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Using Teacher-Enhanced AI-Generated Videos as an Intervention to Teach Experimental Design Ability among Pre-service and In-service Science Teachers

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Abstract. Generative Artificial Intelligence (GenAI) has gained popularity despite skepticism from some people, especially educators, about its implications for learning dynamics. However, it has also proven to be an effective alternative learning tool because it can process a vast array of data with an efficiency that no other digital tool can match. Two challenges in Science Education in the Philippines are overworked teachers and poor scientific literacy, which this kind of digital media may help address. Accordingly, this research explored the effectiveness of the intervention, called Teacher-Enhanced AI-generated Video (TEAIV), in teaching experimental design ability (EDA) among pre-service and in-service science teachers ($n = 22$) using a quasi-experimental pretest-posttest design. The collected data were analyzed using Wilcoxon Signed-Rank and Binomial Tests. Results indicate that teachers significantly increased their EDA ($p = 0.003$; $p = 0.031$). In addition, reflective questions asked of all participants provided more detailed insights about the effectiveness of TEAIV. This study shows how combining human and artificial intelligence in a single learning material enables a better and more efficient teaching-learning process. This is especially useful for institutions that rely heavily on digital and online learning, particularly asynchronous and hybrid modalities, where they can explore interactive, expert-developed AI-generated videos.

Keywords: *generative AI; Experimental Design Ability; science education; pre-service teaching; in-service teaching*

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Introduction

The Philippines' performance in the 2022 Programme for International Student Assessment (PISA) in Science, as well as in other subjects, reveals the limited ability of most 15-year-old students to solve complex problems, think critically, and communicate effectively (OECD, 2022). This has sparked discussions among stakeholders because it offers insights into how well education systems prepare students for real-life challenges and future success.

Efforts have been made to elevate and transform the quality of Science education in the Philippines. To do so, it is imperative to nurture individuals to become scientifically literate (Saro et al., 2023). Scientific literacy is defined as an individual's ability to process scientific facts and concepts and interpret scientific data to show how a community collectively interacts with scientific knowledge and processes (Kelp et al., 2023). One approach to developing scientific literacy among students is inquiry-based learning, a constructivist approach that enables students to participate in investigations actively (Yatin et al., 2024). Pre-service and in-service science teachers must develop this approach (Selland et al., 2023). As they drive scientific literacy, science teachers must be exposed to scientific investigations to develop their science lesson-planning skills (Altan & Ucuncuoglu, 2018). By participating in lessons that involve scientific investigations, students develop science process skills (Majeed et al., 2023).

Ozgelen (2012) defined science process skills (SPS) as thinking skills that scientists use to construct knowledge in order to solve problems and formulate results. SPS are divided into two main categories: the basic and the integrated SPS. The basic SPS include observing, measuring, classifying, inferring, using numbers, predicting, and questioning. Integrated SPS, by contrast, combine two or more basic SPS. They include identifying and controlling variables, defining variables operationally, formulating hypotheses, experimenting, interpreting data, and modeling (Gizaw & Sota, 2023). Disciplined observation and experimentation are required skills for a systematic, scientific process of understanding nature (Papin, 2019). These processes require specific skills that must be developed to ensure students follow the scientific method (Vasquez et al., 2022).

Experimental Design Ability (EDA) encompasses many integrated SPS skills. Meir et al. (2024) defined EDA as students' ability to demonstrate elements such as hypothesis formulation, identifying variables and controls, designing procedures, and possibly replication or trials. Szalay et al. (2020) defined it as the ability to identify and control variables (holding other variables constant and varying only one at a time), choose equipment/materials, and determine the correct order of steps in an experiment.

Several ways can develop one’s EDA. Mafugu (2024) found that preservice science teachers showed significant improvement in their scientific investigation competencies after participating in a constructivist learning intervention. Simseki (2018) noted that experience plays an important role in developing experimental design competency. The use of technology in formative and summative assessment tasks has also been proven to develop students’ scientific literacy (Vlasova & Tubas, 2022).

Videos have long been used in science education. They can improve students’ science process skills and creativity in science learning (Nurhayati et al., 2022). Additionally, mobile-based interactive learning multimedia and computer simulations effectively improve science process skills (Nugroho & Surjono, 2019; Beichumila et al., 2022). Students retain and understand video content better when teachers embed annotations and formative questions in the video (Tseng, 2021).

