Assessing the Potential of Laboratory Instructional Tool through Synthesia AI: A Case Study on Student Learning Outcome

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Abstract: This research study aims to investigate the effectiveness of utilizing Synthesia Artificial Intelligence (AI), an advanced instructional tool, in enhancing laboratory experiments. The research focused on evaluating the impact of incorporating Synthesia AI as a supplementary learning resource on student learning outcomes in laboratory settings. Synthesia AI is a cutting-edge technology that revolutionizes students' immersive learning experience. With its advanced machine learning algorithms, Synthesia AI can generate photorealistic video content featuring virtual actors and presenters that can be programmed to speak in multiple languages, accents, and even emotional tones. In this study, an instructional-based laboratory experiment was conducted using Synthesia AI. The participants were from the Sabah Branch of UiTM, and enrolled in a Basic Plant Science laboratory course under the Pre-Diploma Agrotechnology programme. The course was divided into two groups, an experimental group and a control group. The experimental group received laboratory instructions through Synthesia AI videos, while the control group received traditional laboratory instructions. The quantitative data were collected through pre and post-tests to assess the student's learning outcomes. The qualitative data were obtained through a survey containing open-ended questions to gather the students' feedback on their experience with Synthesia AI videos. The experimental group, which received laboratory instructions through Synthesia AI videos, was expected to perform better in the post-test than the control group. The findings of this research have provided valuable insights into the potential benefits and challenges of integrating Synthesi IO as an instructional tool,

thereby contributing to the enhancement of laboratory-based instruction. With its ability to create realistic virtual simulations, Synthesia AI could significantly enhance laboratory education, allowing for more cost-effective, innovative and accessible teaching methods, and ultimately empowering the next generation of scientists and innovators.
Keywords: Artificial intelligence, instructional experiment, laboratory, Synthesia IO

INTRODUCTION

Experiments in the laboratory are an essential component of scientific education. However, they can be time-consuming, costly, and occasionally hazardous. In recent years, technology has significantly contributed to the enhancement of the student learning experience. Synthesia AI is one such technology that can generate instructional videos by integrating text, images, and audio to simulate the experience of a real laboratory experiment. The purpose of this extended abstract is to investigate the use of Synthesia AI to improve laboratory experiment instruction. Leiker et al. (2023) report that Synthesia AI has been utilised in various disciplines, including education, to create instructional videos for science, mathematics, and languages. Nonetheless, its use in laboratory experiments remains restricted. Synthesia AI can provide a safe, cost-effective, and time-efficient laboratory simulation, which can enhance the learning experience for students ((Hwang et al., 2020).

The technology underlying Synthesia AI is founded on a number of essential components, including computer vision, deep learning, and natural language processing (NLP) (Lim et al., 2023). The purpose of computer vision algorithms is to extract key characteristics from videos of human actors, such as body position, facial expression, and gestures. Using this data, deep learning algorithms then synthesize the movements of the actors onto a virtual 3D model that can be animated and rendered against any background. In educational contexts, Synthesia AI has numerous applications, including the creation of instructional videos, virtual tours, and personalized feedback. For example, Synthesia AI can be used to create instructional videos that elucidate complex concepts or demonstrate practical skills. Synthesia AI can be used to construct virtual tours that provide learners with a virtual experience of a real-world location. However, in the context of traditional

instructor-led laboratory experiments, it can pose several challenges that can hinder student learning and engagement, such as;

  i. Limited hands-on experience : using the traditional instructor led laboratory experiments often involve large groups of students, which can limit each student's hands on experience and access to the equipment.

  ii. Lack of creativity and innovation amongst the students as traditional laboratory experiments often follow predetermined procedures and outcomes.

  iii. Limited student engagement as students may feel disengaged and uninterested in the laboratory experiment if they are merely follow the instructions without any sense of ownership or control over the experiment.

To address this gap, Synthesia AI is deployed to assess the effectiveness of artificial intelligence or machine learning application as an instructor-led laboratory experiment.

