AI in Education Competition Entry Form​ - Higher Education

**Project Title:**

***Empowering STEM Education with AI: Drone-Integrated Simulations for Experiential Learning***

***AI賦能STEM教育：無人機模擬教學的體驗式學習***

Stream 2: Identifying an educational problem and proposing a prototype solution.

Project Description (maximum 300 words): (Required)

***This project redefines STEM education by leveraging GenAI to empower educators without programming expertise to create custom, interactive web-based pedagogical tools. By eliminating the traditional barriers of technical knowledge and high development costs, this breakthrough enables teachers to design engaging, student-centered learning experiences that address specific educational needs. The adoption of GenAI ensures accessibility and scalability, making cutting-edge tools available to educators and students alike, fostering innovation in classrooms worldwide.***

***The project builds upon a drone-integrated, cross-disciplinary STEM curriculum, addressing real-world educational challenges such as the risks of drone crashes, difficulties in grasping abstract concepts, and resource constraints during hands-on activities. Through AI-driven simulations, students gain experiential learning opportunities in a virtual environment, where they can safely explore drone piloting, flight mechanics, navigation coding, and applied physics. These simulations transform theoretical knowledge into tangible, interactive experiences, fostering critical thinking, problem-solving, and interdisciplinary understanding.***

***By integrating web-based technologies, the simulations provide unparalleled accessibility. Students can access the tools simultaneously in class through the internet, without the need for installation. This feature not only facilitates collaborative learning but also allows the simulations to be easily shared with the broader educational community at no cost, promoting inclusivity and equity in STEM education.***

***This project exemplifies the transformative potential of AI in education, making advanced STEM concepts engaging, resource-efficient, and widely accessible. By bridging the gap between educators’ technical limitations and students’ learning needs, it empowers the next generation of learners to tackle future technological challenges with confidence. The combination of GenAI innovation, experiential learning, and global accessibility positions this initiative as a groundbreaking contribution to the future of STEM education.***

File Upload (Required)

Please upload the files required: a video (up to 3 minutes, in mp4 format, less than 300MB) or a presentation deck (in PDF/PPT format, maximum 15 slides and 30MB)

**1.Problem Identification and Relevance in Education (Maximum 300 words) (Required)**

• Describe the thought process that led to your idea: What inspired you to pursue this particular direction?

• Describe the hypothesis underlying your project and explain why you believe it will succeed.

**2a. Feasibility and Functionality (for Streams 1&2 only) (Maximum 300 words) (Required)**

• How will you leverage specific technologies to implement your solution? What resources will you require to support its development, and how do you plan to validate the market demand for it?

• What are the core functionalities of your solution? How will you ensure a positive user experience, and what performance metrics will you use to evaluate its effectiveness?

**3. Innovation and Creativity (Maximum 300 words) (Required)**

• In what ways does your idea represent an innovative and creative solution to the problem outlined in the topic?

• How does your project demonstrate innovation and creativity, and how do these elements enhance its effectiveness in addressing user challenges?

**4. Scalability and Sustainability (Maximum 300 words) (Required)**

• What strategies will you employ to ensure your solution is scalable to meet increasing user demand, and how will you address potential bottlenecks?

• How will your solution ensure environmental sustainability, foster long-term user engagement, and adapt to evolving user needs?

**5. Social Impact and Responsibility (Maximum 300 words) (Required)**

• How does your solution address specific social issues, enhance the lives of its primary beneficiaries, and align with broader social goals such as equity and inclusion?

• What metrics will you use to measure its social impact, and how will you ensure responsiveness to the evolving needs of the community?

STEM education has been actively promoted in all levels of education in the last decade, which has been recognized as a platform of disciplinary integration and experiential learning, allowing students to apply knowledge and skills to solve real-world problem, develop their 21st-century skills, engineering skills and computational thinking skills.

Findings revealed from a systematic review indicate that drone technology could be a promising educational technology promoting STEM learning for secondary school students. I have developed a drone-integrated cross-disciplinary STEM curriculum which is built upon three levels of integration, i.e. multi-, inter- and trans-disciplinary integration, which allows students to immerse into multi-disciplinary learning across science (S), mathematics (M) and technology (T) under the theme of drone technology;, experience inter-disciplinary learning (i.e. S-T, T-M, M-S) in the context of drone piloting, flight principle and autonomous navigation; and engage in trans-disciplinary learning via engineering design project involving drone application.

The following topics are covered in the eight 1.5-hr lessons of the curriculum:

1. Drone Technology & Piloting Skills

2. Newton’s Laws of Motion & Flight Principle

3. Determination of Horizontal Flight Speed

4. Angle of View (AOV) of Drone Camera

5. Drone Coding & Circumnavigation

6. Obstacle Skirting Path Design

7. Drone-assisted Water Sampling System Design

8. Drone-assisted Water Sampling Competition

Students work in pair and use a small programmable drone (Tello) in the lessons.

However, upon several rounds of trials, we found that:

1. Though knowledge content was fully delivered to students before they reached the drones, inexperienced students piloted the drone at the first time was found to be quite dangerous and drone crashing always happened, which significantly reduces the sustainability of the course.