Another technology that has gained many educators' interest is generative artificial intelligence, or AI. AI makes learning more personalized, interactive, collaborative, and engaging, while also empowering students to develop essential skills for success in the twenty-first-century workforce (Ramnarain et al., 2024). Students used generative AI for conceptual clarification, hypothesis generation, and self-regulated learning (Spasopoulos et. al., 2025). While people have divided perceptions of AI-generated media such as videos, this tool still offers advantages such as personalized, efficient media production and assistance with information scouting (Gayed, 2025).

Even with this related information, no study has explored how teacher-enhanced AI-generated videos affect science teachers' science process skills. Moreover, the literature lacks studies that focus specifically on the experimental design ability of either students enrolled in a science class or teachers teaching any science subject. Although this study did not focus on the difference between the two groups of teachers (in-service and pre-service), this will provide preliminary information about the experimental design ability of the preservice teachers who will eventually come up with their own learning activities in their future classes and of the in-service teachers who are already in the field and are expected not only to impart knowledge but also to hone scientific skills.

In addition, the results of this study may serve as a basis for educators to make informed decisions on how to maximize the advantage of AI-generated instructional materials for skills or topics not explicitly taught in a given course but that are necessary prerequisites for the ideas or concepts being introduced. It can also provide insights into how combining human and artificial intelligence in a single learning material enables a better and more efficient teaching-learning process. This type of intervention is highly applicable to adult learners, such as senior high school and university students, as well as professionals in continuing education who have high self-directedness (Ahammad, 2023). Institutions that highly rely on digital and online learning, especially asynchronous and hybrid modalities, can explore the use of interactive AI-generated videos developed by an expert.

This study seeks to determine the effects of Teacher-Enhanced AI-generated videos on the Experimental Design Ability of the Pre-service and In-service Science Teachers. Particularly, the following research questions were explored, and the following hypotheses were assumed:

Research Question 1 (RQ1):
Do Teacher-Enhanced AI-generated videos (TEAIV) significantly increase the Experimental Design Ability (EDA) of pre-service and in-service science teachers?

Null Hypothesis: There is no significant increase in the EDA of pre-service and in-service science teachers before and after exposure to TEAIV.

Alternative Hypothesis: Pre-service and in-service science teachers' EDA increases significantly from before to after exposure to TEAIV.

Research Question 2 (RQ2):
Is there a significant increase in the proportion of those who included a control set-up in the experiment after being exposed to TEAIV?

Null Hypothesis: There is no significant increase in the proportion of those who included a control set-up in the experimental activity after being exposed to TEAIV.

Alternative Hypothesis: The proportion of those who included a control set-up in the experimental activity increases significantly after exposure to TEAIV.

Methodology

Research Design and Participants

This study employed an experimental research design. Twenty-two pre-service and in-service teachers participated in data collection. These participants were students in the two methods courses offered by the Science Education Area, College of Education, UP Diliman during the first semester of SY 2025-2026. Approval from the local ethics board was not required because this research is a major requirement in one of the courses within the institution's Ph.D. program coursework. The author also taught the two methods courses; thus, he had access to the projects that served as the data source. Even so, the researchers obtained informed consent from the participants. All participants completed and signed an agreement form.

Intervention

The intervention in this study is called Teacher-Enhanced AI-generated videos (TEAIV). This contains discussions of the principles of experimental design. The researcher first generated it using InVideo AI, a web-based software that auto-generates a video based on the user's prompt. The researcher then edited and enhanced the videos using Google Classroom, where a series of formative assessments were embedded.

Data Collection and Analysis

To answer RQ1 and RQ2, participants were asked to design an experimental activity (output) that they later used for their teaching demonstration. This was done twice: before and after being exposed to TEAIV.

To measure Experimental Design Ability, three professors, including the researcher, rated the outputs using a tool adapted from the instrument developed by Sirum and Humburg (2011), called the Experimental Design Ability Test (EDAT), with an interrater reliability index of 0.835 at $p < 0.001$. EDAT is a ten-item straightforward scoring rubric that measures students' understanding of the criteria for good experimental design through their open-ended response to a prompt grounded in an everyday life science problem.