MATERIALS AND METHODS

The study was conducted using a mixed-method approach, consisting of both quantitative and qualitative data. The participants were from the Sabah Branch of UiTM, and enrolled in a Basic Plant Science laboratory course under the Pre-Diploma Agrotechnology programme. The course participants were put into two groups, an experimental group, and a control group. The experimental group received laboratory instructions through Synthesia AI videos (Fig. 2), while the control group received traditional laboratory instructions from the lecturer in-charge, Ts. Jacqueline Joseph.

The quantitative data were collected through pre and post-tests to assess the students' learning outcomes (Table 2). The qualitative data were collected through a survey to gather the students' feedback on their experience with Synthesia AI videos (Table 3). The survey included open-ended questions to allow the students to express their opinions on the usefulness of Synthesia AI in enhancing their learning experience (Table 4). Data analyses were performed by using the IBM SPSS Software ver26. There are THREE (3) 3learning outcomes developed for the purpose of integrating Synthesia AI in laboratory learning settings;

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|---|
| **CLO1** : To demonstrate laboratory techniques and procedures with accuracy and precision after completing the Synthesia AI instructional content for laboratory techniques and procedure. |
| **CLO2** : To design and implement experiments to test scientific hypotheses after completing the0
Synthesia AI instructional content. |
| **CLO3**: To analyze experimental data and draw conclusions based on scientific evidence by following the Synthesia AI instructional content. |

Table 1. Learning Outcomes

(a)   (b)   (c)
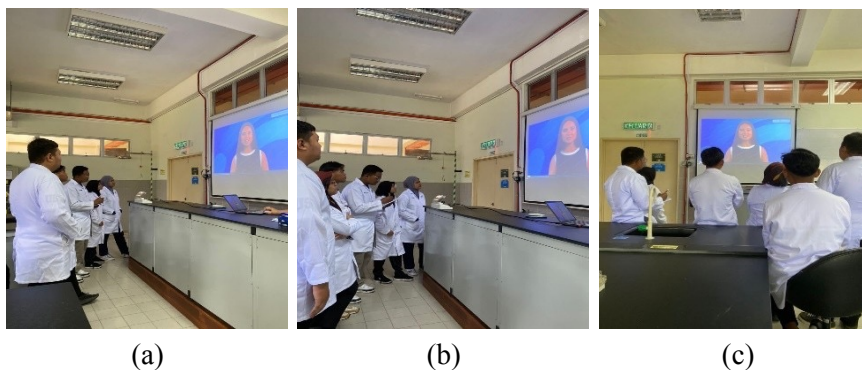
Fig. 1 (a), (b), (c); Students were listened to the experiment instructions delivered by Synthesia AI

Step 1

Visit Synthesia AI at http://www.synthesia.io

Step 2

AI video creation platfrom Synthesia was used to generate text-to-videos with photo-realistic synthetic actres

Step 3
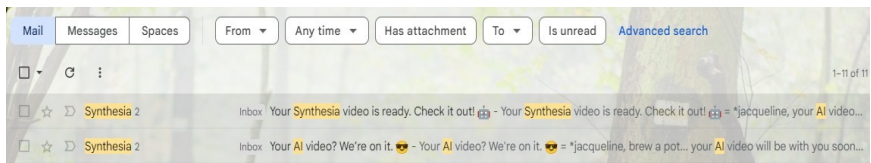
An email is received notifying that the AI video is ready to be downloaded

Step 4

AI video is available to be embedded in any platforms such as Padlet, Microsoft Power Point and others

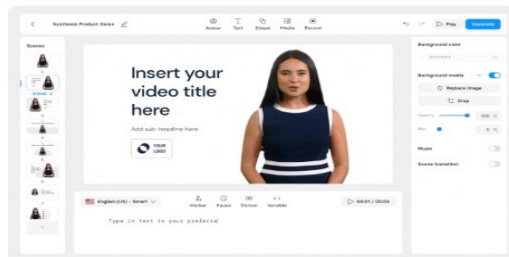**Fig. 2 A Step by Step to Generate an AI Video from Synthesia IO**

