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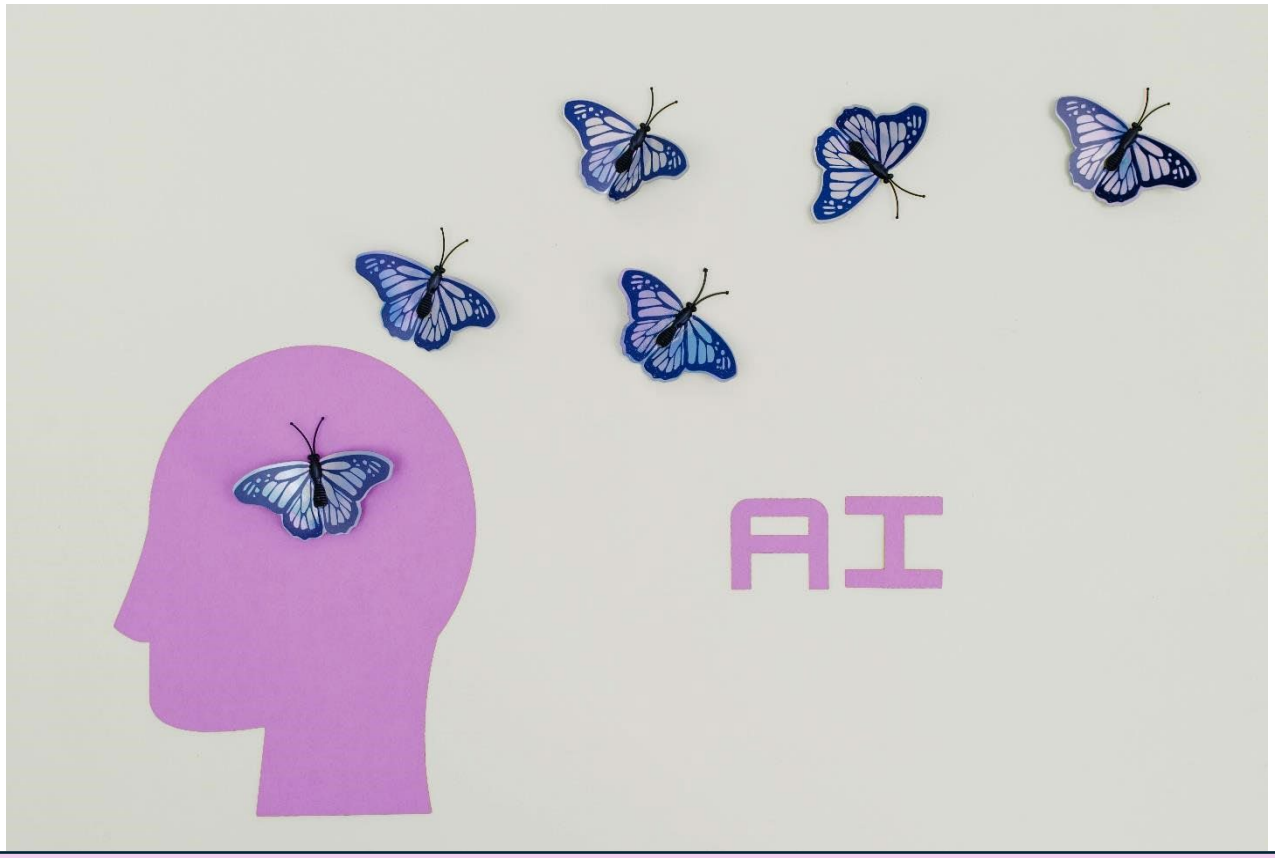

Using AI to promote Education for Sustainable Development (ESD) and widen access to digital skills:

List of Case Studies

September 2024

This list of case studies is an output from the Collaborative Enhancement Project 'Using AI to promote Education for Sustainable Development (ESD) and widen access to digital skills' supported and funded by QAA Membership.

The project is led by

London Metropolitan University (UK)

In partnership with

Coventry University (UK), University of Hertfordshire (UK), University of Staffordshire (UK), Manisa Celal Bayar University (Turkey), Aristotle University of Thessaloniki (Greece), Epoka University (Albania) and University of Elbasan "Aleksander Xhuvani" (Albania).

Find out more about Collaborative Enhancement Projects on QAA's website.

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Case studies for Academic Staff

Case Study 1: AI and Digital Transformation in Higher Education

Introduction:

This case study delves into the use of Artificial Neural Networks (ANN) in higher education, empowering agricultural students to preserve water resources. It underscores the viability of such systems, fostering students' innovation and collaboration and advocating for sustainable practices in the farming sector. The study aims to introduce university students to the principles of sustainability and the potential benefits of integrating software and hardware components for water preservation. The experiments involve creating a classification model and a machinelearning model for water pump defects using vibration data from an accelerometer. The results demonstrate that students gain valuable technical knowledge and practical skills, equipping them for their roles in a rapidly evolving era. Moreover, the initiative has been instrumental in broadening access to digital skills for disadvantaged students, ensuring that they, too, can reap the rewards of the latest technological advancements. The research underscores the potential of ANN and IoT in promoting sustainable practices.

Background:

Education for Sustainable Development (ESD) is a crucial approach to tackle pressing challenges such as resource management and environmental conservation. By integrating advanced technologies like Artificial Intelligence (AI) and Machine Learning (ML), educational institutions are addressing global issues like water scarcity and sustainable farming. Traditionally, students in agricultural programs have used technology to address resource depletion and nutritional demands. This project connected academic theories with real-world applications, facilitating the development of scalable, realistic systems that promote sustainable agricultural practices. By using intuitive software, students developed technically proficient, sustainable, and socially beneficial systems, enhancing their technical, cooperative, and organizational skills. The project aimed to prepare students to become leaders in implementing sustainable technologies in agriculture. Importantly, this initiative enabled disadvantaged students to gain critical digital skills, bridging the gap in educational opportunities.