Additionally, the researchers evaluated whether participants included control setups in their outputs. Wilcoxon matched-pairs signed-rank test and a binomial test were conducted to analyze the data for RQ 1 and RQ 2, respectively. To enrich the discussion, we asked all participants two follow-up reflective questions. However, only 12 of 22 responded. Nevertheless, these 12 included those with the highest, lowest, and zero score gains in EDAT. The thematic analysis procedure was conducted after collating all the responses. The researcher reviewed the synthesized themes with participants to ensure they were derived directly from the data and not the researcher's biases. Two participants validated the synthesized themes, while the rest did not respond.

All statistical tests were run using Jamovi Software version 2.6 (2024). The level of significance (alpha) was set at 5%. The decision rule states that if the p-values in all of these tests are less than alpha = 0.05, the null hypothesis will be rejected; otherwise, the null hypothesis will not be rejected.

Results

RQ 1: Effects of Teacher-Enhanced AI-generated videos (TEAIV) on the Experimental Design Ability (EDA) of Students

Data normality was assessed using the Shapiro-Wilk test (Table 1.1a), which indicated a significant departure from a normal distribution (*W = 0.638, p < .001*). Consequently, we ran a Wilcoxon signed-rank test (Table 1.1b), which revealed a statistically significant difference (*p = .003*).

Table 1a.
Normality Test (Shapiro-Wilk) for RQ 1

		W	**p**
Pre-test	Post-test	0.638	<0.001

Table 1b.
Wilcoxon-Matched Pairs Signed-Ranks Test for RQ 1

			Statistic	**p**		**Effect Size**
Pre-Test	Post-Test	Wilcoxon		0.003	Rank Biserial Correlation	-1.00

Note. H_a: *μMeasure 1 - Measure 2 < 0*

For reference, Tables 1.2 and 1.3 were included in the results. Table 1.2 shows that the median EDAT score for the pre-test is 5.00, whereas for the post-test it is 6.00. Table 1.3 shows that most participants demonstrated skills in variable identification (items 1-5, 7) both before and after the intervention. Notably, none of the participants' outputs exhibited the placebo effect (item 6). Very few of these outputs adhered to the principles of multiple trials and large sample size (items 8 and 9). A significant number of outputs also indicated procedures that warn of a possible source of error (item 10).

Table 1.2.
Descriptives for RQ 1

	Pre-Test	**Post-Test**
N	22	22
Mean	4.55	5.59
Median	5.00	6.00
Standard Deviation	2.36	1.84

Table 1.3.
Frequency of Participants who Exhibited Each EDAT Rubric Before and After the Intervention

	Pre-Test	Post-Test
1. Recognition that an experiment can be done to test the claim (vs. simply reading the product label)	15	18
2. Identification of what variable is manipulated (independent variable is ginseng vs. something else)	16	18
3. Identification of what variable is measured (dependent variable is endurance vs. something else)	16	18
4. Description of how dependent variable is measured	14	16
5. Realization that there is one other variable that must be held constant (vs. no mention)	14	17
6. Understanding of the placebo effect	0	0
7. Realization that there are many variables that must be held constant (vs. only one or no mention)	14	17
8. Understanding that the larger the sample size or # of subjects, the better the data.	1	2
9. Understanding that the experiment needs to be repeated (at least two)	1	4
10. Awareness that there are possible sources of error	10	12

RQ 2: Effects of Teacher-Enhanced AI-generated videos (TEAIV) on the Inclusion of Control Set-up in the Experimental Activity

The Experimental Design Ability Test does not adequately evaluate the principle of control set-up in the experimental activity. After inspecting the presence or absence of the control set-up in the students' outputs, the results are shown in Tables 2.1 and 2.2.