Question Number	Pre-Questions	Post Questions
1	On a scale of 1 to 5, how familiar are you with Synthesia AI as an instructional tool?	On a scale of 1 to 5, how effectively did Synthesia AI help you understand the concepts demonstrated in the laboratory experiments?
2	On a scale of 1 to 5, how confident are you in your laboratory skills and knowledge?	How would you rate your confidence in performing laboratory experiments after using Synthesia AI? (Options: Very low, Low, Neutral, High, Very high)
3	How often do you currently use instructional tools during laboratory experiments? (Options: Never, Rarely, Sometimes, Often, Always)	On a scale of 1 to 5, how helpful was Synthesia AI in guiding you through the laboratory procedures?
4	How would you rate your understanding of the subject matter covered in the upcoming laboratory experiments? (Options: Very poor, Poor, Average, Good, Excellent)	How would you rate the overall effectiveness of Synthesia AI as an instructional tool in laboratory experiments? (Options: Very ineffective, Ineffective, Neutral, Effective, Very effective)
5	On a scale of 1 to 5, how prepared do you feel for the upcoming laboratory experiments?	On a scale of 1 to 5, how engaging was the use of Synthesia AI during the laboratory experiments?
6	How open are you to exploring new instructional tools to enhance your laboratory learning experience? (Options: Not open at all, Slightly open, Moderately open, Very open, Extremely open)	How effectively did Synthesia AI enhance your understanding of the concepts demonstrated in the laboratory experiments? (Options: Not at all effective, Slightly effective, Moderately effective, Very effective, Extremely effective)
7	On a scale of 1 to 5, rate your expectation of the impact of Synthesia AI on your laboratory learning experience.	On a scale of 1 to 5, rate the impact of Synthesia AI on your confidence in performing laboratory experiments.

8	On a scale of 1 to 5, rate your perception of the potential benefits of using Synthesia AI in laboratory experiments.	On a scale of 1 to 10, rate the effectiveness of Synthesia AI as an instructional tool in laboratory experiments.
9	How likely are you to actively engage with instructional tools during laboratory experiments? (Options: Not likely at all, Slightly likely, Moderately likely, Very likely, Extremely likely).	How well did Synthesia AI guide you through the laboratory procedures? (Options: Not well at all, Slightly well, Moderately well, Very well, Extremely well).
10	How important do you consider the use of instructional tools in laboratory experiments for enhancing learning outcomes? (Options: Not important at all, Slightly important, Moderately important, Very important, Extremely important)	How willing are you to adapt to new instructional tools introduced in laboratory experiments? (Options: Not willing at all, Slightly willing, Moderately willing, Very willing, Extremely willing)

Table 2. Pre and Post Questions for the Quantitative Data

RESULTS AND DISCUSSION

The experimental group, which received laboratory instructions via Synthesia AI videos, outperformed the control group on the post-test (Figure 3). In addition, the survey results revealed that students discovered Synthesia AI videos beneficial for augmenting their understanding of laboratory experiments. As summarised in Table 3, students have agreed that Synthesia AI could be enhanced by adding more interaction and feedback opportunities to the videos. For instance, interactive exams or surveys could be incorporated to assist learners in gauging their comprehension of the material, and personalised feedback could be provided to assist learners in improving their performance. In addition, the use of more genuine human gestures and facial expressions could make the videos feel more authentic and engaging.
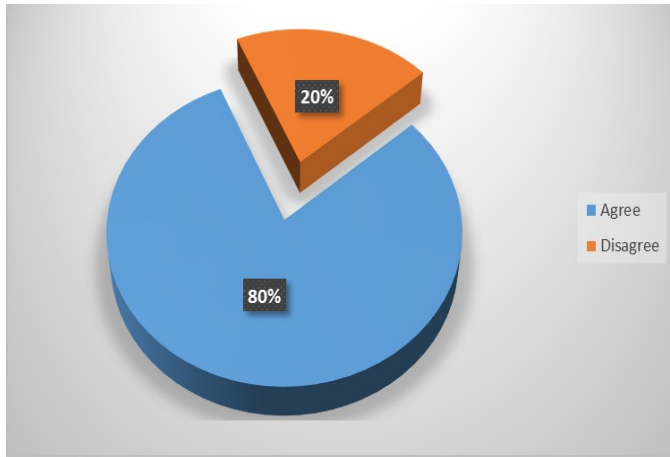
Fig 3. Distribution of Responses to Survey Question on the Application of Synthesia AI in Laboratory Settings.

