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EDUCATION CLASSES FOR PRE-SERVICE TEACHERS USING TEXT-VIDEO-BASED AI

Sejun Oh

Abstract. *Climate change and sustainability pose abstract, interdisciplinary challenges that demand innovative pedagogy. This study aimed to examine how generative text-to-video (TTV) tools influence pre-service teachers' lesson-planning competencies and what educational values and affordances pre-service teachers attribute to the technology. A convergent mixed-methods design was employed with 34 pre-service teachers. Quantitative pre- and post-surveys measuring 18 competencies revealed statistically significant gains in 17 items; five exhibited large effects (e.g., d = 1.01 for selecting instructional materials). Qualitative thematic analysis of group-designed lessons identified four recurrent themes: enhanced creativity, stronger curriculum alignment, heightened student engagement, and differentiated use of TTV for diverse learners. Participants valued TTV's capacity to visualize complex processes, reduce cognitive load, and integrate multiple subjects around climate issues. The converged findings demonstrate that TTV makes abstract content more tangible and motivates learners while expanding teachers' design repertoires. These results offer an empirical foundation for incorporating TTV into teacher-education programmes and suggest directions for future research on scalable, ethically grounded AI applications in education.*

Keywords: *Text-to-Video AI, educational design, pre-service teacher education, educational technology*

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Introduction

With the development of artificial intelligence (AI) technology, the educational environment is changing. AI tools used in education can be classified according to input and output data. Text-to-text AI generates text using large language models and is used as an AI tutor to answer students' questions and enables customized learning (Abas et al., 2023; Denny et al., 2024; Xu et al., 2023). When text is input, the image-generating models have helped visualize abstract concepts (Ali et al., 2023; Brisco et al., 2023) and have added a powerful pictorial layer to teaching.

Text-to-video (TTV) technology autonomously generates high-quality video content with only text input. This process represents a significant advancement in educational technology, operating through a sophisticated natural language understanding and visual synthesis process. Researchers have combined natural language processing (NLP) and computer vision technology to translate textual information into visual elements (Liu et al., 2023; Singh, 2023; Wang et al., 2023a; Wang et al., 2024; Zhou et al., 2024). Advances in TTV technology have gone from simple image generation to sound-combined video production. Deep learning and generative adversarial networks (GANs) have made these advances possible. Currently, TTV technology has efficiently generated customized video content in various fields, such as education and marketing, expanding its applicability. Singh (2024) has emphasized that TTV technology can be utilized in multiple domains.

Related research for generating high-performance videos is being actively conducted. For example, ModelScope T2V has maintained consistency between video frames using a spatial block (Wang et al., 2023a). Meanwhile, MicroCinema has improved the quality of videos by presenting a two-step process of generating videos after generating images from text using a divide-and-conquer method (Wang et al., 2024). OpenAI's Sora, Google's Image Video, and Meta's Make-A-Video are leading the development of TTV technologies. These tools provide a user-friendly interface for easy application in various fields, including education. Sora is drawing attention for its ability to generate high-resolution videos, accurately interpret complex textual information, and express it visually.

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Video-based technologies like TTV help create learning materials and support creative expression. Studies (e.g., Oktaviani, 2022; Zhang et al., 2024) have shown that video-based education improves student engagement and understanding. TTV converts text into videos, which helps students understand abstract concepts and complex information. TTV use in education increases student engagement and helps with complex topics. Video-based technologies also help students with special needs or in specific environments. For example, MARU video tutorials have supported students with hearing impairments (Oktaviani, 2022). TTV provides customized content for different learning styles. Teachers can create engaging video materials, and students can make their videos, encouraging imagination and creativity. Singh (2024) has argued that this practice supports personalized and interactive learning.

Huang (2018) has indicated that AI not only bolsters students' knowledge of environmental issues but also positively shapes their attitudes. Nonetheless, scholars have cautioned that AI use demands vigilance regarding bias and inaccuracy (Alamäki et al., 2024; Atkins et al., 2024; Denny et al., 2023; Leal et al., 2024). Atkins et al. (2024) have noted that tools such as ChatGPT, although beneficial for climate literacy, must be applied carefully to avoid hallucination or misinformation. Effective AI integration, therefore, requires preventing misinformation while fostering critical thinking.

As AI technology plays an increasingly important role in education, pre-service teachers need to develop AI literacy and develop their ability to use these tools effectively. Generative AI supports pre-service teachers to improve lesson-design and produce dynamic learning materials. Using TTV technology, teachers can visualize abstract objects and explain them easily. TTV helps pre-service teachers present complex concepts clearly and interestingly. It is advantageous for education related to life, which considers real-life contexts. Mathematics, in particular, can be learned by inducing students' voluntary motives when connected to life. Mathematical knowledge is also needed to analyze climate, environment, and population problems often encountered in real life, but understanding topics is also essential. For inexperienced students, predicting and presenting real-life situations by artificial intelligence will be a way to increase creativity. However, teachers should be aware of the ethical issues caused by using AI in their classrooms. Floridi et al. (2018) have argued that educators must understand and apply AI responsibly. Students may lose their power to think if they use AI unconditionally. It is time for education to utilize AI effectively. Zhai et al. (2021) have discussed how AI can reshape teaching methods, emphasizing that tools will play an essential role in the future of education. Despite these advantages, challenges such as ensuring the accuracy of content, solving ethical issues, and managing technical limitations remain. For AI to be introduced responsibly and effectively into education, problems such as authenticating AI-generated content, dealing with copyright issues, and protecting student data must be carefully managed.

Although interest in generative AI for education has grown, there is a notable gap in the literature when it comes to TTV applications in teaching. While many studies have examined AI tutors and teacher-created video resources, almost none have systematically investigated how pre-service teachers integrate TTV into lesson design. By focusing on this under-explored intersection, the present study extended the conversation on AI in education to a modality that blended textual, visual, and temporal representations. Therefore, the problem that motivated this study was the absence of empirically grounded guidance that helped pre-service teachers transform textual descriptions of dynamic environmental processes into effective, time-based educational materials. Against this backdrop, the study aimed to determine how integrating TTV tools influenced the lesson-planning competences of future educators who teach topics related to climate and sustainability.

To achieve this aim, this research addressed the following questions:

RQ1. How did a TTV-supported intervention influence pre-service teachers' lesson-design competencies?
RQ2. What educational values and affordances did pre-service teachers attribute to TTV technology?