Table 2.1.
Frequency of Participants who Exhibited Each EDAT Rubric Before and After the Intervention

	After the Intervention		
N	With Control Set-up	Without Control Set-up	**Total**
With Control Set-up	8	0	8
Without Control Set-up	5	9	14
Total	11	11	22

Table 2.2.
Binomial Test for RQ 2

						95% Confidence Interval	
	Level	Count	Total	Proportion	p	Lower	Upper
L	1	5	3	1.000	0.031	0.549	1.00
	2	0	3	0.000	1.000	0.000	1.00

Table 2.1 shows that none (N = 0) of those who initially had a control set-up removed it after the intervention. It also shows that five (N = 5) of the 14 who did not have a control set-up before the intervention added one after the intervention. The Binomial Test (Table 2.2) shows that the *p-value* (L1) is 0.031 (< alpha = 0.05).

Discussion

The Wilcoxon Signed-rank test results (Table 1.1b) suggest a significant difference in the Experimental Design Ability Test (EDAT) scores of pre-service and in-service teachers before and after exposure to Teacher-Enhanced AI-generated videos (TEAIV). Since the median post-test score is higher than its pre-test counterpart (Table 1.2), TEAIV significantly increased the students' EDA.

The binomial test results indicate a significant increase in the proportion of participants who did not have a control setup before the intervention but included one in their experimental activity after the intervention. These results indicate that the TEAIV positively affected participants' ability to enrich experimental design. Although no similar study has examined the effectiveness of teacher-enhanced AI-generated videos in promoting skills development, the results align with findings from several studies.

Videos, in general, can improve students' science process skills and creativity in science learning (Nurhayati et al., 2022). Pellas (2025) specifies that AI-generated instructional videos are increasingly recognized as powerful tools for enhancing educational experiences. He studied the impact of AI-generated instructional videos, designed using established instructional design principles, on self-efficacy, task performance, and learning outcomes in science teacher education. He asserts that AI-generated instructional videos can effectively enhance knowledge retention and transfer, as well as the ability to succeed in specific situations or accomplish a task.

In addition, interactive videos, not necessarily AI-generated, can improve student learning. However, videos with embedded prompts and formative questions, as well as those that provide immediate feedback, can improve student learning (Dahlan et al., 2023). Teacher annotations, literal questions, reflective questions, and inferential questions that are embedded within the video are factors in increasing the learner's behavioral and cognitive engagement as well as their comprehension of the video content (Tseng, 2021). Making these interactive videos more contextualized and fit to the demographics of target learners and learning objectives has the potential to increase students' behavioral and cognitive engagement (Tseng, 2021).

To support these findings, these were some of the themes derived from the responses of the participants regarding the intervention:

Table 3.

Actual Responses to the Questions: “Was the video effective in communicating the principles of experimental design and controls? What is your basis?”

Theme	Sample Actual Responses
Practical Application of the Content	● “Integrated differentiated instruction strategies directly into the laboratory procedure to optimize student engagement and comprehension.” ● “Refined the experimental objectives, making the necessary adjustments to ensure they are appropriate and accurately align with the intended learning outcomes.” ● “I was reminded of the important things such as the proper and appropriate scientific question, forming a hypothesis, and determining the variables.”
Use of Simple Language	● “Simplified explanations using layman’s terms were used to further drive the point of the lessons.” ● “The videos were clear, used simple yet concise language, and made the concepts much easier to grasp.”
Use of Appropriate Examples and Analogy	● “Concrete examples made the ideas easier to understand and served as the main basis for why the video felt effective, even if the explanations were not as detailed as those found in textbooks.” ● “There are also examples and analogies provided which makes the audience understand the concept of control groups more.” ● “The videos used specific examples (i.e., Does playing music help plants grow faster?) as an anchor to discuss the lesson, which is an effective teaching tool.” ● “The video effectively discussed the principles of experimental design by starting with an analogy or setup that immerses the viewers.” ● “The video was effective in communicating the principles of experimental design in terms of the importance of control variables or setups by providing examples of experiments and their corresponding controls.”
Conciseness and Comprehensiveness of the Content	● “I think the videos alone were effective enough since I was able to apply what I have learned from the videos in my work without consulting any other references on the principles of experimental design and controls.” ● “The video explained experimental design thoroughly.” ● “The video did not overload information instead, it focused on the essentials that I needed to understand when developing an experimental design.” ● “The video alone lacked some depth in explaining certain principles.” ● “However, in a broader scope, the video did not explicitly mention [about] other principles, such as replicates and manipulated variables.”
Technical Features	● “I also liked that I could rewatch parts I didn’t fully get or try answering the questions again, which made the learning flexible.” ● “They used clear visuals.”

