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Integrating AI and the Metaverse: Advancing Student Learning Outcomes

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***Abstract*—The advent of Artificial Intelligence (AI) in the field of education has been viewed by many as a Damocles sword for both teachers and learners. Despite its early beginnings in 1956, AI use only boomed in the 2020s with the successful application of machine or deep learning, greater number-crunching power of computers and big data. Its application in the area of education is inevitable and learning institutions have come up with their rules of AI use amidst concerns about originality of work. This study pushed the use of AI and the Metaverse in the final project assignment using topics from the course modules of Science 11 (Living Systems: Concepts and Dynamics), a general education course of the University of the Philippines Open University offered during the 3rd Trimester 2022-2023 and 2nd Trimester 2023-2024. The use of AI was deliberate in the final project assignment and its use was documented in the process flow or project narrative that was also submitted in addition to the final project. Students used Metaverse apps in developing their final projects. Students can start leveraging the use of AI and the Metaverse in their studies and eventually in their work.**

Keywords—metaverse, artificial intelligence, digitalization, virtual reality, virtual exhibit

I. INTRODUCTION

A. Digitalization of Education

Digitalization of education has been pushed to the forefront with the advent of the Covid-19 pandemic. In fact, it has transformed education in ways that institutions practicing face-to-face (F2F) modes of learning were forced to embrace. While there is no turning back to the old ways of F2F learning, institutions have learned to adapt to hybrid learning, flipped classrooms, massive open online courses (MOOCs), and other forms of learning using virtual platforms, social media, and the internet. The digitalization of education, while showing numerous opportunities for authentic learning, was also fraught with challenges and threats for abuse. Its rapid pace of development, complexity, and evolution have outpaced our human capacity to analyze and regulate. Additionally, it has multiplied the "digital divides" in communities coping with the prescriptions to learning, such as home-based learning, online modules, and flipped classrooms. Remote learning and the use of online platforms at home have also increased the risk of students becoming distracted, losing focus, and losing motivation [1]. There were also learning delays and learning loss due to the effect of the pandemic [2].

As generative artificial intelligence (GenAI) took centerstage in 2022, its impact on education had teachers worried about its repercussions on learning. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) churned out several guides and policy on the use of artificial intelligence (AI) in education. It calls for a "human-centered approach to AI" with focus "on the AI's role in addressing current inequalities regarding access to knowledge, research, and the diversity of cultural expressions and to ensure AI does not widen the technological divides within and between countries" [3]. The guidelines laid out were grounded on inclusion and equity (Fig. 1a). The Beijing Consensus on Artificial Intelligence and Education also established some ground rules and best practices on AI technologies for Sustainable Development Goals (SDG) 4-Education [4]. Policy recommendations include the following: "interdisciplinary planning and inter-sectoral governance; policies on equitable, inclusive, and ethical use of AI; developing a master plan for using AI for education, management, teaching, learning, and assessment; pilot testing, monitoring and evaluation, and building an evidence base; and fostering local AI innovations for education."

In May 2023, the Office of Educational Technology of the Department of Education in the USA produced a 67-page report on insights and recommendation on AI and the future of teaching and learning (Fig. 1b). It made seven policy recommendations on learning, teaching, assessment and research, emphasizing education technology that prioritizes student privacy, school data security, and safe application of AI in education [5].

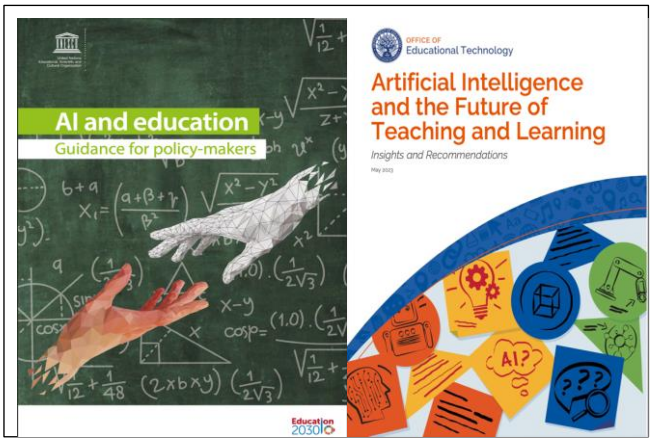

Fig. 1a and 1b. Guidelines and recommendations on the use of artificial intelligence on education. From [3] https://unesdoc.unesco.org/ark:/48223/pf0000376709 and [5] https://www2.ed.gov/documents/ai-report/ai-report.pdf.

