools to prepare individuals for future demands (Varas et al., 2023). Educational institutions are required to equip students with essential competencies such as critical and creative thinking, collaboration, and social-emotional skills. The need for students to develop adaptability and resilience has become more prominent, considering the rapid changes in global society. Positive attitudes such as motivation, perseverance, and self-efficacy must also be fostered to support lifelong learning and personal growth (Azmi, 2020). These demands are especially relevant to chemistry education, where abstract disciplinary knowledge must increasingly be connected to contextual and societal challenges.

One of the challenges in education is teaching chemistry at the senior high school level. In this context, the demand to foster 21st-century competencies makes chemistry learning more challenging, as students are expected not only to understand abstract concepts but also to apply them in meaningful real-world situations. Chemistry involves abstract and

hierarchical concepts that are difficult for students to master through conventional methods (Nusi et al., 2021). Among the materials requiring deeper understanding are global warming and climate change, which are multidisciplinary and directly related to real-life phenomena (Lestari, 2023). Compared with many other abstract chemistry topics, global warming and climate change require students to connect particulate-level chemical processes with atmospheric systems, environmental data, and human activities, making them conceptually and contextually more demanding. These topics fall under Sustainable Development Issues (SDIs), closely linked to the Sustainable Development Goals (SDGs). Thus, the challenge of learning chemistry extends beyond conceptual understanding to helping students interpret scientific issues that are directly related to sustainability. Therefore, students need not only scientific knowledge but also awareness of sustainability and environmental impact (United Nations, 2015; Wissinger et al., 2021).

Sustainable education emphasizes not only knowledge but also the development of values and behaviours that support ecological balance (Lasaiba, 2023). Addressing global warming and climate change is crucial because these issues pose serious threats to the environment, economy, and public health (Choirunisa et al., 2023). In this context, chemistry education is strategically positioned to address SDIs and SDGs because it explains the transformation of matter and energy underlying emissions, atmospheric reactions, material use, waste generation, and sustainable technologies (Wissinger et al., 2021). Consequently, learning models that actively involve students in solving real-world problems are needed. For this reason, pedagogical approaches in chemistry education should not only deliver scientific content but also engage students in designing solutions to sustainability-related problems. Project-Based Learning (PjBL) is one of the most relevant approaches (Cörvers et al., 2016; Poya, 2026).

Among the pedagogical approaches that align with these needs, PjBL is especially relevant because it enhances students' problem-solving abilities through collaborative and product-oriented activities (Arifianti, 2020). Solida & Amir (2023) demonstrated that PjBL significantly improves students' problem-solving skills. Furthermore, PjBL can reinforce sustainability concepts when integrated with digital media. Ulfa et al. (2023) developed a PjBL-based e-module with high validity and practicality, receiving positive responses from students. According to Wicaksana et al. (2022), PjBL involves students in identifying problems, designing solutions, and creating final products, fostering critical and creative thinking. This project orientation makes PjBL particularly suitable for sustainability-oriented chemistry topics because, compared with problem-based learning, which mainly emphasizes problem analysis and solution discussion, and inquiry-based learning, which focuses more on investigation and knowledge construction, PjBL culminates in the creation of tangible products or contextual solutions. This is particularly relevant for global warming and climate change topics, where students are expected not only to understand environmental problems but also to design chemistry-related responses that can be applied in real-life contexts (Kokotsaki et al., 2016; Wicaksana et al., 2022).

Instructional videos are an effective medium to support PjBL in chemistry learning. Videos allow students to revisit complex materials at their own pace, enhancing comprehension (Hamida & Desnita, 2020). They also provide cognitive flexibility and can include interactive features such as quizzes to increase engagement (Nasution et al., 2024; Noetel et al., 2021). When aligned with project tasks, instructional videos can support problem identification through contextual cases, project planning through procedural

guidance, project execution through demonstrations, and reflection through replayable documentation and prompts (Sabolic et al., 2021). However, teachers often face challenges in integrating instructional videos into project-oriented chemistry learning, especially when embedding SDG-related content.