Research Methodology

Background

This study, which adopted an exploratory mixed-methods design, combined a one-group pre-/post-survey (quantitative strand) with in-depth analyses of collaborative lesson-design artefacts (qualitative strand). The convergent structure allowed the researchers to compare numeric shifts in competence with contextual evidence that illustrated how those shifts emerged.

This research was carried out from May 2024 to November 2024, a six-month period during which participants completed training, design, and reflection cycles. The ADDIE model (Analysis → Design → Development → Implementation → Evaluation) served as the educational framework that guided each phase.

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Participants

Lancaster et al. (2004) have recommended that single-group studies include at least 30 participants to obtain stable variance estimates and to test study logistics; the present study's sample of 34 met this threshold. Creswell and Poth (2018) have reported that doctoral-level qualitative studies commonly involve approximately 20–40 participants (median = 28). Although this benchmark is not prescriptive, it offers a useful point of reference when the qualitative strand dominates an exploratory mixed-methods design. Methodological guides for pilot mixed-methods work likewise have noted that samples in the low-to-mid thirties can be adequate when data richness and iterative analysis are prioritized. Patton (2002) has stressed that saturation depends not only on sample size but also on information richness and the scope of analysis; the researcher has shown that many educational studies achieve meaningful saturation with samples in the twenties when data depth is adequate. Hertzog (2008), however, has suggested that 25–40 participants per group are advisable to detect medium effects with adequate statistical power, implying that the present study's total of 34 was practical for a single-group pre-post design but would be insufficient for a two-group comparison. Taken together, these sources indicate that the present study's $N = 34$ represented a reasonable compromise, large enough to identify preliminary quantitative trends and to generate robust qualitative themes, yet compact enough for in-depth exploratory analysis. Future studies seeking stronger statistical power or broader generalizability should expand the sample accordingly.

TTV Tool: Vrew

Vrew[1]—an AI platform that converts text prompts into narrated video clips—was selected because it offers rapid subtitle generation, voice-over synthesis, and basic editing that help educators produce educational videos quickly. Although its customization options are limited, its low entry barrier made it suitable for an exploratory trial.

Design

For this study, lesson plan templates and educational models incorporating TTV were developed through collaborative discussions with in-service teachers (currently pursuing master's and doctoral degrees) across five subject areas: Korean Language, Mathematics, Science, Social Studies, and Art. Based on this foundation, the research design proceeded as follows. The first session introduced TTV technology and included hands-on practice. In the second session, groups utilized TTV to create lesson plans and produce videos. The third session focused on sharing group lessons and refining them through peer feedback.

1) Pre- and Post-Surveys

Pre- and post-surveys were conducted using a systematically developed assessment tool to evaluate changes in lesson-design competency. The assessment tool demonstrated high reliability (Cronbach's α: pre=.938, post=.968). Drawing on the TPACK dimensions operationalized by Lachner et al. (2021) and the indicators synthesized by Rodríguez Moreno et al. (2019), these constructs were reorganized into six lesson-design competency areas—subject-matter expertise, pedagogical design, technology integration, student engagement, learning-environment development, and professional reflection—and the survey items were adapted to fit the TTV educational context. The final assessment tool comprised 18 items measuring six essential dimensions: subject matter expertise, pedagogical design, technology integration, student engagement, learning environment development, and professional reflection. This approach enabled evaluation of the intervention's impact on participants.

2) Group Lesson Design Activities

In the qualitative research component, participants were divided into groups of 3-4 people for collaborative lesson design using TTV technology. This structured group-based approach facilitated in-depth examination through multiple data collection methods, including systematic observation of collaborative processes, documentation of TTV implementation strategies, and analysis of group interactions. Participants selected topics using Generative AI and were provided with recommended materials. Integrating Generative AI in content development and material selection offered opportunities to observe how pre-service teachers navigated and utilized emerging technolo-

1 Vrew is available at https://vrew.ai/ko/

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gies in educational contexts. Smolansky et al. (2023) have emphasized that cooperative activities promote critical thinking and creativity, which are vital in promoting educational innovation.

Procedure

This research was conducted from May to November 2024, following a systematic process incorporating analysis of existing practices, development of new methodologies, and comprehensive evaluation. The detailed procedure is shown in Figure 1

Figure 1
The study follows a structured procedure

No.	Steps	Detailed information
1	Literature Review & Expert Analysis	Analysis of current practices by in-service teachers • Evaluation of TTV application possibilities in education • Review of existing teaching materials and methods
2	Educational Model Development	Expert review by in-service teachers in 5 subject areas • Development of TTV-integrated teaching model • Validation of educational design frameworks
3	Pre-Survey	Initial assessment of participants' existing lesson-design competency
4	TTV Technology Training	Provision of foundational training in TTV technology and guidance on its application in lesson design
5	Group Lesson Design Activities	Implementation of validated teaching models • Integration of subject-specific TTV applications • Production of educational materials using TTV
6	Post-Survey	Evaluation of changes in lesson-design competency following the lesson design process
7	Data Analysis	Evaluation of lesson plans by mathematics education experts with over ten years of experience. Comprehensive analysis of collected data to assess the impact of TTV technology on lesson-design competency, followed by the formulation of conclusions.

The research process was designed to build upon existing educational standards and practices while incorporating innovative TTV technology. While direct comparative analysis with other TTV-based educational studies was limited due to the novelty of the technology, the results were evaluated against established pedagogical frameworks for teaching-material development and lesson-design effectiveness. This study's teaching and learning algorithm followed the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), adapted specifically for TTV integration in educational contexts. Pre- and post-surveys were administered. Participants were explained about TTV technology and practiced. Each group was asked to design classes using TTV. Additionally, mathematics education experts with over ten years of experience independently analyzed the lesson plans using a standardized rubric. Their evaluations contributed to a deeper understanding of the pedagogical effectiveness and coherence of the lesson plans. This approach aimed to evaluate how TTV technology affects the teaching competence of pre-service teachers.

Data Collection and Analysis Methods

The pre-and post-surveys employed a comprehensive assessment framework measuring multiple dimensions of teaching design competency. A quantitative analysis was conducted that used both t-tests and Cohen's *d* effect size, thereby ensuring a systematic and comprehensive approach to data evaluation. The first analytical section was devoted to the quantitative examination of changes in lesson-design competency, as identified through the surveys. The "Pre-Service Teacher Lesson-Design Competency Assessment Tool" was employed; it evaluated specific subcategories of lesson-design competency, including the utilization of educational materials, development of lesson plans, motivation of students, adaptation of content to diverse learning levels, and reflection on teaching practices. These competencies were selected because they play a critical role in enhancing the pedagogical effectiveness of pre-service teachers. Each item was rated on a 5-point Likert scale (1 = strongly disagree, … 5 = strongly agree).