By 2023, UNESCO created guidelines for the use of GenAI in education and research (Fig. 2), prompted by the disruption caused by the launch of ChatGPT in late 2022 [6]. It emphasized how the use of GenAI tools can be designed to safeguard human agency and effectively serve learners, teachers, and researchers. It also evaluated the potential risks posed by GenAI to essential humanistic values that "promote human agency, inclusion, equity, gender equality, and linguistic and cultural diversities, as well as plural opinions and expressions." Moreover, it enjoined government agencies to strictly monitor the use of GenAI tools by ensuring privacy of data and potentially implementing age restrictions. Finally, it urged providers and educational institutions to ensure ethical and efficient use of GenAI, and evaluate its pedagogical suitability for education.

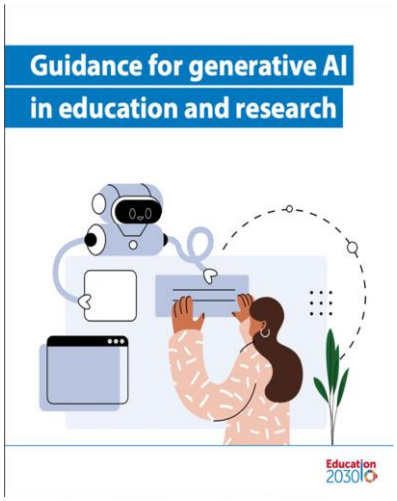

Fig. 2. Guidelines for using GenAI in education and research. From [6] https://unesdoc.unesco.org/ark:/48223/pf0000386693.

The goals of AI can be translated into appropriate and updated learning outcomes for any educational course. In fact, they form part of the 21st century skills that are important for the jobs of the future. Problem-solving ability, promoting creativity, encouraging social intelligence and life-long learning and enabling human-AI synergy can be considered as the promising outcomes of education in the era of AI (Fig. 3) [7].

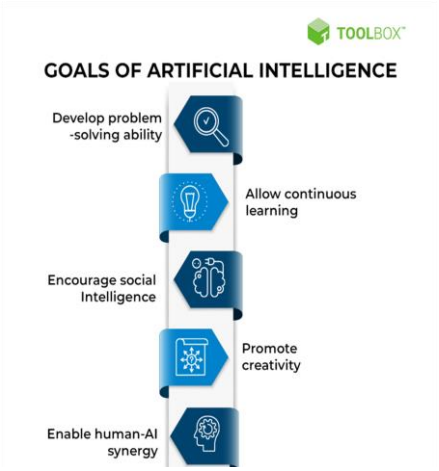

Fig. 3. Goals of AI. From [7].

The use of AI in education is faced with various challenges as shown in Fig. 4. Aside from issues of privacy and ethical use of data, there are AI algorithm bias, black box problems, requirement of high computing power, lack of understanding of implementation strategies, complicated AI integration and legal concerns [7]. Oksana and Jantke [8] explain that GenAI can be true or untrue as it uses a language model that generates responses to query that are not necessarily factual.

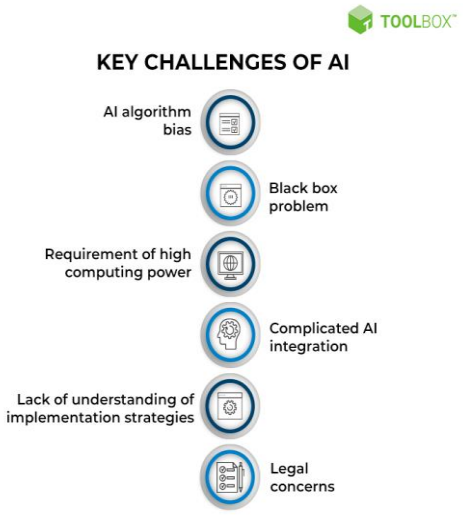

Fig. 4. Challenges of AI. From [7].