Implementation:

The water alert system was a novel approach that utilized an Artificial Neural Network (ANN) model to detect water pump malfunctions. The system measured water flow and controlled it in a closed system. The data collected was used to train the ANN model, which was then integrated into a microcontroller. The model was trained using a processing block and a learning block to modify the data and select the appropriate neural network. The system included five classes of data: normal operation, simulated failures, and noise data. A monitoring application was created using the MIT App Inventor environment for Android devices. Using Raspberry Pi 3 Model B+, services were tackled to address multiple sensors requiring further optimization for security and privacy settings. These implementations particularly benefited disadvantaged students by providing them with hands-on experience with advanced technologies.

Results:

The study showcased the application of machine learning (ML) and AI in bolstering water conservation in agricultural practices. Students designed and implemented two systems for monitoring water usage and assessing water pump functionality, using ML algorithms to optimize water usage and reduce waste. The ML models were highly accurate, with the water usage monitoring system achieving an accuracy rate of over 96% and the pump functionality system scoring 98.91%. This project significantly influenced students' technical and professional growth, enhancing their hands-on experience in ML and IoT technologies and instilling confidence in their ability to handle advanced tools. The project also enhanced problem-solving skills, teamwork, and project management capabilities, which are vital for their future careers in sustainable agriculture. Importantly, it broadened access to digital skills for disadvantaged students, providing them with opportunities to excel in a rapidly evolving digital landscape. The project not only demonstrated the tangible benefits of integrating advanced technologies into agricultural education but also highlighted how such initiatives could lead to more sustainable agricultural practices. This experience prepared students to contribute effectively to sustainable agriculture, equipped with the knowledge and skills to implement similar technologies in their future professional endeavours.

Conclusion:

This case study presents two systems designed for higher education, focusing on water preservation and sustainability. The systems utilized machine learning and low-cost microcontrollers to transform a retired water pump and faucet into smart IoT systems. The challenge was to balance practicality with implementation reproducibility and cost. The approach effectively increased social awareness about water conservation and enhanced students' understanding of IoT and ML matters. The proposed approach helped students acquire multidisciplinary benefits, gain technical knowledge, and implement applications contributing to sustainability objectives. University students with little technological background were assisted in demystifying cutting-edge technologies and bridging the gap between small-sized educational constructions and real-size systems. Similar activities should be incorporated into educational institutions to foster future professional careers for students, particularly benefiting disadvantaged students by widening their access to essential digital skills.

Case Study 2: AI in Agriculture Education ML and IoT Integration

About:

Integrating cutting-edge technologies such as artificial intelligence (AI) and machine learning (ML) into practical applications hold immense promise for addressing pressing global challenges. AI and ML offer innovative solutions to critical issues, such as water preservation, by enhancing traditional equipment with intelligent functionalities. The current study explored the integration of ML into real equipment within the context of higher education. By leveraging AI and ML technologies, the study addressed water preservation challenges and set a precedent for incorporating advanced technologies into educational practices. The intersection of engineering education and sustainability was at the forefront of this investigation, highlighting the transformative potential of integrating AI and ML into real-world scenarios for sustainable solutions.

Introduction:

In response to the evolving demands of higher education, this study investigated the integration of machine-learning techniques into water preservation education for engineering students. Recognizing the gap between theoretical learning and practical application, the study aimed to equip students with the skills needed to address real-world challenges in agriculture. By leveraging affordable hardware and software solutions, students engaged in hands-on activities focused on monitoring and optimizing agricultural equipment. This approach fostered innovation and sustainability while preparing students for their future roles in a rapidly changing industry.

Related Work and Rationale:

In agricultural engineering education, there was a growing recognition of the need to integrate sustainability principles and technological advancements, particularly in AI and ML. However, existing approaches often lack practical experiences and fail to address real-world challenges adequately. This study aimed to bridge this gap by transforming ML-based detection systems into educational tools for agricultural engineering laboratories. By combining hands-on learning with sustainability awareness, students developed practical solutions and prepared for careers in sustainable agriculture.

Smart Agriculture Education and AI Integration:

Incorporating smart agriculture education revolutionized traditional lectures into dynamic learning experiences. Students gained technical skills in ML, networking, and embedded systems through real prototype systems like a smart agriculture application and a water usage alert system. Soft skills like communication and teamwork were also emphasized. Challenge-Based Learning engaged students in resolving real-world agricultural issues, while practical implementation using versatile hardware components provided hands-on experience. Despite using simple components, students faced real-world challenges, enhancing both their technical proficiency and innovation mindset. This integration equipped future agricultural engineers to tackle sustainability challenges effectively.

Design and Implementation Overview:

The study provided a comprehensive overview of the design and implementation details of the farm systems, encompassing hardware and software aspects as well as neural network training. The water alert system, anchored by an Arduino Nano BLE unit, employed a Hall effect meter sensor for water flow measurement, while the water pump system integrated plastic tubes, valves, and an Arduino Nano with an accelerometer. Training involved data acquisition, model training, testing, and deployment, with the water pump system utilizing 33 features and the water alert system employing raw data. On-device integration was facilitated by the ESP8266 chip for real-time alerts, with ESP-01 or NodeMCU boards utilized as needed, and a monitoring app for Android smartphones was developed for receiving and inspecting alerts via Wi-Fi.

Results and Evaluation:

The study delved into the results and evaluation of the farm systems, emphasizing both technical and educational aspects. Participants, including students involved in system construction and testing, were assessed on their understanding and engagement with the ML-based systems. Technical evaluations included data collection, model training, and system testing, yielding high accuracy rates for both the smart faucet and water pump malfunction detection systems. Participants reported positive educational outcomes, with activities enhancing understanding of ML concepts, networking basics, and real-world problem-solving skills. The modularity and simplicity of the systems fostered learning and creativity among participants. Future directions included optimizing systems for broader real-world applications and developing commercial versions to promote sustainability and provide hands-on experience for students and professionals alike.