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For quantitative analysis, the study employed two complementary statistical approaches. First, t-tests were applied to determine statistical significance, given the study's matched pre-post design and continuous dependent variables. A p-value of .05 or less was used as the threshold for statistical significance; this level is widely adopted because it balances the risks of false positives with sensitivity to meaningful effects. Second, Cohen's *d* effect sizes were calculated to assess practical significance, enable comparison with similar studies, and identify the most meaningful improvements in teaching competencies. This dual approach provided both statistical- and practical-significance information.

Drawing on the six-phase thematic-analysis procedure of Braun and Clarke (2006), the researchers confined each group's artefacts to a single self-selected educational topic—treating that topic as a bounded data set defined by the study's analytic interest—and then applied an iterative coding-to-theme cycle. Generative-AI use was documented during the activities. When the results were presented for each group, participants were asked which stages of lesson design had involved generative AI, why it had been used, and what they had learned from it.

To complement the quantitative survey data, mathematics educators independently reviewed each group's lesson plan. Each expert applied the evaluation framework detailed in Appendix A, focusing on aspects such as learning objectives, pedagogical organization, TTV integration, and assessment clarity. They submitted written evaluations separately, ensuring an unbiased appraisal of the lesson designs. Discrepancies or convergent themes in their evaluations were synthesized so that common strengths—such as the innovative use of TTV for engaging students—and notable challenges, including the need for more precise assessment rubrics and careful selection of AI tools, might be identified. Vital to this study was the expert evaluation, which added a crucial qualitative perspective and thus enhanced the depth and reliability of the findings.

Comprehensive insights into how TTV technology affects lesson-design capabilities were provided by this mixed-methods approach. That the combination of quantitative and qualitative methods strengthened the study's validity despite the limited sample size cannot be overstated. That mixed research methods are best suited for investigating complex educational problems is further emphasized by Creswell and Poth (2018).

Research Results

Changes in Lesson-Design Competency

The study examined changes in pre-service teachers' lesson-design competency after implementing TTV technology, employing a pre-post survey design with robust reliability measures (pre-survey Cronbach's α = .938, post-survey Cronbach's α = .968). To evaluate the practical significance of the intervention beyond mere statistical significance, Cohen's *d* effect sizes were calculated, following established practices in educational research. This approach aligns with recent educational studies that have successfully used Cohen's *d* to quantify the impact of innovative teaching interventions (Delos et al., 2024)

The decision to use Cohen's $d \geq 0.8$ as a threshold for identifying significant educational impacts is supported by comparable educational technology studies. For instance, research by Wee et al. (2015) on computer-based learning tools in physics education has shown similar effect sizes ($d = 0.79 \pm 0.23$) when implementing new educational technologies. Additionally, O'Regan et al. (2023), examining the impact of innovative teaching methods on graduate capabilities, have demonstrated comparable effect sizes ($d = 0.89$) for educational interventions.

Table 1
Pre- and post-surveys Comparison of Lesson-design competency(N=34).

Items	Pre-surveys *M*	Post-surveys *M*	*M* Difference	*t*-Statistic	*p*-value	Cohen's *d*
Ability to understand subject area and expertise	3.82	4.26	0.44	2.99	.0052	0.68
Ability to analyze and reorganize curriculum content	4.09	4.38	0.29	2.15	.0392	0.5
Ability to design lessons using effective teaching materials	3.88	4.47	0.59	4.18	.0002	0.84
Ability to establish teaching strategies for learners and objectives	3.97	4.44	0.47	3.88	.0005	0.76

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Items	Pre-surveys *M*	Post-surveys *M*	*M* Difference	*t*-Statistic	*p*-value	Cohen's *d*
Ability to analyze and reconstruct content for learners	4.03	4.47	0.44	3.9	.0005	0.74
Ability to create effective lesson plans	3.97	4.53	0.56	3.51	.0013	0.81
Ability to select or develop educational materials	3.82	4.56	0.74	4.6	.0001	1.01
Ability to organize lessons according to student level	4	4.53	0.53	5.02	.0001	0.81
Ability to design lessons following analysis-design-development-implementation-evaluation	3.74	4.29	0.56	3.79	.0006	0.78
Ability to self-evaluate voice, tone, and pace during teaching	4.15	4.47	0.32	3.2	.003	0.43
Ability to evaluate and reflect on my teaching.	4.12	4.5	0.38	4.04	.0003	0.61
Ability to reflect on words and actions as a teacher	4.29	4.59	0.29	3.27	.0025	0.52
Ability to build positive relationships with students	4.5	4.71	0.21	2.23	.0326	0.33
Ability to build rapport for students to easily seek help	4.53	4.65	0.12	1.44	.1604	0.19
Ability to use positive language in student interactions	4.41	4.68	0.26	2.32	.0267	0.44
Ability to ask questions to keep students focused during class	4.03	4.56	0.53	4.13	.0002	0.74
Ability to motivate students to learn.	4	4.47	0.47	4.46	.0001	0.6
Ability to create a learning environment	4.06	4.62	0.56	4.62	.0001	0.83

Note:1. Shaded cells indicate Cohen's *d* values ≥ 0.8, representing large effect sizes .
2. According to common guidelines, Cohen's *d* = 0.2 denotes a small effect, 0.5 a medium effect, and 0.8 or above a large effect.
3. A total of 18 items were measured, 17 of which showed statistically significant improvement ($p < .05$). Table 2 lists the items with the greatest gains; values with $p < .05$ appear in bold.

The results show broad improvements across most measured competencies, with all but one item (ability to build rapport for students to seek help easily, $p = .1604$) showing statistically significant improvements ($p < .05$). More importantly, several competencies demonstrated large effect sizes ($d \geq 0.8$), indicating substantial practical significance. This analytical approach follows similar methodologies used in recent studies O'Regan et al., 2023), where effect sizes are increasingly recognized as crucial indicators of practical significance in educational interventions, particularly when evaluating new teaching technologies and methods.

By focusing on items with Cohen's $d \geq 0.8$, the analysis identified those areas where TTV technology had the most substantial practical impact on pre-service teachers' competencies, providing valuable insights for future teacher education programs and technology integration strategies. This analytical approach follows the precedent of Delos et al. (2024), where effect sizes were used to evaluate the practical significance of educational innovations and interventions in teacher training programs.