B. The Metaverse

The metaverse shall redefine how we interact with the digital world. With the recent advances in digital technology, the metaverse has been described as an evolution of the internet, with AI being the cornerstone. Visconti [9] defined the metaverse as a connected system of virtual spaces formed by merging augmented physical reality with persistent virtual environments, and encompassing all virtual worlds, augmented reality, and the internet (Fig. 5). Another definition by [10] emphasized how it creates a shared virtual world environment for users so they can "interact just like in a real world." In this 3D-enabled digital space, advanced

internet technologies, virtual reality (VR) and augmented reality (AR) are used to simulate life-like experiences.

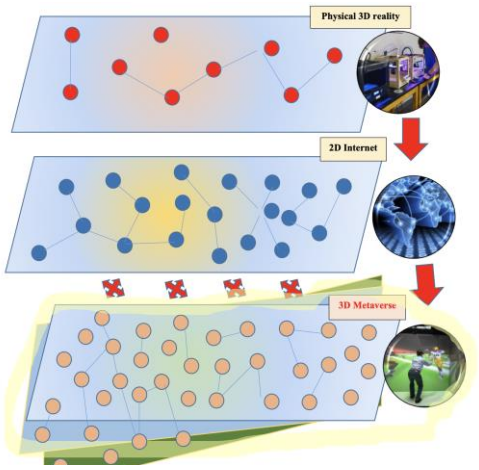

Fig. 5. From the physical 3D reality to the internet and to 3D metaverse. From [9] https://dergipark.org.tr/en/download/article-file/2247581.

Representatives of metaverse are social media, online gaming, digital identity/avatar, decentralization/blockchains, cryptocurrencies, virtual reality, augmented reality, and creator economy (value co-creation patterns) [9].

C. The Future of Education

Williamson, Komljenovic, and Gulson [11] explored how advanced digital technologies are reshaping educational practices, institutions, and policy processes. They delved into the social, scientific, and historical factors influencing development and implementation of new technologies, while also addressing the political economy of digitalization and datafication in managing modern education systems. They also considered the adverse effects of digitalization, including issues of bias, discrimination, inequality, and its environmental impact.

The challenges arising from digitalization persistently posed risks as technology rapidly advances, heightening the need for institutions to equip students with future skills needed to navigate an increasingly complex world [12]. Future skills are defined as abilities enabling an individual to address upcoming shifts and effectively solve problems independently. Among the skills mentioned were making independent decisions, completing tasks proactively, regulating one's behavior, solving problems creatively, being proficient with digital tools, reflecting on and learning from past experiences, and collaborative teamwork in a multicultural and diverse setting [13].

Gervacio [12] demonstrated how integrating digital learning into group assignments effectively promoted future skills in the students of the Master of Public Management Program (MPM) in the University of the Philippines Open University (UPOU). The study observed competencies on digital literacy, initiative, collaboration, and cooperation among the participants.

By incorporating digital tools such as GenAI and metaverse applications, the students' learning outcomes extend beyond increased knowledge. They also gain valuable skills to effectively manage both student life and life beyond school.

II. OBJECTIVES

This study has the following objectives:

1) To know what GenAI and metaverse apps were used by Science 11 students in their final project; and
2) To understand how students applied GenAI and metaverse apps in achieving the learning outcomes for Science 11.

III. METHODOLOGY

Students from the Science 11 course in two trimesters (3rd trimester AY 2022-2023 and 2nd trimester AY 2023-2024) of UPOU participated in the study. The class, mostly consisting of freshmen students, had a total of 424 enrollees (176 from the 3rd trimester and 248 from 2nd trimester). Table 1 lists the programs to which the students belong.

TABLE I. ACADEMIC PROGRAMS AND DESCRIPTIONS OF PARTICIPANTS.