Engagement and Learning Activities:

Through hands-on experimentation with the smart water preservation systems, students were actively engaged in exploring concepts of IoT and ML while addressing real-world challenges related to water conservation. The interactive nature of the activities allowed students to collaborate in collecting and analyzing data, refining ML models, and troubleshooting system functionalities. Moreover, the integration of graphical user interfaces and smartphone applications provided students with intuitive tools to interact with the systems and visualize their impact on

water usage. By immersing themselves in these practical learning experiences, students gained a deeper understanding of sustainability principles and the role of technology in addressing environmental issues.

Challenges and Solutions:

Implementing the water preservation systems posed several challenges, particularly in terms of hardware compatibility and data management. One significant challenge was integrating the ML models into the low-cost microcontrollers while ensuring optimal performance. To address this, extensive testing and optimization were conducted to fine-tune the models and streamline their deployment on the microcontrollers. Another challenge was managing the large volumes of data generated by the systems, especially during the training and testing phases. To overcome this, efficient data handling techniques, such as data compression and batching, were implemented to optimize memory usage and processing speed. Additionally, ensuring the scalability and sustainability of the systems presented challenges, given the diverse educational settings and resource constraints. To tackle this, modular design principles were adopted to facilitate easy expansion and adaptation of the systems to different environments and requirements. Moreover, close collaboration with students and educators provided valuable insights and feedback, enabling continuous improvement and refinement of the systems to better meet the needs of diverse users and contexts.

AI Tool used:

The study used a machine learning model, specifically a neural network, integrated into low-cost microcontrollers like Arduino Nano BLE units and ESP8266 chips. This AI tool facilitated water preservation by accurately detecting issues and sending real-time alerts via an Android app. By engaging hands-on with these AI and IoT technologies, students enhanced their understanding of machine learning, networking, and embedded systems, thereby promoting digital skills and sustainability awareness.

Conclusion:

This study presented the development of two systems aimed at fostering educationally meaningful activities in higher education focused on water preservation and sustainability. By repurposing a

retired water pump and a faucet into smart IoT systems with the aid of ML and lowcost microcontrollers, the project tackled the challenge of balancing real-world applicability with affordability and reproducibility. Initial survey results indicated that the approach effectively increased social awareness about water conservation while enhancing students' understanding of IoT and ML concepts crucial for their future careers. The multidisciplinary benefits of the proposed approach empowered students with technical knowledge while addressing sustainability objectives. Incorporating similar activities into educational curricula can further support students' professional development in the future.

Case Study 3: Enhancing Climate Change Education with ChatGPT

Introduction:

This study investigates the integration of ChatGPT in higher education to enhance learning and engagement in a climate change course. It underscores the potential of AI tools in making complex environmental topics more accessible and interactive. The research aims to introduce university students to the principles of climate science and sustainable practices, leveraging ChatGPT to bridge knowledge gaps and foster critical thinking. The initiative aimed to prepare students for active roles in environmental conservation and climate action, broadening access to digital resources and personalized learning experiences. The study demonstrates the transformative impact of AI in promoting sustainable education.

Background:

Education for Sustainable Development (ESD) is crucial in addressing global challenges like climate change, resource management, and environmental conservation. Integrating advanced technologies such as Artificial Intelligence (AI) can significantly enhance the learning experience by making complex topics more accessible. Traditionally, climate change education involves theoretical knowledge that can be challenging for students to grasp. This project aimed to connect academic theories with real-world applications, facilitating the development of practical, scalable solutions for climate action. By employing ChatGPT, students were able to develop a deeper understanding of climate science, improve their critical thinking skills, and engage more actively in sustainability discussions. This approach also provided disadvantaged students with equal access to advanced digital learning tools, bridging educational gaps.

Implementation:

ChatGPT was integrated into various aspects of the climate change course to support learning and engagement:

1. **Interactive Lectures:** ChatGPT facilitated real-time Q&A sessions during lectures. Students could ask questions about complex topics like climate models, carbon cycles, and mitigation strategies, receiving immediate, detailed responses. This made lectures more interactive and engaging, helping students clarify doubts instantly.
2. **Study Materials:** ChatGPT was used to generate concise lecture notes, summaries, and study guides from course content. The AI processed detailed lecture materials to create high-quality, consistent resources tailored to student needs. This ensured all students had access to valuable learning materials.
3. **Personalized Feedback:** ChatGPT provided personalized feedback on assignments and projects. By analyzing each student's work, the AI offered constructive comments, highlighting strengths and areas for improvement. This timely feedback helped students understand their progress and enhance their work.
4. **Supporting Research:** For group projects on climate change mitigation strategies, students used ChatGPT to gather data, find relevant research articles, and draft initial project reports. This facilitated efficient collaboration and ensured all group members could contribute effectively.

Results:

The integration of ChatGPT in the climate change course yielded significant positive outcomes:

1. **Improved Understanding:** Students reported a better grasp of complex climate change concepts due to the detailed explanations and immediate feedback provided by ChatGPT.
2. **Increased Engagement:** The interactive nature of the lectures and personalized feedback increased student engagement and participation in the course.
3. **Enhanced Collaboration:** Group projects benefited from ChatGPT's support, leading to more effective collaboration and higher-quality submissions.

4. **Broadened Access:** Disadvantaged students gained equal access to advanced learning tools, promoting inclusivity and digital literacy.

Conclusion:

This case study highlights the successful integration of ChatGPT in a climate change education course. By providing interactive, personalized, and high-quality learning experiences, ChatGPT significantly enhanced student understanding, engagement, and collaboration. The approach not only prepared students for future roles in environmental conservation but also demonstrated the potential of AI in promoting sustainable education. Such initiatives should be incorporated widely to foster critical digital skills and sustainability awareness among students.

Case Study 4: Widening Participation in Sustainable Consumption Education with ChatGPT

Introduction:

This study explores the use of ChatGPT to support diverse learning needs and promote wider participation in a course on sustainable consumption and production. The research highlights the role of AI in making technical topics more accessible and engaging for students from varied academic backgrounds. The initiative aimed to prepare students for active roles in promoting sustainable practices, providing them with personalized learning experiences and bridging educational gaps for disadvantaged students. The study demonstrates how AI can foster inclusivity and enhance learning outcomes in sustainability education.