The ability to select and develop educational materials demonstrated the most significant improvement, rising from 3.82 to 4.56 ($t(33) = 4.60$, $p < .0001$) with the highest effect size among measured competencies ($d = 1.01$). Pre-service teachers showed efforts to use TTV technology aligned with lesson-design intentions during lessons' introduction, development, and conclusion stages. Instead of using AI-recommended video scripts, participants adapted the content to reflect mathematical knowledge. Additionally, participants utilized various features of Vrew, including video creation, automatic subtitle generation, and voice synthesis, to produce educational content.

The ability to foster an effective learning environment improved significantly from 4.06 to 4.62 ($t(33) = 4.62$, $p < .0001$, $d = 0.83$). Pre-service teachers designed lessons using TTV in the motivation phase to capture attention on the topic. participants employed TTV to illustrate the importance of climate and sustainability over time, enabling students to engage deeply with the subject matter through intrinsic motivation

The ability to design lessons using effective educational materials showed a notable increase from 3.88 to 4.47 ($t(33) = 4.18$, $p < .0001$, $d = 0.84$). Pre-service teachers designed lessons addressing climate change and sustainable development topics utilizing TTV. While not all groups used TTV at every stage (introduction, development,

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and conclusion), participants strategically integrated it based on lesson objectives. For instance, some groups used TTV for motivational purposes, others for visualizing mathematical modeling results during the development phase, and others in the conclusion phase to predict future scenarios using AI. These approaches align with pre-planned lesson designs informed by expert consultations with five teachers.

The ability to create effective lesson plans improved from 3.97 to 4.53 ($t(33) = 3.51$, $p = .0013$, $d = 0.81$). Pre-service teachers enhanced their skills in drafting lesson plans incorporating TTV technology. During group design activities, participants engaged in in-depth discussions, drafted lesson plans integrating TTV at relevant stages, and iteratively refined them by generating videos and receiving peer feedback. It was the collaborative approach to lesson design that contributed significantly to developing effective lesson plans through TTV.

The ability to adapt lessons to student levels improved from 4.00 to 4.53 ($t(33) = 5.02$, $p < .0001$, $d = 0.81$). Demonstrated by pre-service teachers were concerted efforts to customize TTV-generated content to suit varying student needs. Tailored during group activities were TTV materials that aligned with students' diverse learning achievements and styles. For example, while some groups used TTV to explore topics such as climate change and sustainable development, it was others that focused on delivering mathematical knowledge more effectively. These efforts reflect a strong commitment to personalizing learning experiences for a wide range of educational needs.

The following insights can be drawn from the quantitative analysis. First, the ability to plan lessons and utilize materials effectively using TTV has improved, enabling the realization of tailored education for students with diverse learning styles.

Second, the ability to critically reflect on and adjust teaching practices using technology-driven insights aligned with current educational standards that emphasize continuous professional development. These findings point to the potential for TTV technology to be integrated into teacher training programs to prepare educators for modern, technology-rich classrooms.

Although statistically and practically significant improvements were observed in five core competencies, the results should be interpreted within the context of pre-service teacher education; generalization to other settings requires caution. More research with larger and more diverse samples is warranted to confirm these effects in varied educational environments.

Emergent Themes in Lesson Design

Beyond the pre- and post-survey data (see Table 1), the quantitative gains were triangulated with an independent expert review of each lesson plan. Mathematics education specialists, each with over a decade of teaching and curriculum-development experience, applied the criteria listed in Appendix A to assess every group's lesson plan or educational use-case proposal. Classes designed by pre-service teachers focused on topics such as climate change, environmental protection, and sustainability. The analysis confirmed the consistency between the creativity of lesson-design and learning goals.

1) Evaluation of Creativity and Originality in Lesson Design

TTV technology stimulates imagination by visualizing abstract objects, especially in climate change education. This practice reflects the strongest survey gain—"select or develop educational materials," which rose by 0.74 points ($t(33) = 4.60$, $p < .0001$, $d = 1.01$). For example, a group analyzed climate data using mathematics and expressed it as a visual graph based on this. Based on this result, a video was produced to predict climate change using TTV. The climate of 2050 was predicted using mathematics and artificial intelligence. Visualizing these prediction results made it possible to link the meaning of numbers with life. This creative visualization can help students connect with their lives and increase their participation. Other groups designed project classes using tools such as ChatGPT and Vrew in class. Participatory classes could be practiced by designing classes so that students can directly do data from collection to video production. TTV technology could be used in various class processes, from data visualization to student-led content production and introductory video production.

2) Evaluation of Alignment with Learning Objectives

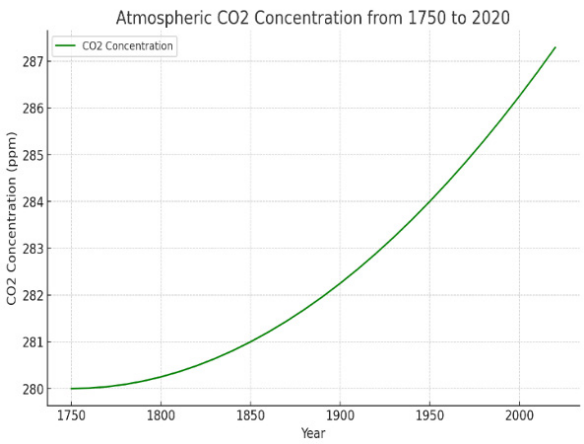
All groups considered the curriculum and conducted class design using the SDGs framework. Such tight curricular alignment parallels the 0.56-point increase in "create effective lesson plans" ($t(33) = 3.51$, $p = .0013$, $d = 0.81$). As a notable example, Group 3 used AI tools to simulate future CO_2 levels and integrated mathematics and climate science. This interdisciplinary approach emphasized the potential of TTV technology, which connects different subject areas and improves the depth and relevance of learning. While dealing with topics such as climate,

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environment, and population, the class was organized to achieve the curriculum's achievement standards and learning goals. Students' learning goals are "Graphing a function to understand climate change", "Graphing the number of infected people" in the middle school function graph unit, "Graphing the number of infected people" in the high school practical statistics unit, and "Lesson on a mathematical modeling project using Generative AI" in the high school's practical statistics unit. It was composed of activities to visualize data encountered in real life by using mathematical contents of functions, differentials, and statistics, and to predict based on this. In particular, as can be seen in Figure 2, a function is created to predict changes in the concentration of CO_2 based on past data. The domain of this function was the year, and the domain was the CO_2 concentration.