Undergraduate Program	**3rd Trimester 2022-2023**	**2nd Trimester 2023-2024**	**Total**
Bachelor of Arts in Multimedia Studies (BAMS)	106	140	246
Bachelor of Education Studies (BES)	28	48	76
Associate in Arts (AA)	40	19	59
Associate of Arts in Instructional Design and Technology (ASIDT)		1	1
Associate of Arts in Digital Design and Art (AADDA)		28	28
Associate of Arts in Digital Entrepreneurship (AADE)		2	2
Associate of Science in Information Technology (ASIT)		4	4
Cross enrollees	2	6	8

Of the 424 students who enrolled for the two trimesters, only 355 (148 from 3rd trimester and 207 from 2nd trimester) completed the course and 49 students (20 from 3rd trimester and 29 from 2nd trimester) were given EXT or incomplete grades.

The final capstone project for the Science 11 course had the following instructions:

1) Choose a topic or a learning object from Modules 1-10 of the course;
2) Post a description of the project or rationale;
3) Include the name of the group or presenter, leader, and group members;
4) Specify the kind of project to be implemented (game, a learning video, an interactive activity, etc.);

a) If it will be a video lecture, it should be in Pecha Kucha style (maximum of six minutes) with references credited in the end;

b) If you are using AI for your project, please include in the process flow document or project narrative which AI was used and how you modified it.

Final project presentation was scheduled on the last week of each term. Group and individual presenters were given fifteen minutes for their presentation. Since some of the students were working even on weekends, there was an option to submit a recorded presentation. Group members assessed their peers' participation by filling out and submitting a peer evaluation form.

IV. RESULTS AND DISCUSSION

The final project presentation consisted of 64 groups (29 for the 3rd trimester and 35 for the 2nd trimester) and 53 individual presentations (6 for the 3rd trimester and 47 for the 2nd trimester) with chosen topics from the ten modules of the Science 11 course.

The Science 11 students were required to use AI and the metaverse in their final project. Fifteen presentations (seven groups from the 3rd trimester, six groups from the 2nd trimester, and two individuals from the 2nd trimester) used Frame VR to showcase their chosen topics (Fig. 6a, 6b, and 6c).

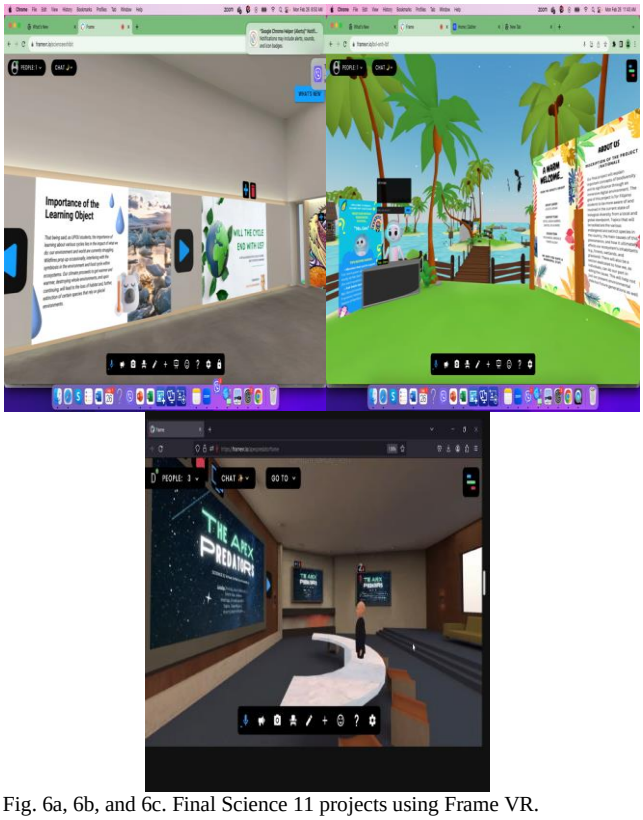

Fig. 6a, 6b, and 6c. Final Science 11 projects using Frame VR.

One group used AI generated characters in the accompanying audio of their immersive AR project (Fig. 7).

