IOT-integrated SDGs Scenario-based Games in the Classrooms

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Abstract: The Internet of Things (IoT) technology has found widespread application in various facets of daily life, including education. Through the integration of IoT technology and authentic open data into educational materials, students can engage in more interactions and develop a sense of participation. This, in turn, enhances their learning interests and motivation. Additionally, students can gain a more lifelike and tangible learning encounter in the classroom, particularly through scenario-based gaming. This research endeavors to utilize the Sustainable Development Goals (SDGs) as content for the creation of IoT-integrated classroom games. These games aim to immerse participants in the intricate web of social and environmental conflicts. Employing an exploratory learning approach, the goal is to augment students' awareness of SDG issues and cultivate multiple representation literacies.

Keywords: IOT-integrated Games, Multiple Representations, Data Visualization

1. Introduction

In today's society, IoT technology is increasingly prevalent, touching various life aspects, including education. Unlike passive learning from traditional materials, IoT-integrated educational resources promise a more practical, engaging, and interactive learning experience. This study aims to create an IoT-integrated SDGs scenario game via online platforms and IoT firmware. Visualized data from diverse sources will aid seamless gameplay. Analyzing students' cognitive recognition and outcomes will form a basis for multidimensional representation analysis. IoT devices and sensors will visualize relevant data, fostering an immersive learning atmosphere. This enables active involvement in content-rich scenarios, aligning with real-world applications.

2. Related Work

2.1 Multiple Representations

"Representation" serves both as a learning medium and a contemplation tool. In the game, we analyze students' varied representations through data visualization, aligning with their preferences. This fosters comprehensive, multi-dimensional comprehension, linking new knowledge with real-life scenarios. Students find more enjoyment and satisfaction in learning. Chen, Chen, Zuo, & Hou (2023) highlight that multiple representations stimulate thinking and learning. Offering diverse representations promptly supports learning, enhancing understanding of surroundings and cognitive growth. This study employs a game format with multiple representations, visually showing students' diverse patterns of representation during gameplay.

2.2 IOT

In the changing educational landscape, traditional teaching falls short of reform needs. IoT and Artificial Intelligence (AI) technologies n education lay the foundation for progress (Yu & Mi, 2023). Merging education and tech drives efficient learning, improves quality. IoT

enables personalized education (Tripathy, Mishra, & Dash, 2021), offering real-world application through sensors and devices. This enhances comprehension, lowering costs, boosting efficiency. This study aims to use IoT for a context-based classroom game, amplifing students' practical experience, engagement, and digital skills. The goal is to prepare students for the digital future.

2.3 Data Visualization

Duke, Brodlie, Duce, & Herman (2005) propose that visualization initiates when individuals possess data they wish to explore and interpret. Visualization involves converting information from one representation form to another (Chen & Golan, 2015). Data visualization can render information more compelling (Pandey, Manivannan, Nov, Satterthwaite, & Bertini, 2014). Moreover, research has indicated a robust connection between data visualization and the humanities (Manovich, 2010). In fact, graphical representation can be more precise and impactful compared to traditional statistical calculations (Tufte, 2001). Hence, our aim is to utilize data visualization techniques to assist students in attaining a lucid comprehension of diverse data points. We intend to convert the multifaceted data representations generated by students into intuitive and understandable charts, images, or visual presentations. This approach will aid students in achieving a deeper understanding of the learning material and heighten their learning outcomes.

3. Game Design

This game utilizes task design, game prompts, data exploration, and technological assistance from IoT to facilitate diverse forms of communication, interaction, cooperation, and coordination among students. The game involves students taking on specific roles, including Farmer, Conservation Group, Hunter, Government, and Developer. These five members constitute a group, each role equipped with unique physical cards.

The game's cards have two main purposes. The Inquiry card lets students interact with map areas using IoT icons, exploring diverse data like water resources, land details, forest distribution, population structure, and animal ecology. Personalized data exploration strategies can be formed based on their interpretation of game missions. The Action cards are to initiate interaction with other players. It acts as the initial condition for engaging with others. Each card is equipped with a sensing device, and corresponding sensing zones are established in the game environment. When students use these cards to interact with the sensing zones, the screens they possess will promptly exhibit numerical values or dynamic scene changes. This grants students an intuitive comprehension of the broader impact of their actions within the game (see Figure 1).
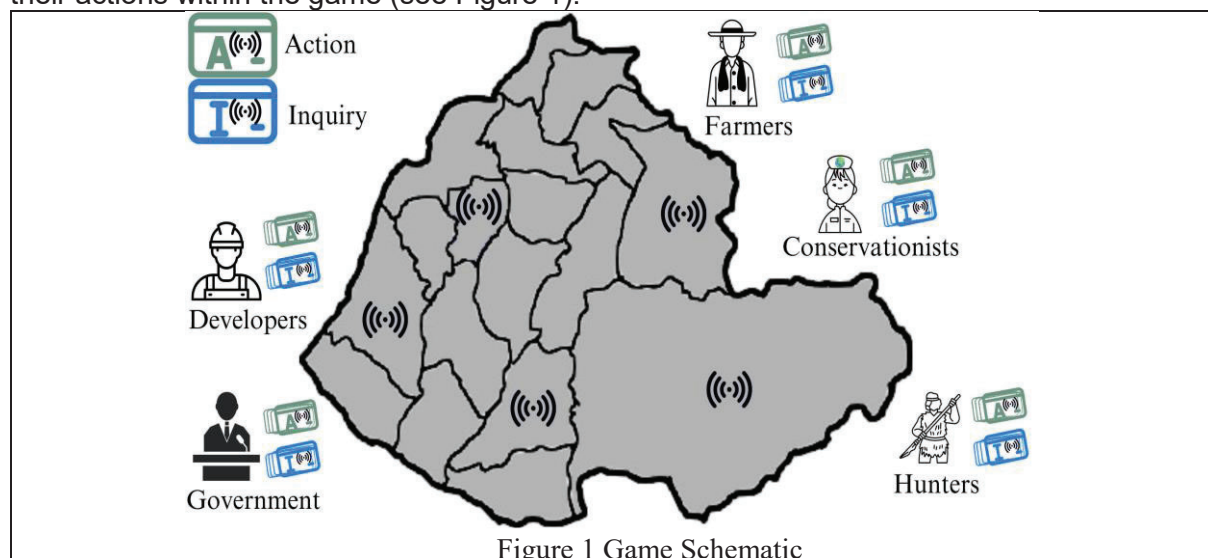

Figure 1 Game Schematic

4. Expected Result

This study uses IoT tools to enhance students' tech experience, boost motivation, and explore diverse data representations within SDG-framed gameplay analysis, uncovering multiple literacies. Possible research methods for this study include a combination of qualitative and quantitative approaches using in-depth interviews and focus groups to gather insights into students' perceptions, experiences, and motivations within the IoT-integrated game; at the same time using surveys and gameplay analytics to provide statistical data on students' engagement patterns, learning outcomes, and problem-solving strategies. Data from these methods will be synthesized to gain a comprehensive understanding of students' behaviors and outcomes.

This research aims to elevate learning motivation through gamification and leverage data visualization for students' scientific insight. Gathering multiple representations showcases interactive engagement with data and peers in-game, comprehensively analyzing learning behaviors, problem-solving, and creativity. This contributes to personalized instruction and diverse learning, fostering self-reflection and growth. Efforts seek continuous improvement and educational optimization.

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