Background:

Education for Sustainable Development (ESD) is vital for addressing pressing global challenges such as resource depletion and environmental degradation. Integrating AI technologies like ChatGPT can enhance the educational experience by simplifying complex topics and making them more accessible. Traditionally, courses on sustainable consumption involve technical content that can be difficult for some students to understand. This project aimed to make the content more inclusive by leveraging ChatGPT to provide personalized support, enhance engagement, and foster critical

thinking. The approach ensured that all students, including those from disadvantaged backgrounds, had equal access to advanced learning tools and resources.

Implementation:

ChatGPT was integrated into various aspects of the sustainable consumption course to support diverse learning needs and promote wider participation:

Bridging Knowledge Gaps:

ChatGPT provided simplified explanations and additional resources for technical topics like life cycle assessment (LCA) and sustainable supply chains. This made the content accessible to all students, regardless of their academic background.

Language Support: For international students, ChatGPT offered translations and summaries in multiple languages. This support helped non-native English speakers better understand the course material and participate more actively in class discussions.

Research and Assignments: Students used ChatGPT to assist with research for their assignments and projects. The AI provided relevant literature, data, and suggestions for structuring their work, ensuring comprehensive and well-informed submissions.

Developing Rubrics: ChatGPT helped create detailed rubrics for assignments, ensuring clear expectations and consistent grading criteria. This transparency helped students understand the assessment standards and improve their work accordingly.

Results:

The use of ChatGPT in the sustainable consumption course resulted in significant improvements in learning outcomes and participation:

- **Widened Participation:** The course content became more accessible to students from diverse linguistic and academic backgrounds, increasing overall participation and inclusivity.
- **Improved Performance:** Students showed improved performance in assignments and exams, benefiting from the personalized support and comprehensive resources provided by ChatGPT.
- **Positive Feedback:** Both students and faculty provided positive feedback on the integration of ChatGPT, noting its effectiveness in enhancing understanding and engagement in complex sustainability topics.
- **Broadened Access:** Disadvantaged students gained equal access to advanced learning tools, promoting digital literacy and inclusivity.

Conclusion:

This case study demonstrates the successful use of ChatGPT in a sustainable consumption education course. By providing personalized support and making technical content more accessible, ChatGPT significantly enhanced student participation, performance, and engagement. The approach not only prepared students for future roles in sustainability but also highlighted the potential of AI in promoting inclusive and effective education. Such initiatives should be widely adopted to foster digital literacy and sustainability awareness among students.

Case Study 5: Enhanced Education with Smart Sparrow: An Adaptive eLearning Experience

Introduction

This case study explores the integration of the AI-driven platform "Smart Sparrow" within a Petroleum Engineering course. The study addresses the challenge of providing personalized learning experiences to students in large, diverse classes. By leveraging adaptive eLearning tools, the university aimed to enhance educational outcomes, improve student engagement, support flexible learning environments, and equip students with essential competencies for the modern

workforce. This initiative aligns with Sustainable Development Goal 4, quality education, which emphasizes inclusive and equitable quality education and the promotion of lifelong learning opportunities.

Background

Delivering personalized learning experiences to a large and diverse student body is a common challenge in Higher education. Traditional teaching methods often need to be revised to address the individual learning needs and styles of students. Recognizing this, the university sought to implement a solution that could tailor content delivery to each student's unique pace and performance. The AI-driven platform "Smart Sparrow" was chosen to meet this need. Smart Sparrow allows educators to create adaptive learning pathways, offering personalized feedback and resources based on students' progress and response patterns. This technology not only enhanced learning outcomes but also provided students with crucial digital skills, making education more accessible and inclusive.

Implementation

The implementation of Smart Sparrow in the Petroleum Engineering course involved creating adaptive quizzes, known as Smart Quizzes, that provided real-time feedback tailored to each student's needs. The platform enabled the creation of interactive and adaptive online resources without requiring specific programming skills, allowing educators to maintain pedagogical ownership of their content. The Smart Quizzes were introduced after students attended face-toface lectures and tutorials. Each quiz consisted of six to eight questions with adaptive feedback linked to each question. The feedback varied depending on the complexity of the question, ranging from simple verification (indicating whether an answer was correct or incorrect) to elaborated feedback that provided hints or detailed explanations. The quizzes were made available on the course's Learning Management System (LMS) and remained open until the examination period, allowing students to access them at their convenience.

Data on student usage and interaction with the quizzes were collected through the platform's analytics engine. This data provided insights into how students were using the quizzes, their performance, and any misconceptions they had. Additionally, a participant questionnaire was used to gather information on students' attitudes and perceptions regarding the Smart Quizzes. The questionnaire included questions on a five-point Likert scale and open-ended questions.

Results

The implementation of Smart Sparrow led to significant improvements in student engagement and academic performance. Students overwhelmingly accepted the Smart Quiz concept, with high participation rates and positive feedback. Out of 113 students enrolled in the course, 96.9% accessed the week seven quiz, and 92.9% accessed the week eight quiz, with a 100% completion rate for both quizzes. Students from various academic backgrounds engaged with the quizzes, demonstrating their broad appeal and effectiveness.

The adaptive feedback provided by the quizzes helped students understand complex concepts better and learn from their mistakes. Students particularly appreciated the "try again" feedback that included hints, as it encouraged them to reflect on their answers and understand their mistakes. The flexibility to access the quizzes at any time and place allowed students to learn at their own pace, which was reflected in the data showing quiz usage at all hours of the day and night.

The analytics revealed that the instant feedback provided by the quizzes helped students identify and address their misconceptions, leading to improved understanding and performance in the course. The platform also offered faculty valuable insights into student learning patterns, enabling them to refine their teaching strategies further and tailor their instruction to better meet their students' needs. By interacting with the adaptive eLearning platform, students developed essential digital skills that are increasingly important in today's technology-driven world.