2. Students did not understand the 3D spatial concepts and the eight control dimensions before their first flight. Moreover, many students could not understand the relationship between propeller spinning speed, strength of gravity and atmospheric pressure through the piloting experience, and thus they could not appreciate the drone designs for planet exploration in environments different from the Earth.

3. Though the principle of GNSS positioning technology and return-to-home (i.e. drone returns to the take off point automatically guided by the GNSS) were taught in class, students could not appreciate these technology which were rather "abstract" since they had no chance to "experience" it.

4. Though students were able to calculate drone speed "value" from the flight distance and time, they could not recognize the relationship between the relative speed and the slope presented in the distance-time graph.

5. Students could not apply the trigonometric ratio concept to measure the landscape dimension with drone using the concept of angle of view of drone camera from a known altitude since they are not allowed to fly the drone at a height higher than 30m due to the law restriction.

6. Students experienced iterative code refinement in the progress of code development for autonomous navigation of designated path, but many cannot explicitly understand and draw the path expressed by the code drafted, and thus it was inefficient to identify the problems to be refined, and batteries drained considerably in these code performance testing.

To address these issues identified from the preliminary trial lessons, we plan to create a series of interactive web-based simulations, including GNSS positioning simulation, flight practice simulator, quadcopter physics simulator, virtual experiment platform of horizontal speed measurement, virtual experiment of landscape dimension measurement with drone and code performance simulation. However, I am a science teacher and do not have sufficient programming skills to create any of them, and thus I am exploring the possibility to create these simulations with GenAI chatbots, with specific approaches of content delivery, educational functionalities, and pedagogical requirement.

The above background, curriculum development, preliminary findings from trial lessons and ideas of GenAI application are to be presented as a package for the competition "AI in Education Competition" under the stream "Identifying an educational problem and proposing a prototype solution". Please comment critically whether it is appropriate and aligns well with the theme of competition.  
  
I have created a simulation and the code is shown below. The html will be published to the internet via GitHub so that all educators and students can use it free of charge. Please critically comment whether this simulation could (if then, how) address some of the mentioned concern.

Please revise the GNSS html with an addition of the following functions:

1. assessment task that requires students to "Position the drone to maximize the number of satellites in range",

2. Add an option to simulate satellite movement, showing how GNSS systems work with constantly orbiting satellites, and

3. Add an interactive tutorial or guided mode to walk students through key concepts, such as "How GNSS positioning works" and "The importance of having at least three satellites in range for accurate positioning".

Please keep all existing functions and setting unchanged, and give me the full code. Thanks.

**GNSS Satellite Positioning of Drone**Transforms abstract GNSS drone positioning into an interactive experience for secondary students. Key strengths include a user-friendly design developed with AI, allowing teachers without programming skills to create engaging tools. Features like draggable drones, dynamic satellite movements, and multilingual support enhance accessibility and interactivity. This innovative application makes complex technology tangible, deepening student understanding and appreciation of drone positioning.

**Virtual Flight Simulator**

This simulation exemplifies an innovative AI application in education by addressing the critical gap between theoretical knowledge and practical drone piloting skills. Developed with the assistance of the GenAI chatbot o1-mini, this interactive tool engages students through hands-on virtual flight experiences, enhancing their understanding of 3D spatial concepts and the eight control dimensions. By enabling safe, repetitive practice before actual drone operations, the simulation significantly reduces the risk of crashes and builds student confidence. This AI-assisted development empowers educators without extensive programming expertise to create effective learning solutions, thereby fostering a more sustainable and impactful educational environment.

**Drone Camera AOV Experiment**

It is an AI-assisted educational tool developed using GenAI, bridging trigonometric concepts with practical drone-based measurements. Students can adjust angles of view and aspect ratios while receiving real-time altitude and field of view metrics. Featuring three iconic buildings—the School, Trident Buildings, and Bank Tower—students perform virtual measurements to grasp relative heights effectively. A comprehensive multilingual tutorial ensures accessibility, and interactive visuals provide immediate feedback. This simulation transforms abstract mathematics into engaging, real-world applications, fostering deeper understanding and enhancing STEM education.

**QuadPhysics: Quadcopter Flight Explorer**

It is an AI-powered educational simulation that engages students by allowing interactive manipulation of propeller speed, gravity, and atmospheric pressure. Visual elements like a larger quadcopter size represent increased weight, deeper ground colours signify stronger gravity, and more gas particles indicate higher atmospheric pressure. These cues enhance understanding of complex physics concepts and enable dynamic application of scientific principles, fostering critical thinking and appreciation for drone technology in diverse planetary environments.

**Code Performance Simulation**

It is an innovative AI-driven educational tool that allows students to design and test drone navigation code within a virtual 3D environment, effectively preventing heavy battery usage during real-world experiments. This free simulation platform offers intuitive command buttons, a dynamic code editor, and path preview functionalities, enabling iterative code development and immediate visualization of autonomous flight paths. By providing a hands-on, resource-efficient learning experience, it bridges theoretical programming concepts with practical application. Currently, no free drone coding simulation tools are available in the market, making this platform a valuable asset for accessible and sustainable STEM education.