Table 4.

Responses to the Question: Did the questions embedded in the two videos help you in learning the content?

Theme	Sample Actual Responses
Guided and Deep Learning	● "Leading questions during class discussions help move the lesson forward, these questions act as a guide for students during independent learning." ● "The guide questions helped me pay attention to important details and made me think more deeply about the content of the topic." ● "They also encouraged deeper thinking because they were not just about memorizing definitions, but about applying concepts and relating them to real examples shown in the video."
Assessment and Immediate Feedback	● "The questions helped me confirm what I learned from the video." ● "They served as checkpoints in learning pertinent information." ● "It helped in a way that we can assess if we understood correctly the principle behind controls." ● "Those checkpoint questions are short pauses that gave me time to digest what the examples are trying to illustrate and to think about how to apply these ideas immediately." ● "The questions definitely helped me learn the content better, as they allowed me to assess my newly acquired knowledge and check if it was truly retained in real time." ● "The questions are exactly timed to reveal right after the video explains what the supposed answer/content is."
Active Engagement	● "They instantly activated my focus, ensuring I fully grasped every detail of the discussion." ● "The questions helped in the reinforcement of learning because the viewer would actively comprehend the video to answer the question or go back to review the video to get the answer for the questions." ● "The embedded questions helped me learn the content by allowing me to actively engage with the material rather than just passively watch the video." ● "I also liked how the questions gave us opportunities to correct ourselves and reflect on our choices, which made the learning process more engaging and effective."

Their responses focus on how the teacher-embedded interactive and formative questions check their understanding of the video content at their own pace and enable deeper learning by focusing on essential skills. Several highlighted the active learning process they experienced as they worked through the learning material. They pointed out specific qualities of the TEAIV that make it effective, such as practical application, use of simple language, conciseness, and unique technical features. However, some also wanted a more comprehensive discussion of experimental design principles.

Overall, this study provides a basis for claiming the importance of human intervention in using and evaluating AI-generated media before using it as learning material, regardless of modality. Also, the results of this study may serve as a baseline for more quantitative and qualitative studies on the impact of combined AI and human intelligence in developing contextual instructional materials, not only for Science skills and concept teaching but also in other fields and situations that align with its applicability.

The results of this study may support the idea that, while AI tools can generate learning materials, the teacher's role in contextualizing content and assessing students' progress remains equally important. However, to strengthen this claim, it is recommended to conduct a similar study with at least three groups (e.g., control, exposed to AI-video only, exposed to Teacher-Enhanced AI-video) to provide a clearer picture of the differences in the impacts of these treatments on teaching knowledge or skill. This suggests that a larger sample size is needed to do so. In addition, a higher frequency of exposure to TEAIV is recommended to provide more precise results and a broader window for discussion. This study could not implement these recommendations because of time limitations and the number of groups the researcher could directly involve in data collection.

References

Altan, E. B., & İrem Ucuncuoglu. (2019). Examining the Development of Pre-Service Science Teachers' STEM-Focused Lesson Planning Skills. Eurasian Journal of Educational Research, 19(83), 103–124. https://dergipark.org.tr/en/pub/ejer/issue/50254/648539

Gayed, J. M. (2025). Educators' perspective on artificial intelligence: equity, preparedness, and development. Cogent Education, 12(1). https://doi.org/10.1080/2331186x.2024.2447169

Gizaw, G., & Sota, S. (2023). Improving Science Process Skills of Students: A Review of Literature. Science Education International, 34(3), 216–224. https://www.icaseonline.net/journal/index.php/sei/article/view/526

Kelp, N., McCartney, M., Sarvary, M. A., Shaffer, J. F., & Wolyniak, M. J. (2023). Developing Science Literacy in Students and Society: Theory, Research, and Practice. Journal of Microbiology & Biology Education, 24(2). https://doi.org/10.1128/jmbe.00058-23

Majeed, S., Yasmin, F., & Ahmad, R. (2023). Inquiry-Based Instruction and Students' Science Process Skills: An Experimental Study. Pakistan Journal of Social Sciences, 43(1), 155–166. https://www.researchgate.net/publication/370153492_Inquiry-Based_Instruction_and_Students