Conclusion

This study demonstrates the significant potential of AI-powered tools like Smart Sparrow to enhance the learning experience in higher education. The adaptive eLearning platform provided a flexible, personalized learning environment that catered to students' diverse needs. The instant, adaptive feedback helped students engage with the material more effectively and gain a deeper understanding of complex concepts. By offering a low-risk, supportive learning environment, the Smart Quizzes empowered students to take control of their learning and improve their academic performance.

The initiative reinforced the potential of AI to enhance personalized learning and highlighted the scalability challenges in creating adaptive course materials. It also emphasized the importance of integrating faculty insights with AI capabilities to develop a truly adaptive learning environment.

Continuous collaboration between AI technologists and educators was crucial in tuning the system to meet actual educational needs, ensuring that technology served as a complement to, rather than a replacement for, traditional teaching methods. This approach aligns with the goals of SDG 4 by promoting inclusive and equitable quality education, widening access to digital skills, and equipping students with essential competencies for the future.

Case Study 6: Digital Skills through AI Integration within ERP Systems

Introduction:

In response to the evolving demands of modern business, this study investigated the integration of Artificial Intelligence (AI) into Enterprise Resource Planning (ERP) systems to enhance organizational efficiency and innovation. Recognizing the gap between traditional ERP functionalities and the needs of today's dynamic business environment, the study aimed to equip organizations with advanced tools for optimizing operations and decision-making. By leveraging AI technologies such as machine learning, natural language processing, predictive analytics, and cognitive computing, businesses automated processes, gained predictive insights, and improved resource utilization. This approach fostered innovation and resilience while preparing organizations to navigate the complexities of the digital era. The convergence of AI and ERP systems represented a transformative moment, offering unprecedented opportunities for streamlining operations and enhancing competitive advantage.

Related Work and Rationale:

In organizational management, the convergence of Artificial Intelligence (AI) and Enterprise Resource Planning (ERP) systems has drawn considerable scholarly attention for its transformative potential in operations and decision-making. This review synthesized existing research on AI's impact on ERP systems, tracing their historical evolution and discussing AI technologies such as machine learning, natural language processing, predictive analytics, and cognitive computing. While AI integration offered benefits like enhanced decision-making and operational efficiencies, challenges like data privacy, security, and workforce upskilling persisted. Empirical studies highlighted AI's positive impact on ERP systems across industries. The review concluded by

identifying research gaps and future directions, emphasizing AI's transformative role and offering insights for academia, industry, and policymakers.

Enterprise Resource Planning:

Enterprise Resource Planning (ERP) systems, fundamental to modern organizational management, integrated and managed core business processes, serving as centralized repositories of data facilitating seamless coordination and collaboration across departments. These systems streamlined operations, enhanced efficiency, and improved decision-making by providing realtime insights into business activities. Spanning areas such as finance, accounting, supply chain management, human resources, manufacturing, and customer relationship management, ERP systems optimized processes, maintained optimal inventory levels, and improved customer satisfaction. Key characteristics included integration, real-time reporting, standardization, automation, scalability, and security. However, successful ERP implementation required careful planning, stakeholder engagement, customization, user training, and ongoing support. While offering numerous benefits, challenges such as cost, complexity, and resistance to change had to be addressed. ERP systems were pivotal in enabling efficient resource management, enhancing operational effectiveness, and fostering agility in dynamic business environments.

Results and Evaluation: Quantitative Results from the Research:

Derived from a comprehensive survey of 300 enterprises, the research findings illuminated the transformative impact of integrating Artificial Intelligence (AI) within Enterprise Resource Planning (ERP) systems. The analysis revealed significant improvements across various operational facets: a 27% reduction in task processing times, a 35% increase in accuracy levels, an 18% decrease in maintenance costs, and a 22% boost in Overall Equipment Effectiveness (OEE) among companies implementing AI-driven predictive analytics within their ERP platforms. Furthermore, a comparative study highlighted a compelling 30% surge in customer satisfaction levels post AIpowered user experiences within ERP systems. These quantitative findings underscored the tangible advantages achieved through AI-ERP integration, validating its efficacy in driving efficiency, reducing costs, enhancing productivity, and elevating customer satisfaction levels within organizations.

Engagement and Learning Activities:

The integration of Artificial Intelligence (AI) tools in education for sustainable development offered a transformative approach to engage students in dynamic learning experiences. By leveraging AI technologies like machine learning, natural language processing, and predictive analytics, students could explore complex sustainability challenges while gaining practical skills and insights. Hands-on activities, such as developing AI-based solutions for environmental monitoring or analyzing data to optimize resource utilization, provided students with tangible experiences that bridged theoretical knowledge with real-world applications. Collaborative projects and interactive simulations enabled students to work together in addressing sustainability issues, fostering teamwork, critical thinking, and innovation. Moreover, the integration of AI-powered learning platforms and intelligent tutoring systems personalized the learning experience, catering to individual student needs and preferences. Through this engagement and learning activities, students not only developed proficiency in AI technologies but also cultivated a deeper understanding of sustainability principles and their role in shaping a more resilient and equitable future.

Challenges and Solutions:

Incorporating AI into ERP systems faced hurdles like accessibility, ethical considerations, complexity, and inclusivity. Solutions entailed promoting affordable AI integration, implementing robust ethical frameworks, offering comprehensive training, and ensuring inclusivity in adoption. Addressing these challenges fostered equitable access to AI-driven ERP systems, ensured responsible AI utilization, simplified comprehension, and encouraged diverse participation, empowering organizations to navigate digital transformation effectively.

AI Tools used:

The AI tools used in this study included machine learning, natural language processing, and predictive analytics. These tools were leveraged to analyze data, automate processes, and gain predictive insights within Enterprise Resource Planning (ERP) systems, ultimately driving efficiency and innovation in organizational management.