Existing instructional videos generally support conceptual explanation, demonstration, and engagement, but they are rarely designed to scaffold project phases while explicitly integrating sustainability frameworks in chemistry learning (Sabolic et al., 2021). This limitation is also reflected more broadly in the literature on digital learning media, which tends to emphasize content delivery and video design principles rather than the integration of project-based pedagogy with sustainability-oriented chemistry instruction (Aydin Gunbatar et al., 2025; Fiorella, 2021). As a result, teachers still face difficulties in locating or developing videos that align with the Merdeka Curriculum and simultaneously support PjBL and SDG-oriented instruction (Mellyzar et al., 2025; Nabilah & Hardeli, 2025). This gap is pedagogically significant because, without such media, chemistry learning risks remaining content-focused rather than guiding students to investigate sustainability problems and develop contextual solutions (Poya, 2026).

This study aims to analyze the needs of senior high school chemistry teachers in developing project-oriented instructional videos integrated with Sustainable Development Issues (SDIs), particularly in teaching global warming and climate change. The findings will serve as the basis for designing relevant and accessible media that support both student learning and teacher facilitation of project-based, sustainability-oriented instruction. Beyond providing a practical basis for media development, this needs analysis contributes empirical evidence on teachers' pedagogical and media needs and offers a conceptual foundation for designing sustainability-oriented digital media in chemistry education. It also clarifies how digital media can support chemistry learning that connects conceptual understanding, project work, and sustainability-oriented practice.

RESEARCH METHOD

General Background

This study employed a qualitative exploratory survey design because the primary aim was to identify teachers' needs and to map the gap between theoretical expectations and practical implementation in chemistry learning. At this stage, a qualitative approach was considered more suitable than a quantitative survey because the study sought to capture the diversity of teachers' understandings, experiences, and constraints rather than to test hypotheses or generalize findings to a larger population (Jansen, 2010; Mudjiyanto, 2018). In this study, the theoretical expectations referred to the principles of the Merdeka Curriculum, SDG integration, and Project-Based Learning (PjBL), whereas practical implementation referred to teachers' reported classroom practices, media use, prior implementation experiences, and perceived barriers in the field. The aim of this study was to describe the gap between theoretical understanding and practical implementation in the field regarding the Merdeka Curriculum, which is oriented toward project-based learning and integrated with Sustainable Development Issues (SDIs), particularly in chemistry education.

Sample

The research data were collected from senior high school (SMA/MA) chemistry teachers in Yogyakarta. Assuming the participants were selected based on their relevance to the research focus, this study used purposive sampling to recruit information-rich participants, namely chemistry teachers who were directly involved in classroom instruction and therefore able to report their experiences related to curriculum implementation, learning media, SDG integration, and PjBL practices (Palinkas et al., 2015). The total number of participants was ten chemistry teachers from public and private high schools in Yogyakarta. This sample size was considered appropriate for an exploratory qualitative study because the purpose was to obtain varied and in-depth insights rather than statistical representativeness or generalization (Vasileiou et al., 2018). Therefore, the findings should be interpreted as exploratory insights into teachers' needs within the Yogyakarta context.

The demographic details of participants included gender, years of teaching experience, experience in developing learning videos, and prior implementation of SDGs and project-based learning. These participant characteristics were included not only to describe the sample but also to support the interpretation of differences in teachers' needs, readiness, and implementation challenges. For example, teaching experience and prior exposure to video development, SDG integration, and PjBL helped contextualize variations in perceived barriers and expectations. The demographic characteristics of the participants can be seen in Table 1.

Table 1. Participant demographics

Variable	Category	Frequency	Percentage (%)
Gender	Male	3	30%
	Female	7	70%
Years of Teaching Experience	< 5 years	1	10%
	5–10 years	3	30%
	> 10 years	6	60%
Experience in Developing Learning Videos	Yes	2	20%
	No	8	80%
Experience Integrating SDGs into Teaching	Yes	3	30%
	No	7	70%
Experience Applying Project-Based Learning	Yes	4	40%
	No	6	60%

Instrument and Procedures

The data were collected using a semi-open-ended questionnaire that was adapted from Rothwell (2015). The questionnaire consisted of 30 items that explored teachers' needs regarding the use of videos as a medium for project-based chemistry learning integrated with Sustainable Development Issues (SDIs), specifically on the topic of global warming and climate change. The questionnaires were distributed through both offline and online means. Offline distribution was conducted in schools, while online distribution was conducted via WhatsApp links. Participants answered the questions based on their real teaching experiences and current challenges. Some questions were open-ended, while others were closed-ended to ensure clarity and consistency in responses.