Figure 2
Pre-service Teacher-generated Visualization of CO_2 Concentration Changes and Future Scenarios Using AI Tools



(a)



(b)

The year and the CO_2 concentration were expressed as functions, and 2050 was input into this function to calculate the CO_2 concentration in 2050. Since the abnormal climate phenomenon according to the CO_2 concentration is not covered in the mathematics subject, the results were obtained with the help of Generative AI, and an image was produced based on this. If the CO_2 concentration were high, forest fires would likely occur due to global warming. It can be judged that the unit's learning goals were well implemented by making a video predicting climate change because one of the reasons for learning the function's graph is future prediction. TTV was mainly used to visualize the predicted results as images. It could be evaluated that the appropriate tools were used to visualize the future that could not be expressed explicitly with artificial intelligence.

3) Evaluation of Prospective Student Engagement

As a result of analyzing the class design and group presentation, all groups strongly emphasized promoting student participation and creating a dynamic learning environment using TTV technology. This emphasis on active learning corresponds to the 0.56-point rise in "create a learning atmosphere" ($t(33) = 4.62$, $p < .0001$, $d = 0.83$). The lesson-design of Group 4, illustrated in Appendix B (Figure B1), justifies this analysis. Group 4 involved students in the entire process, from climate data collection to analysis and visualization, using Generative AI tools. Participatory classes have been shown to improve students' understanding and retention of complex concepts (Shana & El, 2022); Therefore, it is crucial to design teaching and learning and project design in which students can participate. Group 4's lesson-design showed how technology can arouse students' interest and promote participation. Students' digital literacy and data analysis skills can be improved through student participation. The focus on student participation observed in all groups suggests that pre-service teachers recognize the importance of interactive and participatory learning experiences. It can be seen that the use of TTV and other AI tools to promote student participation is effective in subject-centered mathematics education (climate, environment, population, etc.). It is to make it possible to relate concepts on a global scale to the lives of individual learners. Students will be able to interact directly with the data, create their visual expressions, and recognize the usefulness of mathematics.

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4) Evaluation of the Educational Values and Affordances of TTV Technology

Analysis of lesson-design, including TTV technology, was helpful in sustainability education. These differentiation strategies echo the 0.53-point gain in "adapt lessons to student level" ($t(33) = 5.02$, $p < .0001$, $d = 0.81$). A striking example of TTV's educational impact can be found in Group 3. Participants innovatively used TTV in a news-style format to visualize future CO_2 concentration scenarios, highlighting how the technology can engage students and simplify abstract concepts. The choice to present climate change scenarios in a news format is particularly important. This can attract students' attention and contextualize the data to highlight its importance. This method was able to close the gap between academic knowledge and practical understanding. By presenting potential future outcomes in a clear, narrative-oriented video, students could empathize with current climate environmental issues and change their current behavior to change the future.

Teams reported instances where Vrew selected avatars that over-represented Western male scientists as narrators. In response, participants enacted three corrective practices: fact-checking numerical output and revising subtitles, substituting more diverse visual characters, and embedding on-screen disclaimers that invite students to question AI-provided information. One group explained, "We had to recalculate the modelled CO_2 values because the auto-generated chart exaggerated the trend." Another noted, "Students should see both female and non-Western experts, so we re-rendered the clip with broader representation." These reflections show that pre-service teachers were not passive consumers of TTV output; rather, participants positioned themselves as curators who actively safeguard instructional integrity, underscoring the importance of explicit ethical-use training in future AI-integrated teacher-education programs.

As shown in Table 2, TTV technology enhances several vital aspects of learning beyond content delivery. The positive impact of TTV technology on pre-service teachers' lesson-design skills is noteworthy. The experience of lesson-design using these advanced technologies enhances the ability to design effective teaching. The use of TTV could confirm its potential through pre-service teacher education. As it has become essential to use technologies such as Edutech in education, introducing tools such as TTV into the pre-service teacher curriculum can better prepare future educators. TTV technology can improve many aspects of the learning experience.

Table 2
Key Affordances and Values Identified through TTV Technology

No.	Learning Aspect	Description
1	Visualizing Complex Data	TTV transforms intricate climate data into visually engaging and easily digestible formats.
2	Scenario Building	The technology allows for creating future scenarios, fostering a deeper understanding of environmental trends.
3	Interdisciplinary Learning	As demonstrated by Group 3, TTV promotes interdisciplinary learning, integrating scientific data with media literacy.
4	Engagement and Motivation	Using familiar formats like news broadcasts increases student engagement and interest in the material.
5	Critical Thinking	TTV encourages students to critically assess and analyze the information presented through its visual narratives.

These functions suggest that TTV is more than just an educational tool and a technology that can fundamentally improve the learning process. This study showed that TTV technology can contribute to education and improve pre-service teachers' lesson-design capabilities. Abstract concepts can be made into videos easily to understand. In the future, educators and researchers should continue to study how to use these tools so that AI technologies such as TTV can be used in various teaching and learning situations.

Meanwhile, the lesson design plan shown in Appendix B (Figure B1) will be one of the key outcomes of this study. This lesson design can serve as an example in pre-service teacher training programs and teacher professional development workshops utilizing newly introduced TTV technology. Additionally, the pre-service teacher training program that facilitated the creation of this lesson design—comprising three phases: Phase 1, TTV technology introduction and practice; Phase 2, collaborative lesson design; and Phase 3, sharing and mutual feedback—can be proposed as a model for preparing pre-service teachers to integrate TTV into their teaching practices.

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Discussion

The present study's findings demonstrate that integrating a generative TTV tool into pre-service teacher education yielded substantial benefits in lesson planning and delivery. Quantitatively, large effect sizes (Cohen's $d \geq 0.80$) were observed in participants' development of educational materials, creation of engaging learning environments, and overall lesson plan effectiveness. Qualitative analysis further revealed themes of enhanced creativity, stronger curriculum alignment, heightened student engagement, and flexible, differentiated uses of the TTV tool in teaching. In this section, these results are interpreted through relevant theoretical frameworks and situate them in the context of existing research. The discussion also addresses the significance of TTV for climate and sustainability education, examines the unexpected non-significant effect on teacher–student rapport, considers ethical implications of AI in education, and concludes with educational implications, limitations, and directions for future research.