Conclusion:

The research underscored the transformative impact of AI integration within ERP systems, revealing significant improvements in efficiency, accuracy, cost reduction, productivity, and customer satisfaction. Enterprises witnessed a notable 27% reduction in task processing times and a remarkable 35% increase in accuracy levels. Implementation of AI-driven predictive analytics resulted in an 18% decrease in maintenance costs and a substantial 22% enhancement in Overall Equipment Effectiveness (OEE). Moreover, AI-powered personalized user experiences led to a compelling 30% surge in customer satisfaction levels. Future research should focus on industryspecific impacts, longitudinal studies, ethical implications, user adoption, and exploring advanced AI applications within ERP systems to maximize organizational success in dynamic business landscapes.

Case Study 7: Enhancing Student Success through Predictive Analytics

In the rapidly evolving landscape of higher education, ensuring student success and improving retention rates are vital. This case study explores how predictive analysis tools were used to tracking student performance. This approach helped lecturers to achieve significantly enhanced student outcomes, particularly in business courses by providing timely interventions. The analytical aid through Canvas (a virtual learning environment) enabled lecturers to achieve this effectively.

The higher education organisation in which this case study took place has a diverse range of student, across all departments including the business school, which presents unique challenges in ensuring academic success across various demographics. Traditional methods of monitoring student performance were proving inadequate in identifying at-risk students early enough for effective intervention. Consequently, this organisation required a more proactive and data-driven approach to support its students and academic staff.

This organisation implemented a comprehensive predictive analytics system designed to track and analyse student performance data from multiple sources, including grades, attendance, participation in campus activities, access to online resources, and even financial aid status. The

system uses sophisticated algorithms to identify patterns and predict which students are at risk of academic difficulties.

A crucial aspect of the implementation was the integration of data from contrasting sources into a unified platform. This required collaboration between various departments, including IT, academic affairs, and student services. The system was designed to be user-friendly, providing faculty and advisors with real-time alerts and actionable insights.

One of the standout features of UH approach is its focus on undergrad student engagement, where data indicated further focus is required. By investigating into course-specific data, the university was able to identify specific pain points and tailor interventions more effectively. These interventions included targeted tutoring, advising 121 sessions, and workshops designed to address common academic challenges.

Here's how it could be applied:

1. **Data Integration and Analysis**:
    - Collect data from various sources related to student performance in their courses, participation in activities, and engagement with projects.
    - Analyse this data to identify patterns and predict which students might struggle. This was happening through Canvas and the report has been communicated to the relevant stake holders.
2. **Early Identification of At-Risk Students**:
    - Use predictive models to flag students who may be at risk of underperforming or disengaging from programs. This includes tracking attendance, assignment submissions, access resources for further study, and feedback from educators. Using predictive analytics to identify at-risk students early and providing timely interventions is an example of a proactive approach to education. This helps create a supportive learning environment, which is an essential component of ESD.
3. **Targeted Interventions**:

- Develop specific support mechanisms for students identified as at-risk. This could include personalized tutoring, mentoring, workshops, and resources. This holistic approach to education supports the development of well-rounded individuals who are better equipped to contribute to sustainable development.
- Offer additional support for students from diverse backgrounds to ensure equitable access to opportunities.

4. **Faculty and Advisor Training**:
    - Train educators and advisors to interpret data insights and implement appropriate interventions. This aligns with ESD principles by promoting lifelong learning and professional development.

The impact of university's predictive analytics initiative has been great. Since its implementation, the university has seen a marked improvement in student engagement and academic performance. Specifically, in undergraduate courses, there has been a significant decrease in the number of students struggling or dropping out. The early identification and support mechanisms have enabled students to receive the help they needed before their difficulties became challenging.

1. **Improved Student Engagement and Performance**:
    - By providing targeted support, students are more likely to succeed in their courses and projects, leading to better academic outcomes.
2. **Higher Retention Rates in Programs**:
    - Early interventions help retain students in their programs by addressing challenges before they become critical, ensuring more students complete their education.
3. **Enhanced Equity**:
    - Predictive analytics can help identify and address disparities in access and success, ensuring that all students, regardless of their background, have the opportunity to benefit from education. This focus on inclusivity aligns with the ESD goal of promoting social equity and reducing inequalities.

However, this is not the only university which using data analytics approach to enhance student success. Georgia State University (GSU) use similar pattern and established the use of predictive analytics to address these challenges. GSU reported a 3.5% increase in overall retention rates within the first two years of implementing the predictive analytics system. Additionally, students who received early interventions showed a 12% improvement in their academic performance compared to those who did not.

The use of predictive analytics serves as a compelling example of how data-driven approaches can enhance student success in higher education. By leveraging technology to monitor and support student performance proactively, the university has not only improved student engagement but also fostered a more supportive and responsive educational environment. I would like to put emphasis on the potential of predictive analytics to transform educational institutions and better support diverse student populations.

This experience covers several elements that align with the principles of Education for Sustainable Development (ESD), including proactive and data-driven approaches, equity and inclusivity, capacity building, sustainable educational practices, holistic support systems, real-life application, continuous improvement, and cross-departmental collaboration. These aspects collectively contribute to creating a supportive, equitable, and sustainable educational environment.

Case Study 7: GeoAI: Where machine learning and big data converge in GIScience

Introduction

The integration of Artificial Intelligence (AI) in education has opened new pathways for enhancing learning experiences and widening access to digital skills. In the context of Geographical Information Science (GIScience), GeoAI emerges as a powerful tool that leverages machine learning and big data to tackle complex geospatial problems. This case study delves into the application of GeoAI in GIScience, highlighting its potential to support education for sustainable development (ESD) and digital skill acquisition.

Background

GeoAI, or geospatial artificial intelligence, integrates AI with geospatial big data and highperformance computing to address data-intensive GIScience challenges. The rapid advancements in Earth Observation (EO), machine learning, and computational resources have significantly enhanced our ability to process and analyze geospatial data. These advancements enable educators to develop new pedagogical practices that are data-driven and highly interactive, fostering a deeper understanding of spatial phenomena and their implications for sustainable development.