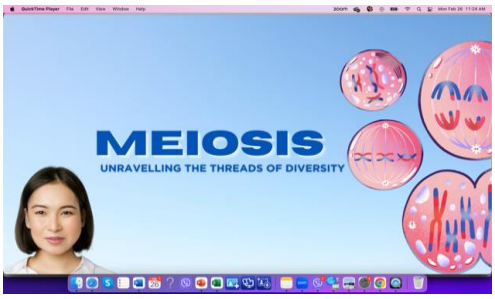

Fig. 7. Frame VR using an AI generated character.

Five final projects used AI for background visuals and voice-over. Out of the five, four were visual novels and one was a learning video that used murf.ai for the voice-over (Fig. 8a, 8b, 8c, and 8d).

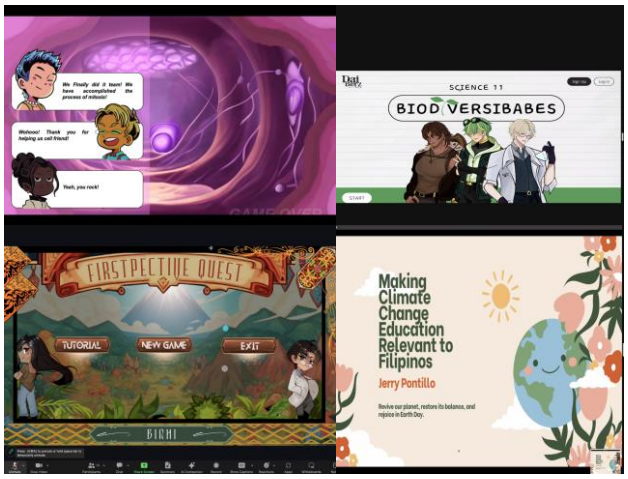

Fig. 8: Using AI for background visuals and voice-over. (a) Visual novel about mitosis with three characters named Micho, Cella, and Dippy by group Eleven Labs.(b) Visual novel inspired by RPG (role-playing game) featuring Biodiversity concepts and made by group Biodiversibabes. (c) Visual novel with clickable options showcasing a cultural perspective of living systems prepared by group Binhi. (d) A learning video on climate change education with AI-generated voice over.

Three presentations (two groups and one individual) created immersive games (Fig. 9a), using Roblox (a game VR) and Playtogether (a 3D game) in constructing their interactive website. An individual presenter developed an online role-playing game called, "Biodiversity Quest" (Fig. 9b).

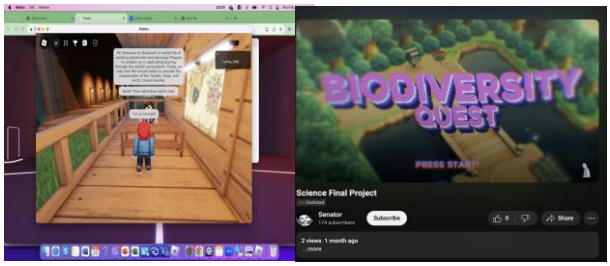

Fig. 9: (a) BioQuest, a gaming adventure using Roblox. (b) Biodiversity Quest.

A group used a mobile app, FlipaClip, and turned their sketches into 2D animation that they used to liven up their interactive Canva presentation on biogeochemical cycles (Fig. 10).

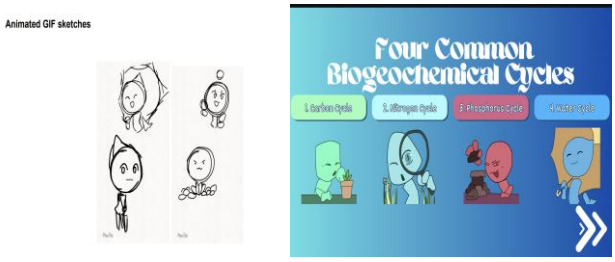

Fig. 10. Sketches made into 2D animation using FlipaClip mobile app presented by group SciCle.