Emerging reviews of generative AI in educational settings have synthesized empirical evidence showing its potential to enhance creativity, engagement, and differentiated teaching strategies (Bahroun et al., 2023). The present findings can be understood in light of established educational technology theories. The improvements in material development and lesson effectiveness align strongly with the Cognitive Theory of Multimedia Learning (CTML). CTML posits that learners construct deeper understanding when information is presented in both verbal and visual forms, allowing them to build connections between words and pictures (Sorden, 2013). In the context of this study, the TTV tool enabled pre-service teachers to create rich multimedia content (combining narration, text, and dynamic visuals) for climate and sustainability topics. This likely reduced extraneous cognitive load and supported dual-channel information processing as described by CTML, thereby making abstract concepts (e.g., carbon cycles, climate models) more concrete and understandable. In other words, students exposed to TTV-generated videos could "learn more deeply than they could have with words or pictures alone". The qualitative theme of enhanced student engagement is consistent with CTML's assertion that well-designed multimedia can capture learners' attention and facilitate active processing of content. Thus, the large gains in lesson effectiveness may be partly attributed to CTML principles at work: TTV-based lessons encouraged students to form coherent mental representations of complex sustainability concepts, improving their grasp and interest.

From a teacher knowledge perspective, the results suggest growth in the participants' Technological Pedagogical Content Knowledge (TPACK). Initially, many educators may struggle to effectively integrate new technology with pedagogy and content (Lee et al., 2024). However, the significant improvements in lesson planning and curriculum alignment indicate that participants learned to harmonize these domains. By using TTV to convey content in pedagogically sound ways, pre-service teachers demonstrated an enriched TPACK – effectively blending their climate science content knowledge, pedagogical strategies, and technical skills (Yang et al., 2025). This is in line with other recent studies; for example, Cun and Huang (2024) applied the TPACK framework and found that exposure to generative AI tools (like ChatGPT) improved pre-service teachers' understanding of how to integrate technology into teaching practice. In the present study, the pre-service teachers' creative uses of TTV – from illustrating phenomena to differentiating lessons for diverse learners – reflect a sophisticated command of TPACK, where technology is leveraged to meet pedagogical goals and content standards.

The positive outcomes observed in this study align with and extend findings from emerging literature on AI in education. The present results echo Wang et al. (2023b), who identified a range of technological affordances of generative AI in higher education and highlighted these tools' potential usefulness in enhancing educational practice. In particular, the significant gains in lesson plan quality and learning environments support Wang et al. (2023b)'s notion that generative AI can make education more accessible, personalized, and interactive when integrated responsibly. Similarly, Denny et al. (2024) have reported that generative AI can improve learners' performance on complex tasks. Researchers observed, for example, that students using AI assistance in programming achieved better outcomes, although struggling students sometimes faced increased cognitive load from misleading AI outputs. This nuanced finding accords with the present mixed-methods results: broad benefits were noted (e.g., creativity and effectiveness increased markedly), yet caution remained necessary—teachers needed to verify AI-generated content to avoid misinformation. Thus, the study reinforces Denny et al.'s (2024) conclusion that AI tools, when used judiciously, can yield substantial learning gains while requiring vigilance regarding potential pitfalls for novices.

In the specific domain of climate and sustainability education, comparable studies are still nascent (Alamäki et al., 2024; Atkins et al., 2024; Leal Filho et al., 2024), but the present findings resonate with preliminary reports (Atkins et al., 2024). Smolansky et al. (2023) have surveyed generative AI in academic settings and found a mix of excitement and hesitation among educators. The present study mirrors that duality. Participants exhibited a similar balanced perspective, embracing TTV for lesson design but questioning, for instance, the accuracy of AI-generated

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content and its influence on student perceptions of learning. This alignment with prior research bolsters the credibility of the results and suggests that the trends observed (high effectiveness of AI tools tempered by prudent skepticism) are part of a broader shift in education practices (Smolansky et al., 2023).

Conclusions and Implications

Confirmed by this study is that TTV-based AI technology demonstrated strong influence on lesson design and offered valuable affordances that address climate change and sustainable development issues. Demonstrated is that TTV serves as a valuable tool for enhancing pre-service teachers' lesson planning competencies and fostering student engagement. Evident is that it also facilitates interdisciplinary education by integrating knowledge from various fields to tackle real-world challenges, promoting student participation through intrinsic motivation.

Emphasized is that technical advancements are needed to ensure TTV-generated educational videos exclude violent or inappropriate content. Furthermore, that TTV can predict future scenarios necessitates ethical discussions aimed at preventing over-reliance on AI tools among students.

Examined in this study were the influence of a TTV-supported intervention on pre-service teachers' lesson-design competencies and the educational values and affordances they attributed to the technology, using data from 34 pre-service teachers across two classes. Essential for future research is that larger samples and more diverse regions be involved to analyze the long-term impact of TTV on teacher competencies and student outcomes. Recommended is that studies also assess sustained educational gains, including improvements in lesson planning, student achievement, creativity, and critical thinking, while extending TTV's application beyond mathematics to other disciplines for broader utilization.

Furthermore, paramount is that guidelines addressing ethical considerations in AI-assisted education be established. Critical to these guidelines are mitigating potential biases in content creation, ensuring data privacy, and developing technological innovations to filter violent or inappropriate material. Ongoing guidance is needed so that teacher training programs address both lesson planning and the ethical dimensions of TTV technology. Equally crucial is that literacy education be provided to ensure the effective use of generative AI tools.

Based on these discussions, it is imperative that researchers, educators, pre-service teachers, and policy-makers collaborate to explore effective and ethical applications of TTV technology in preparing for the future of education. Looking ahead, recommended is that future investigations adopt a longitudinal design to examine how sustained exposure to TTV technology influences the developmental trajectory of teaching competencies over multiple semesters. In addition, implementing TTV across varied subjects and educational contexts could reveal broader applications and potential interdisciplinary synergies. By pursuing larger-scale, multi-semester, and cross-curricular studies, researchers can more definitively establish the generalizability and long-term impact of TTV on pre-service teacher education.

This research is one of the first to detail the step-by-step lesson flow using TTV in a pre-service teacher education context. By presenting specific pedagogical sequences and lesson plan templates, it provides a practical framework that can be readily adapted by teacher training programs. This explicit structuring underscores the educational potential of TTV, expanding its utility beyond the scope of this study.

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References

Abas, M. A., Arumugam, S. E., Yunus, M. M., & Rafiq, K. R. M. (2023). ChatGPT and personalized learning: Opportunities and challenges in higher education. *International Journal of Academic Research in Business and Social Sciences*, *13*(12), 3536–3545.