Methodology and Implementation of GeoAI

GeoAI employs two primary methodological approaches: data-driven and knowledge-driven. The data-driven approach utilizes machine learning, particularly deep learning, to extract meaningful patterns from large datasets without explicitly programming the analytical rules. On the other hand, the knowledge-driven approach relies on ontological frameworks and logical reasoning to interpret spatial data. In practice, GeoAI utilizes convolutional neural networks (CNNs) for tasks such as scene classification, change detection, and object recognition in remote sensing imagery. By integrating machine learning with geospatial data, GeoAI facilitates the automatic extraction of features and the prediction of spatial phenomena, enhancing the capability to analyze and visualize complex geospatial data. Additionally, knowledge graphs in GeoAI support semantic search, intelligent question answering, and the discovery of new insights from geospatial data.

Engagement and Learning Activities

Lecturers can harness the power of GeoAI to create dynamic and interactive learning environments. By incorporating GeoAI tools into their teaching practices, they can offer students hands-on experience in analyzing real-world geospatial data. This approach not only enhances the learning experience but also equips students with practical skills in AI and geospatial analysis, which are crucial for addressing sustainable development challenges. For students, GeoAI offers improved access to diverse and complex datasets. The use of AI-powered tools allows them to explore geospatial phenomena in greater depth, fostering critical thinking and problem-solving skills. Interactive learning activities, such as projects involving the analysis of satellite imagery or the creation of predictive models, engage students and promote a deeper understanding of the principles of GIScience and sustainable development.

Challenges and Solutions

One of the significant challenges in implementing GeoAI is ensuring the quality and availability of training data. High-quality geospatial data can be sparse, noisy, or biased, affecting the accuracy of GeoAI applications. To address this, efforts should be made to curate and share high-quality geospatial datasets for educational purposes, with collaborations between academic institutions and industry partners being particularly beneficial. Another challenge is the interpretability of deep learning models. While these models offer high predictive power, their complexity can make them difficult to interpret, posing a challenge for educational purposes where understanding the decision-making process is crucial. Developing and incorporating explainable AI techniques into GeoAI applications can help make the models more transparent and interpretable, facilitating better understanding and trust among users. Lastly, both lecturers and students need a certain level of technical proficiency to effectively use GeoAI tools. This requirement may limit the accessibility of these tools to those with advanced technical skills. Providing comprehensive training programs and support resources for both lecturers and students can help bridge this technical skills gap. Online tutorials, workshops, and mentorship programs can enhance their proficiency in using GeoAI tools.

Conclusion

GeoAI represents a significant advancement in the field of GIScience, offering powerful tools for geospatial analysis and sustainable development education. By leveraging AI and big data, GeoAI enhances the ability of educators to create engaging, data-driven learning experiences that equip students with essential digital skills. Addressing the challenges associated with data quality, model interpretability, and technical proficiency is crucial to maximizing the potential of GeoAI in promoting education for sustainable development.

Case Study 8: Improving Inclusive Education for Students with Special Needs through Integration of AI tools and ChatGPT in Teaching

Contextual Background:

In line with its post-communist educational reform and adherence to the EU and UN Charter of Human Rights and non-discriminative policies, the Albanian government issued Law 93/2014 "On the Inclusion and Accessibility of Disabled Persons". Students who have long-term physical, mental, intellectual, or sensory impairments which, in interaction with various barriers, including environmental and residential ones, may impede their full and efficient participation in society, on equal terms with the others, are considered to be "students with disabilities". EPOKA University, a private international English-instructed university, reupdated its EPOKA University
Policy "On Students with Disabilities" Document code Entrance in force No. of Update Date of Update EU-PLC-004-EN 26.02.2021 001 Page/Overall pages 08.11.2022 1. PURPOSE AND APPLICATION 1 / 5 EPOKA University is committed to ensuring that all students with disabilities receive education in a supportive environment that values diversity, inclusion, and participation. All units will use inclusive practices and reasonable adjustments to carry out changes in procedures or environments to remove any disabling effects or barriers to participation. This policy applies to all disabled students regardless of nationality, fee status, or residence. However, be it at the national and/or individual institutional level there are no tailored innovative digital pedagogical tools to facilitate effective learning styles and equal knowledge acquisition by such learners who display a lack of mental concentration, reading, and articulating abilities in foreign language or sound reasoning for independent analytical writing tasks.

Didactic Barriers to Inclusive Education in the mainstream lecture:

Albanian higher education authorities have legally offered provision for equal accession and learning opportunities to disabled students, for instance, students suffering from full autism or semi-autism syndrome to be fully immersed in normal academic classes. These normal classes are taught by professors who have not had any didactic training in their academic studies to harness them with the pedagogic competence and tools to cope with special needs learners amid a normal class. Conversely, the pre-primary school departments and elementary teacher departments at three universities in Albania, the University of Shkodra, University of Gjirokastra, and the University

of Duress, have seriously included in their academic curricula for teacher programs, the special didactics for disabled children as included in the normal pre-university teaching program (2016). Conversely, some EU universities, for instance, the University of Copernicus in Torun Poland do not include students with special needs in mainstream classes. Instead, this university is given public funds for individual tutorials to special needs students by tailored professors with the appropriate academic and teaching competence for disabled mature learners.

Integration of AI Tools to Harness Effective Inclusive Education and Promote Education for Sustainable Development

Scholars have examined and assessed the academic databases exploring the effect of AI Tools to positively transform and facilitate the teaching /learning process with students who display exceptional requirements and learning disabilities ascertaining that AI integration has had a dual effect, not only on learners with special needs but also on educational institutions by facilitating the development of inclusive teaching methods (Abbasi, Zulfiqar, Rasool, & Quadri.2024). In Albania, the integration of AI tools and platforms in higher education has been prioritized by educational institutions for both staff and students through international project collaboration.
For instance, EPOKA University participated as a partner member of the *IDEA project in the Balkans* and held a special training for the inclusion of students with disabilities in universities and pedagogical training of the staff before that inclusion (https://2023.unishk.edu.al/aktivitetiplote?tx_news_pi1%5Baction%5D=detail&tx_news_pi1%5Bcontroller%5D=News&tx_news_pi1%5Bnews%5D=1044&cHash=6e8bbd31faa4bf1de4372df548cfa357. Nonetheless, the pedagogical guidelines were not closely related to the usage of AI tools and digital platforms as facilitators for effective inclusive education for all.