No.	Questions	Feedbacks
1	Do you agree that the personalized content of the videos addressed your individual needs and interests?	Yes
2	Do you agree Synthesia AI could be improved in order to enhance the instructional experience?	Yes
3	Do you agree that Synthesia AI has the potential to improve the quality of education?	Yes
4	Do you agree that the quality of the videos created using Synthesia AI is more engaging compared to other instructional videos you've seen?	Yes

Table 3 Sample of Survey Questions

Questions	Respondent Feedbacks
Based on your experience with Synthesia AI, how do you envision its potential for future applications?	It can facilitate collaborative learning experiences by encouraging teamwork, communication, and the exchange of ideas, fostering a more engaging and cooperative laboratory environment.
Please share any unexpected benefits or drawbacks you experienced when using Synthesia AI in the laboratory experiments.	Lack of tactile experience, which can limit students' hands-on learning and their ability to develop certain manual skills or techniques.
In what specific ways did Synthesia AI assist you in overcoming challenges or difficulties encountered during the laboratory experiments?	It provides visual demonstrations, step-by-step instructions, conceptual explanations and interactive simulations.
How did the integration of Synthesia AI as an instructional tool enhance your overall understanding of the laboratory experiments?	It promotes a deeper understanding by encouraging students to apply their knowledge, make decisions, and observe the outcomes in a controlled setting.

Table 4 Open-Ended Questions for Respondents

Step 1	Dateset	M	SD	r	p
	Pre Feedbacks	.485	.137	.945	>0.5
	Post Feedbacks	.655	.120		

Table 5 Pair t-test between the Two Datasets of Pre and Post Respondent Feedbacks

Nevertheless, according to the respondents, the videos generated by Synthesia AI lacked some of the nuances of human speech and gesture. This rendered the videos less natural and engaging than they could have been otherwise. This scenario might greatly affect learner–instructor interaction, such as communication, support, and presence (Kang and Im, 2013).

In addition, there are significant differences between the two datasets (p > .05) that derived from the pre and post respondent feedbacks. It shows that the respondents highly favored the application of Synthesia AI as laboratory instructional tool based on the mean value (Table 5). Despite the disadvantages, the respondents agreed that Synthesia AI is well-known for producing engaging and interactive instructional videos that are frequently commended for their high production value and innovative use of technology (Table 4). The use of avatars powered by AI and personalized learning experiences can increase student engagement and motivation, making the learning experience more pleasurable and effective. Respondents also noted that Synthesia AI can reduce the resources required for conventional teaching methods, such as the hiring of instructors and the provision of tangible learning spaces. Synthesia AI could be an ideal solution for lecturers with demanding schedules or workload who still need to conduct onsite briefings and laboratory monitoring (Haseski, 2019). Lecturers can delegate the instructions to Synthesia AI and focus on other academic obligations, such as the writing of research papers. In addition, the use of AI in education can increase instruction and learning standardization and consistency. As a teaching instrument for laboratory experiments, Synthesia AI has demonstrated promising outcomes. It has the potential to increase student engagement, enhance learning outcomes, and decrease the time and resources required for conventional laboratory experiments (Roll and Wylie (2016). However, the use of Synthesia AI in laboratory experiments should supplement rather than replace conventional laboratory experiments. Certain laboratory skills, including the physical manipulation of apparatus and materials, may not be effectively taught by Synthesia AI. Concerns of theoretical and practical nature must be addressed regarding the use of AI in laboratory education, and ethical considerations should govern the development and implementation of such technologies.

CONCLUSION

Further research is required to determine the most effective and efficient methods for integrating Synthesia AI into laboratory instruction and to evaluate its impact on student engagement and learning outcomes. With its ability to create realistic virtual simulations, Synthesia AI could significantly enhance laboratory education, allowing for more cost-effective, innovative and accessible teaching methods, and ultimately empowering the next generation of scientists and innovators.

ACKNOWLEDGEMENT

None.

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