Before distribution, the questionnaire was reviewed by the academic supervisor in chemistry education to assess the relevance, clarity, and alignment of the items with the study objectives. Because this study was exploratory and used a semi-open-ended questionnaire, the review focused on content appropriateness and clarity of wording rather than formal psychometric validation. Permission to conduct the survey was obtained from the participating schools prior to data collection. Participation was voluntary, and participants were informed about the purpose of the study before completing the questionnaire. Informed consent was obtained from all participants. To protect confidentiality, participant identities were anonymized during analysis and reporting.

Data Analysis

The responses were analyzed using thematic analysis following Braun & Clarke (2006) six-phase framework, namely familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. In the first-level coding, meaningful units in teachers' responses were labeled using descriptive codes. In the second-level coding, related codes were grouped into broader categories and themes to identify recurring patterns across responses. For example, a response such as "the video should be interesting and related to daily life" was initially coded as "attractive visuals" and "contextual relevance," which were then grouped into the broader theme of "preferred characteristics of instructional videos." Themes were refined through repeated comparison across responses and through researcher discussion to improve interpretive clarity and consistency (Braun & Clarke, 2006; Nowell et al., 2017). This analysis was intended to identify the gap between theoretical expectations and practical implementation, where theoretical expectations referred to the principles of the Merdeka Curriculum, SDG integration, and PjBL, while practical implementation referred to teachers' reported practices, implementation barriers, and media-related needs in classroom settings.

RESULTS AND DISCUSSION

Results

This stage of questionnaire distribution to teachers served as the initial phase of the development research to identify the needs of teachers in supporting the chemistry learning process in the classroom. The findings of this needs analysis were used as the foundation for developing project-oriented instructional videos integrated with Sustainable Development Issues (SDIs), particularly for the topic of global warming and climate change. Because this study was exploratory and involved a small number of participants, the percentages presented in this section are used only for descriptive clarity rather than for statistical generalization. The results of the teacher needs analysis, based on questionnaires completed by ten senior high school chemistry teachers, are presented in Table 2.

Table 2. Teacher needs analysis results

Indicators	Results
Assessment of Current Status	
<ul style="list-style-type: none"> Understanding of the Merdeka Curriculum Understanding of learning media Understanding of instructional videos Understanding of SDGs Understanding of project-based learning 	<ul style="list-style-type: none"> 70% of teachers understood the Merdeka Curriculum because it had been implemented in their schools. 30% had not understood it yet because their schools had not implemented it. Teachers explained that the media help simplify material delivery. Teachers stated that videos can be self-made or accessed from platforms such as YouTube or Rumah Belajar. 90% of teachers understood SDGs as global agendas that can be integrated into chemistry learning. 10% did not, due to a lack of integration in previous lessons. 100% of teachers understood PjBL as collaborative activities resulting in a product.
What Should Ideally Happen	
<ul style="list-style-type: none"> Theoretical view of the Merdeka Curriculum Theoretical view of learning media Theoretical view of instructional videos Theoretical view of SDGs Theoretical view of project-based learning 	<ul style="list-style-type: none"> The curriculum is designed to meet student needs and connect to real-life contexts. Effective media should be engaging, easy to use, and goal-oriented. Videos should be accessible, contextually integrated, concise, and equipped with relevant illustrations. SDGs are sustainability frameworks that can be integrated into chemistry education. PjBL encourages students to develop innovative ideas in response to real-world problems.
Gap Between Current Practice and Ideal Conditions	
<ul style="list-style-type: none"> Barriers to implementing the Merdeka Curriculum Barriers in using learning media to support the curriculum Barriers in integrating SDGs into chemistry teaching Barriers in implementing project-based learning 	<ul style="list-style-type: none"> 40% experienced difficulties; 60% had not, either due to non-implementation or smooth teaching flow. 80% had used video media but encountered issues; 20% had not used them due to curriculum limitations. 30% had done so with obstacles; 70% had not due to lack of materials or curriculum implementation. 40% had used PjBL with challenges; 60% had not due to preference for other models or lack of curriculum use.
Importance of the Gaps	
<ul style="list-style-type: none"> Importance of videos for curriculum implementation Importance of videos for integrating SDGs 	<ul style="list-style-type: none"> 100% agreed that instructional videos are important in supporting the Merdeka Curriculum. 100% agreed that videos are important for demonstrating SDG integration.