Other groups used web builders such as MakeStories, wix.com, webflow (Fig. 11), gather town, and card.co to create content with AI already embedded in the platform. There were students who made online quizzes (Fig. 12) to help users review concepts learned in the module and reinforce learning. Other groups made a 6-minute Pecha Kucha presentation, used Canva, YouTube, and TikTok (Fig. 13).

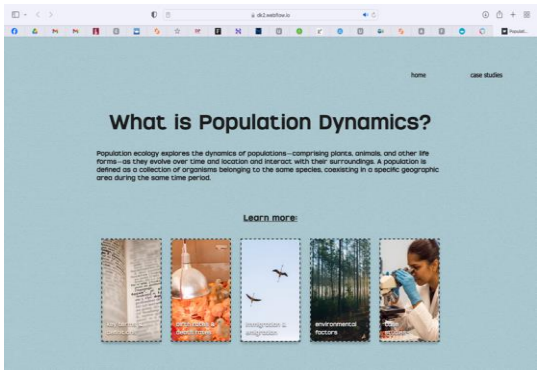

Fig. 11. Used webflow to build an informative website.

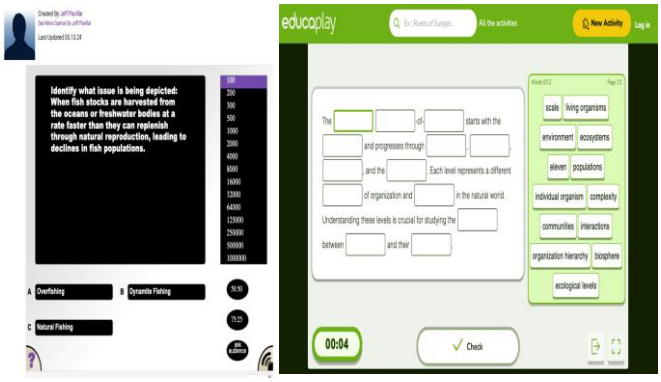

Fig. 12: Online quizzes (a) Used wisc-online for a 25-item quiz about sustaining living systems. (b) Drag-and-drop and fill-in-the-blanks quiz on living systems from a biological perspective.

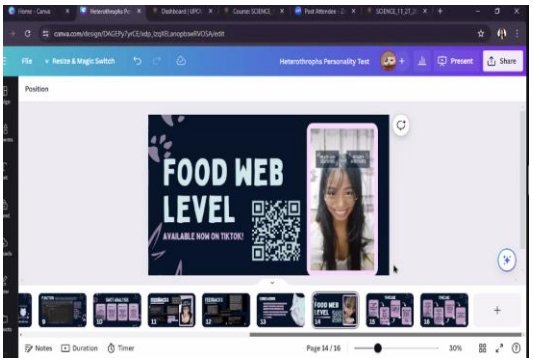

Fig. 13. Tiktok Filter that determines which tropic level a user belongs to.

One student presented an educational mobile prototype named as, "Likhang Buhay App," developed to educate users about sexual health and reproductive biology. The app has an AI chatbot that answers user queries (Fig. 14).

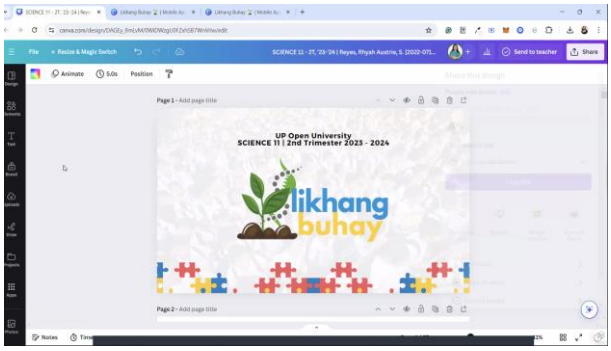

Fig. 14. Likhang Buhay App, an educational mobile prototype on sexual health.

There were students who were assisted by AI in crafting card and board game design and mechanics (Figure 15a, 15b, and 15c).