Alamäki, A., Nyberg, C., Kimberley, A., & Salonen, A. O. (2024, March). Artificial intelligence literacy in sustainable development: A learning experiment in higher education. *Frontiers in Education, 9*, Article 1343406.

Ali, S., Ravi, P., Moore, K., Abelson, H., & Breazeal, C. (2024). A Picture Is Worth a Thousand Words: Co-designing Text-to-Image Generation Learning Materials for K-12 with Educators. *Proceedings of the AAAI Conference on Artificial Intelligence*, *38*(21), 23260-23267. https://doi.org/10.1609/aaai.v38i21.30373

Atkins, C., Girgente, G., Shirzaei, M., & Kim, J. (2024). Generative AI tools can enhance climate literacy but must be checked for biases and inaccuracies. *Communications Earth & Environment*, *5*(1), Article 226. https://doi.org/10.1038/s43247-024-01392-w

https://doi.org/10.33225/jbse/25.24.538

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

Bahroun, Z., Anane, C., Ahmed, V., & Zacca, A. (2023). Transforming education: A comprehensive review of generative artificial intelligence in educational settings through bibliometric and content analysis. *Sustainability, 15*(17), Article 12983.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101.

Brisco, R., Hay, L., & Dhami, S. (2023). Exploring the role of text-to-image AI in concept generation. *Proceedings of the Design Society*, *3*, 1835–1844.

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE Publications.

Cun, X., & Huang, Y. (2024). TPACK growth among pre-service teachers using generative AI tools. *Australasian Journal of Educational Technology, 40*(1), 23–40. https://doi.org/10.14742/ajet.8812

Delos Santos, J. U., Sucgang, R. J., Solano, B. R., Sarabia, T. J. A., Samar, A. C. R., & Navejas, A. T. (2024). Conduct and validation of an educational lecture series on the integration of faith and scientific research methodology. *International Journal of Research and Scientific Innovation,* 1385–1400. https://doi.org/10.51244/IJRSI.2024.1108107

Denny, P., Prather, J., Becker, B. A., Finnie-Ansley, J., Hellas, A., Leinonen, J., J., Luxton-Reilly, A., Reeves, B. N., Santos, E. A., & Sarsa, S. (2024). Computing education in the era of generative AI. *Communications of the ACM*, *67*(2), 56–67. https://doi.org/10.1145/3624720

Floridi, L., Cowls, J., Beltrametti, M., Chatila, R., Chazerand, P., Dignum, V., Luetge, C., Madelin, R., Pagallo, U., Rossi, F., Schafer, B., Valcke, P., & Vayena, E. (2018). AI4People—An ethical framework for a good AI society: Opportunities, risks, principles, and recommendations. *Minds and Machines, 28*(4), 689–707. https://doi.org/10.1007/s11023-018-9482-5

Hertzog, M. A. (2008). Considerations in determining sample size for pilot studies. *Research in Nursing & Health, 31*(2), 180–191.

Huang, S. P. (2018). Effects of using artificial intelligence teaching system for environmental education on environmental knowledge and attitude. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(7), 3277–3284.

Lachner, A., Fabian, A., Franke, U., Preiß, J., Jacob, L., Führer, C., & Thomas, P. (2021). Fostering pre-service teachers' technological pedagogical content knowledge (TPACK): A quasi-experimental field study. *Computers & Education, 174*, Article 104304.

Lancaster, G. A., Dodd, S., & Williamson, P. R. (2004). Design and analysis of pilot studies: Recommendations for good practice. *Journal of Evaluation in Clinical Practice, 10*(2), 307–312.

Leal Filho, W., Ribeiro, P. C. C., Mazutti, J., Lange Salvia, A., Bonato Marcolin, C., Lima Silva Borsatto, J. M., Sharifi, A., Sierra, J., Luetz, J. M., Pretorius, R., & Viera Trevisan, L. (2024). Using artificial intelligence to implement the UN sustainable development goals at higher education institutions. *International Journal of Sustainable Development & World Ecology*, *31*(6), 726–745.

Lee, D., Arnold, M., Srivastava, A., Plastow, K., Strelan, P., Ploeckl, F., Lekkas, D., & Palmer, E. (2024). The impact of generative AI on higher education learning and teaching: A study of educators' perspectives. *Computers and Education: Artificial Intelligence*, *6*, Article 100221.

Liu, Y., Li, L., Ren, S., Gao, R., Li, S., Chen, S., Sun, X., & Hou, L. (2023). Fetv: A benchmark for fine-grained evaluation of open-domain text-to-video generation. *Advances in Neural Information Processing Systems*, *36*, Article 62352-62387.

O'Regan, M., Carthy, A., McGuinness, C., & Owende, P. (2023). Employer collaboration in developing graduate employability: a pilot study in Ireland. *Education+ Training*, *65*(10), 1–13.

Oktaviani, J. N. (2022). The Use Maru Video Tutorials to Improve Skills Make Dowry from Paper Money for Children with Hearing Impairment. *Journal of ICSAR*, *6*(2), 158–161.

Patton, M. Q. (2002). *Qualitative Research & Evaluation Methods*. SAGE Publications.

Rodríguez Moreno, J., Agreda Montoro, M., & Ortiz Colon, A. M. (2019). Changes in teacher training within the TPACK model framework: A systematic review. *Sustainability, 11(7)*, Article 1870.

Shana, Z. A., & El Shareef, M. A. (2022). Science Teachers' Use of Analogies: Findings from Classroom Practices. *European Journal of Educational Research, 11*(2), 1023–1036.

Singh, A. (2023, May). A survey of ai text-to-image and ai text-to-video generators. In O. H. Karam (Ed.), *Proceedings of the 2023 4th international conference on artificial intelligence, robotics and control* (pp. 32–36). IEEE. https://doi.org/10.1109/AIRC57904.2023.10303174.

Singh, P. P. (2024). The Impact of the Development of Artificial Intelligence with Generative Ability on Education. *Journal of Research in Vocational Education*, *6*(6), 46–52.

Smolansky, A., Cram, A., Raduescu, C., Zeivots, S., Huber, E., & Kizilcec, R. F. (2023, July). Educator and student perspectives on the impact of generative AI on assessments in higher education. In D. Spikol, O. Viberg, A. Martínez-Monés, & P. J. Guo (Eds.), *Proceedings of the tenth ACM conference on Learning @ Scale* (pp. 378–382). Association for Computing Machinery. https://doi.org/10.1145/3573051.3596191

Sorden, S. D. (2013). The Cognitive Theory. In *The Handbook of Educational Theories* (pp. 155–168). Information Age Publishing.