Meir, E., Pope, D. S., Abraham, J. K., Kim, K. J., Maruca, S., & Palacio, J. (2024). Designing Activities to Teach Higher-Order Skills: How Feedback and Constraint Affect Learning of Experimental Design. CBE- Life Sciences Education, 23(1). https://doi.org/10.1187/cbe.22-08-0158

Nugroho, T. A. T., & Surjono, H. D. (2019). The effectiveness of mobile-based interactive learning multimedia in science process skills. Journal of Physics: Conference Series, 1157, 022024. https://doi.org/10.1088/1742-6596/1157/2/022024

Nurhayati, N., Lasmawan, I. W., Arnyana, I. B. P., & Candiasa, I. M. (2022). Effectiveness of animated videos to improve science process skills and creativity in science learning during the COVID-19 pandemic. International Journal of Health Sciences, 6(2), 942–955. https://doi.org/10.53730/ijhs.v6n2.8971

Özgelen, S. (2012). Students' Science Process Skills within a Cognitive Domain Framework. EURASIA Journal of Mathematics, Science and Technology Education, 8(4). https://doi.org/10.12973/eurasia.2012.846a

Pellas, N. (2025). The Impact of AI-Generated Instructional Videos on Problem-Based Learning in Science Teacher Education. Education Sciences, 15(1), 102. https://doi.org/10.3390/educsci15010102

PISA 2022 Results Factsheets Philippines PUBE. (n.d.). https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/11/pisa-2022-results-volume-i-and-ii-country-notes_2fca04b9/philippines_dbf92b65/a0882a2d-en.pdf

Ramnarain, U., Ogegbo, A. A., Penn, M., Ojetunde, S., & Mdlalose, N. (2024). Pre-Service Science Teachers' Intention to Use Generative Artificial Intelligence in Inquiry-Based Teaching. Journal of Science Education and Technology. https://doi.org/10.1007/s10956-024-10159-

Seland, T., Ellen Karoline Henriksen, & Kirsti Marie Jegstad. (2023). Inquiry-based science education in science teacher education: A systematic review. Studies in Science Education, 60(2), 1–59. https://doi.org/10.1080/03057267.2023.2207148

Şimşekli, Y. (2018). Investigation of the Experiment Design Skills of Biology and Science Teachers and Preservice Teachers. Journal of Education and Training Studies, 6(9), 199. https://doi.org/10.11114/jets.v6i9.3564

Sirum, K., & Humburg, J. (2011). The Experimental Design Ability Test (EDAT). 8(1). https://files.eric.ed.gov/fulltext/EJ943887.pdf

Spasopoulos, T., Sotiropoulos, D., & Kalogiannakis, M. (2025). Generative AI in Pre-Service Science Teacher Education: A Systematic Review. Advances in Mobile Learning Educational Research, 5(2), 1501–1523. https://doi.org/10.25082/amler.2025.02.007

Szalay, L., Tóth, Z., & Kiss, E. (2020). Introducing students to experimental design skills. Chemistry Education Research and Practice, 21(1), 331–356. https://doi.org/10.1039/c9rp00234k

Training teachers in the design of experimental tasks for the development of students' science literacy. (2022, March 10). https://pnojournal.wordpress.com/2022/03/10/vlasova/

Tseng, S.-S. (2021). The influence of teacher annotations on student learning engagement and video watching behaviors. International Journal of Educational Technology in Higher Education, 18(1). https://doi.org/10.1186/s41239-021-00242-5

Vázquez-Villegas, P., Mejía-Manzano, L. A., Sánchez-Rangel, J. C., & Membrillo-Hernández, J. (2023). Scientific Method's Application Contexts for the Development and Evaluation of Research Skills in Higher-Education Learners. Education Sciences, 13(1), 62. https://doi.org/10.3390/educsci13010062

Yatin Mulyono, Sapuadi Sapuadi, Yuliarti Yuliarti, & Suhailee Sohnui. (2024). A framework for building scientific literacy through an inquiry learning model using an ethnoscience approach. International Journal of ADVANCED and APPLIED SCIENCES, 11(8), 158–168. https://doi.org/10.21833/ijaas.2024.08.01

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