Indicators	Results
<ul style="list-style-type: none"> Importance of videos for integrating project-based learning 	<ul style="list-style-type: none"> 100% agreed that videos are crucial for illustrating project-based chemistry learning.
Knowledge/Skill/Attitude Gap	
<ul style="list-style-type: none"> Experience using general instructional videos Experience using videos related to curriculum, PjBL, and SDGs Experience in developing such videos 	<ul style="list-style-type: none"> 100% of teachers had used videos aligned with their learning goals. 50% had experience; 50% had not, due to implementation barriers. 20% had developed videos; 80% had not, due to time and skill limitations.
Feasible Solutions	
<ul style="list-style-type: none"> Desired video format Desired video content Preferred video duration Suitable delivery platforms Accessibility expectations 	<ul style="list-style-type: none"> Teachers requested animated, interactive, and infographic video formats. Teachers preferred videos with attractive visuals, contextual links to SDGs, and integrated quizzes. 6–10 minutes. YouTube, Instagram, Google Drive, and others. Easy access and Gen Z–friendly design.

Table 2 shows three major patterns. First, most teachers demonstrated a basic understanding of the Merdeka Curriculum, SDGs, PjBL, and the general function of instructional videos, indicating that the conceptual foundation for innovation was already present. Second, the most prominent gaps were found not in conceptual awareness but in practical implementation, especially in integrating SDGs into chemistry teaching, applying PjBL consistently, and developing instructional videos that align with these demands. Third, the most urgent teacher needs were directed toward accessible and engaging videos that are concise, visually attractive, contextually linked to SDGs, and supported by interactive features such as quizzes. These findings suggest that the main challenge lies in bridging teachers' existing conceptual understanding with practical media and pedagogical support for implementation.

Discussion

The findings of this study highlight the significance of the Merdeka Curriculum in improving the quality of education in Indonesia. The majority of teachers (70%) are familiar with the Merdeka Curriculum due to its implementation in schools, while the remaining 30% have not yet adopted it. This finding aligns with Mantra et al. (2022), who emphasize the importance of curricular changes for teaching and learning. Furthermore, the importance of teacher training is underscored by Wibawa et al. (2022), who report that interactive workshops significantly improve teachers' motivation to implement the Merdeka Curriculum. Therefore, more intensive and widespread training programs are recommended to ensure the success of this new educational paradigm.

The Merdeka Curriculum grants teachers the flexibility to differentiate instruction based on student capabilities and local contexts (Barlian et al., 2022). This flexibility supports students' meaningful learning experiences, as emphasized by the Minister of Education, Nadiem Makarim. However, implementation challenges remain. About 40% of teachers reported difficulties, particularly in planning differentiated instruction due to time constraints and lack of teaching resources, especially in overcrowded classrooms (Yuliani & Pujiastuti, 2023). In addition, difficulties in reading learning outcomes and aligning content with the curriculum goals were observed (Suryani & Maida, 2023). Meanwhile, 60% of teachers did not report difficulties, likely because the curriculum had not been implemented yet or due to adequate school infrastructure and preparation (Ihsan, 2022).

In terms of teaching media, teachers agree on the importance of media tailored to students' needs. Technological learning media are favored for improving content delivery (Rahmi & Samsudi, 2020), with visual, audio, and audiovisual forms offering varied modalities for student engagement (Suprianto, 2020). Effective media must be easy to use, engaging, and aligned with learning objectives (Karisma & Hendratno, 2022). It also aligns with the learning preferences commonly associated with Generation Z students, who tend to prefer visually engaging, interactive, and technology-mediated learning materials. In this study, these preferences are reflected in the teacher-identified needs in Table 2, namely attractive visuals, interactive elements, contextual illustrations, concise duration, and easy accessibility as key characteristics of instructional videos. These features are consistent with the visual, interactive, and technology-mediated learning preferences commonly associated with Generation Z students (Hernandez-de-Menendez et al., 2020; Shorey et al., 2021).

Among the different media, video-based learning emerged as a preferred tool, particularly when accessed via YouTube. Approximately 90% of teachers use YouTube videos to aid in instruction (Mardhiyah et al., 2023), mostly as introductory tools. Research by Lutfi et al. (2019) confirms the effectiveness of game-based video learning in chemistry. These videos not only support learning but also offer replayability and cognitive flexibility (Noetel et al., 2021). However, teachers face challenges such as finding relevant videos or editing them to suit their lesson content (Ramadhina & Rohman, 2022), as well as managing time constraints and increasing interactivity (El Shaban & Egbert, 2018). Professional development in media integration is thus crucial. The integration of Sustainable Development Goals (SDGs) into the curriculum, especially in chemistry, is promising but challenging. Teachers (90%) understand SDGs and recognize their relevance to chemistry, which closely relates to global issues such as climate change. This disciplinary relevance is important because chemistry conceptually underpins sustainability issues related to energy transformation, climate processes, material production and use, waste management, and resource efficiency (Wissinger et al., 2021). Studies support collaborative teaching methods to address such topics effectively (Carman et al., 2021). Nonetheless, limited learning resources and time constraints hinder full integration (Astuti et al., 2021; Husain et al., 2023). Thus, more resources and practical strategies are needed to bridge chemistry content and sustainability principles.