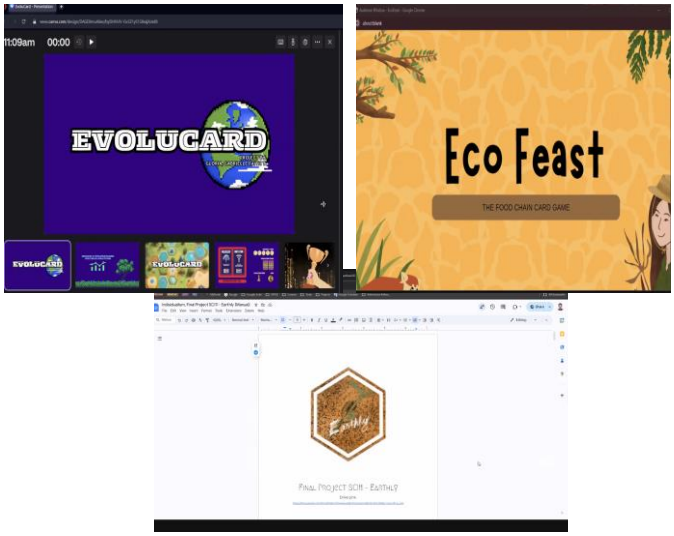

Fig. 15. (a) Evolucard, a board game incorporating population dynamics, with mechanics and design crafted with the use of Poe's AI Assistant powered by gpt-3.5-turbo and Calude 3 Haiku. (b) EcoFeast, a food chain card game that consulted AI for its name and in creating flashcards. (c) Earthly, another board game on population dynamics, fleshed out with the help of ChatGPT.

Students were required to demonstrate their use of AI and metaverse elements in their final projects through a project flow documentation or project narrative. Groups and presenters outlined how AI influenced topic selection, idea generation, project design, voice-overs, and review of readability of some statements and passages.

The project narrative enabled the students to appreciate their creative process and look back on the steps they took in developing their outputs. Their reflections emphasized common themes and goals they aimed to achieve. One common goal of the students is to make their presentations both informative and engaging. AI and metaverse elements helped them flesh out their creativity and enhance their outputs in producing captivating visuals, backgrounds, layouts, and animations while integrating learned concepts.

Audience engagement was also deemed important and was targeted through interactive presentations. As online learners with firsthand experience, they understood the challenges of online education, including overwhelming and intimidating modules. Distraction, a common reason why students often lose motivation and focus when studying online, was addressed with learning materials designed to be stimulating, easy on the eyes, and readily absorbed. One group mentioned how they ensured keeping their explanations concise and straightforward to maintain the audience's attention and facilitate easy understanding of the concepts. Another thing highlighted in their reflection, as well as something that the groups would often mention while they tour the class around their virtual exhibits, is to note that learners should be able to move at their own pace and space. Concepts in posters and learning videos were strategically positioned within the exhibit to allow users to digest important key points at a comfortable pace.

Beyond showcasing their knowledge, students found that presenting their work in transferable bits also deepened their understanding for the subject matter. It increased their passion to facilitate learning, and heightened their commitment to promote awareness about its relevance and related issues.

The involvement of AI and metaverse elements also enabled the students to hone their future skills displayed in decision-making, collaboration, and teamwork. Working remotely with a group presented logistical challenges, particularly when members were working students or reside in different time zones. This issue has often been noted in the project narrative as a significant obstacle, leading some groups to disband and reform. But for those who pushed through, they learned the importance of task appropriation, delegation, and taking advantage of digital communication to manage schedules, documentation, task status monitoring, and completion tracking. These skills will undoubtedly benefit students as they continue their studies and eventually embark on their careers in the future. Their outputs empower students to leverage technology and media, preparing them for future academic and professional endeavors, benefitting both the academia and the communities they serve.

V. SUMMARY AND CONCLUSION

AI and the metaverse have caused disruptions in our education. The rapid development in these areas has caused excitement and also apprehension within the education community. Educational institutions and the policy-makers can harness the potential of AI and the metaverse to help students prepare for future jobs. By adopting a "human-centered" approach, the educational community can continue to leverage these technologies for learning and career readiness.

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