Wang, J., Yuan, H., Chen, D., Zhang, Y., Wang, X., & Zhang, S. (2023a). Modelscope text-to-video technical report. *arXiv preprint arXiv:2308.06571*. https://doi.org/10.48550/arXiv.2308.06571

Wang, T., Lund, B. D., Marengo, A., Pagano, A., Mannuru, N. R., Teel, Z. A., & Pange, J. (2023b). Exploring the potential impact of artificial intelligence (AI) on international students in higher education: Generative AI, chatbots, analytics, and international student success. *Applied Sciences*, *13*(11), Article 6716.

Wang, Y., Bao, J., Weng, W., Feng, R., Yin, D., Yang, T., Zhang, J., Dai, Q., Zhao, Z., Wang, C., Qiu, K., Yuan, Y., Sun, X., Luo, C., & Guo, B. (2024). MicroCinema: A divide-and-conquer approach for text-to-video generation. In Z. Akata, D. Crandall, A. Farhadi, R. Pless, I. Sato, & J. Wu (Eds.), *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition* (pp. 8414–8424). IEEE.

Wee, L. K., Tan, K. K., Leong, T. K., & Tan, C. (2015). Using Tracker to understand 'toss up' and free fall motion: A case study. *Physics Education, 50*(4), Article 436.

https://doi.org/10.33225/jbse/25.24.538

ISSN 1648–3898 /Print/
ISSN 2538–7138 /Online/

Xu, X. S., Wang, X., Zhang, Y., & Ma, W. (2023). Can ChatGPT facilitate the implementation of personal learning environments in tertiary education: Benefits and risks. In M. Koc, O. T. Ozturk, & M. L. Ciddi (Eds.), *Proceedings of the International Conference on Research in Education and Science* (Vol. 9, pp. 1113–1123). The International Society for Technology Education and Science.

Yang, Y., Xia, Q., Liu, C., & Chiu, T. K. (2025). The impact of TPACK on teachers' willingness to integrate generative artificial intelligence (GenAI): The moderating role of negative emotions and the buffering effects of need satisfaction. *Teaching and Teacher Education*, *154*, Article 104877.

Zhai, X., Chu, X., Chai, C. S., Jong, M. S. Y., Istenic, A., Spector, M., Liu, J., Yuan, J. & Li, Y. (2021). A Review of Artificial Intelligence (AI) in Education from 2010 to 2020. *Complexity*, *2021*(1), Article 8812542. https://doi.org/10.1155/2021/8812542

Zhang, H., Mohammed, A., & Dimitrova, V. (2024). Weakly supervised short text classification for characterising video segments. In O. Poquet, A. Ortega-Arranz, O. Viberg, I.-A. Chounta, B. McLaren, & J. Jovanovic (Eds.), *Proceedings of the 16th international conference on computer supported education (CSEDU 2024)* (Vol. 2, pp. 197–204). SCITEPRESS. https://doi.org/10.5220/0012618600003693

Zhou, P., Wang, L., Liu, Z., Hao, Y., Hui, P., Tarkoma, S., & Kangasharju, J. (2024). A survey on generative ai and llm for video generation, understanding, and streaming. *arXiv preprint arXiv:2404.16038*. https://doi.org/10.48550/arXiv.2404.16038

Appendix A

Expert Evaluation Criteria and Feedback The table below presents the evaluation criteria used by experts, each with more than ten years of experience in mathematics education. They independently assessed the lesson plans and pedagogical proposals created by each group.

Table A *Evaluation Criteria*

Item No.	Evaluation Category	Evaluation Criteria
1	Learning Objectives and Standards	Are learning goals and standards clearly and appropriately defined? Are curriculum standards logically aligned with lesson content?
2	Overall Lesson Design and Overview	Are the pedagogical intent and overall plan explicit and feasible? Are the step-by-step activities well-tailored to achieve the learning goals?
3	Teaching-Learning Activities	Do introduction, main activities, and conclusion phases effectively align with the intended objectives? Does the use of digital tools (TTV, generative AI) contribute to achieving the lesson goals? Are cooperative or project-based methods suitable for fostering student engagement and creativity?
4	Assessment Methods	Do the assessment methods (e.g., observations, performance tasks) appropriately measure learning outcomes? Are evaluation criteria clear, fair, and linked to the learning activities?
5	Cautions and Areas for Improvement	Do the stated cautions or guidelines genuinely aid practical classroom application? Are there any additional suggestions or issues that must be addressed?
6	Specialized Feedback	Which lesson aspects are considered particularly effective? What supplementary measures could further enhance learning outcomes?
7	Other Suggestions	How effectively does the lesson integrate each component? Are there shared improvements or strategies to increase the likelihood of success?

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Appendix B

Figure B1 *Student group-generated example of interactive learning with AI tools and TTV technology*

Representing the Number of Infected Individuals in a Graph

Achievement Standards		Explanation of Achievement Standards	Considerations When Applying Achievement Standards
Students can represent various situations using graphs and interpret given graphs.		The aim is to enable students to easily grasp changes such as increase, decrease, and periodic variations by representing various situations in graphs. By having students interpret given graphs and explain the situations they represent, they can recognize the usefulness of graphs.	Engage students in activities that involve representing various situations using everyday language, tables, graphs, and equations, and converting between these representations. Utilize technological tools to draw function graphs or explore the properties of function graphs. Apply mathematical modeling to solve problems related to real-life, social, and natural phenomena, encouraging students to tackle challenging problems. Use diverse problem situations related to environmental and climate change issues to foster interest in ecological transition.
Content Elements	Knowledge and Understanding:	Coordinate plane and graphs	
	Process and Skills:	Representing situations or relationships using tables, equations, and graphs	
	Values and Attitudes:	Cultivating a challenging attitude towards solving problems related to real-life, social, and natural phenomena through mathematical modeling	
Core Ideas		Patterns in changing phenomena that contain repetitive elements can be expressed as numbers or equations. Exploring these patterns forms the basis for mathematical conjecture and generalization. Functions and their graphs, which represent the correspondence between two quantities where one quantity determines the other, mathematically express various relationships within changing phenomena.	
Technological Tools	ChatGPT	Capable of writing code that explains phenomena based on input commands	
	Colab	Used to input code and verify graph shapes	
	TTV Program:	·Utilized to produce scenes that are difficult for students to film directly or imaginary scenes when creating media-based message delivery videos	
Learning Objectives		Students can represent various social phenomena using AI-based technology to create graphs and interpret given graphs.	

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