Project-Based Learning (PjBL) provides a potential solution to the challenges of implementing the Merdeka Curriculum and integrating SDGs because it encourages students to engage actively in solving contextual problems and producing meaningful

outputs. Teachers also appreciate its potential to develop creativity and active engagement (Yuniarti et al., 2021). However, Teacher readiness for PjBL should be understood as variable rather than uniform. Although this study did not compare teachers based on teaching experience or prior exposure to PjBL, previous studies indicate that these factors shape teachers' perceptions of its feasibility and implementation challenges, especially in project design, time allocation, and classroom management (Farrow et al., 2022; Haatainen & Aksela, 2021; Markula & Aksela, 2022). This variation may help explain why some teachers viewed PjBL as feasible, whereas 40% of those who had implemented it still reported difficulties in project design and time management (Nugrohadi & Anwar, 2022; Sunaryo et al., 2023). These findings indicate the need for additional training and resources to support PjBL in chemistry instruction.

To address these gaps, this study proposes the development of project-oriented instructional videos integrated with SDGs. While 100% of teachers have experience using instructional videos, only half have used them in the context of Merdeka Curriculum, PjBL, or SDGs. Furthermore, only 20% of teachers have developed their own videos due to time constraints. Unlike general instructional videos, which mainly support explanation, demonstration, and content review, project-oriented instructional videos can more explicitly scaffold key PjBL phases and activities, including problem identification, project planning, execution, revision, and reflection, while embedding sustainability-related contexts into chemistry learning (Hinostroza et al., 2025; Sablic et al., 2021; Wan et al., 2024). As supported by Muchtar et al. (2022), video media provide contextual learning opportunities that transcend spatial and temporal limitations. Research by Lugiati (2020) also indicates that project-oriented videos significantly improve student learning outcomes. Building on this rationale, this study contributes a needs-based foundation for designing chemistry instructional videos that are both project-oriented and integrated with SDGs. Specifically, it identifies the pedagogical, contextual, and design features needed by teachers to support the Merdeka Curriculum, PjBL implementation, and sustainability-oriented chemistry learning.

Teachers prefer video formats that include animation, infographics, interactive elements, and contextually relevant illustrations (Mega et al., 2019). Videos should be between 6–10 minutes long, with engaging design and embedded quizzes. According to Kusmaryati et al. (2022), short, animated videos increase student knowledge and reduce boredom. YouTube was the most recommended platform due to its accessibility and flexibility (Salsabila et al., 2023) (Salsabila et al., 2023). This study has several limitations. First, the findings were derived from a relatively small number of teachers in one regional context, so they should be interpreted as exploratory rather than representative. Second, the analysis relied on self-reported responses, which may not fully reflect actual classroom practices. Third, because the study focused on needs analysis, it did not include classroom observation or implementation trials of the proposed instructional videos. Future research should focus on developing instructional videos that meet these criteria to improve the quality of chemistry education and support the realization of SDGs.

CONCLUSION

Fundamental Finding: In the 21st-century education landscape, integrating sustainable development issues into secondary school chemistry has become increasingly crucial. Project-oriented instructional videos show strong potential to enhance learning quality. Teachers acknowledge the significance of the Merdeka Curriculum, educational media, instructional videos, SDGs, and project-based learning, although implementation challenges remain. **Implication:** The development of project-based learning videos that integrate sustainability issues can support both student needs and teacher empowerment, ultimately improving the relevance and quality of chemistry instruction. **Limitation:** This study did not include classroom trials or in-depth teacher training evaluations, and the integration of SDGs remains mostly conceptual at this stage. **Future Research:** Future studies should focus on developing, implementing, and evaluating project-oriented instructional videos that meaningfully embed SDGs into chemistry lessons. Research could also explore effective strategies for teacher support and curriculum alignment.

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