My Experience with AI tool- ChatGPT in the undergraduate course of English for IT

This bachelor's course is offered to students enrolled in Computer engineering, software engineering, and Electronics engineering programs. Students in these programs, undoubtfully are keen on technology and programming and innovations in AI. Recently, these programs have been chosen by students possessing exceptional needs displaying semi-autism or low autism syndrome. Some of them lack social interaction and confident public speaking but can articulate better in written form. most importantly, they showed a positive cognitive reaction to tech-merged classes using video lecturing, e-books, and interaction with virtual assistants. A survey was delivered by

me the lecturer to all enrolled students on their attitude towards the positive or negative usage of ChatGPT to further develop their academic writing in the field of completing engineering essays. The overall class survey found that students found ChatGPT very useful and time-saving for brainstorming and mapping ideas in thematic clusters; afterward, they would see it more beneficial to go through the writing drafts and revisions in the conventional learning styles.

The use of ChatGPT to structure initial thoughts, a cluster of ideas be them theoretically, empirically, and linguistically related to IT vocabulary, was a perfect channel to shatter cognitive and learning gaps between the mainstream students and the limited ones with special learning needs and uncommon knowledge acquisition patterns. Throughout the entire course, all types of sources of knowledge were intertwined evenly, the main written textbook, the internet video lecturers, and other updated online demonstrations of English used in IT situations, plus the ChatGPT as a means of enhancement derive substantial benefits rather than replacement. Students with special needs likewise others, reflected critically on the capabilities and limitations of this AI language-generated tool applied in an ESP class; and frequently interacted with ChatGPT to become alert of its response pattern as compared to their previous authentic draft of the linguistic task. In addition, and most importantly, students with special needs could use this tool as a tutor and personal assistant to offer prompt organizational tips, set goals and objectives, and aid with complicated home assignments.

Case Study 9: On exploiting Data Visualization and IoT for Increasing Sustainability and Safety in a Smart Campus

Introduction

The integration of Data Visualization and Internet of Things (IoT) in educational environments offers significant opportunities to enhance sustainability and safety. This case study examines the deployment of a smart campus initiative, focusing on the use of a responsive web-based dashboard that leverages IoT data to improve campus management. This case study illustrates the practical implementation of AI tools to promote sustainable development in higher education.

Background

In an increasingly digital world, the need to manage and interpret large volumes of data is critical. Several universities have implemented smart campus projects. The project uses IoT sensors and data visualization techniques to monitor real-time occupancy and environmental conditions. This initiative aligns with the goals of Education for Sustainable Development (ESD) by fostering a safer and more efficient campus environment.

Methodology and Implementation of AI Technology

The smart campus project is built on an IoT infrastructure consisting of cameras and environmental sensors. Intel RealSense D415 Depth cameras are used for people counting, while Canarin II sensor stations monitor air quality, temperature, humidity, and air pressure. A custom model based on YOLOv3 performs people counting by analyzing images and predicting the number of individuals in a given space.

The data collected by these devices is integrated into a web-based dashboard developed using Angular, HTML5, CSS3, and TypeScript. This dashboard provides real-time insights into campus occupancy and environmental conditions, helping to optimize space usage and ensure safety. The system architecture follows a client-server model, ensuring robust data processing and visualization capabilities. The client-side application offers responsive design, allowing access from various devices including smartphones and tablets. Additionally, the server-side infrastructure employs Node.js and Express, facilitating seamless communication with multiple data sources and ensuring scalability for future enhancements.

Engagement and Learning Activities

The system enhances engagement and learning activities by providing faculty members with realtime data on classroom occupancy and environmental conditions. This information allows lecturers to adjust their teaching strategies and ensure that students are learning in a safe and comfortable environment. The dashboard also facilitates the scheduling of classes and the allocation of resources, promoting more effective and efficient use of campus facilities.

Challenges and Solutions

The project faced several challenges, including ensuring the accuracy of the people counting system and integrating various data sources into a single platform. The team addressed these

challenges by employing a three-layer architecture that ensures scalability, availability, and privacy compliance. The use of edge-based computing and transfer learning methodologies improved the accuracy of people counting, achieving an average accuracy rate of 91%.

Conclusion

This smart campus initiative demonstrates the potential of AI-powered tools to enhance sustainability and safety in educational environments. By leveraging IoT and data visualization technologies, the project provides faculty members with the tools they need to manage campus facilities effectively and create a safer, more sustainable learning environment. This case study highlights the importance of integrating digital skills and AI technologies in promoting ESD in higher education.

Case Study 10: Personalising Education with the Cognitive Tutor

Introduction:

In the rapidly evolving educational landscape, the demand for personalised learning experiences has become more pronounced. Intelligent Tutoring Systems (ITS) have emerged as a powerful tool to address this need. One notable example is the Cognitive Tutor which tailors learning experiences to individual students' needs. This case study explores the implementation and impact of the Cognitive Tutor on student learning, particularly in business-related courses such as statistics and economics.

Background:

Recognising the limitations of traditional, one-size-fits-all teaching methods, the Cognitive Tutor was developed. This ITS leverages cognitive science principles to create a dynamic learning environment that adapts to each student's unique pace and style. Initially designed for mathematics education, the Cognitive Tutor has been expanded to various subjects, including business courses.

Implementation:

The Cognitive Tutor system integrates seamlessly into the existing curriculum, providing an interactive platform where students can engage with course material. The system collects data on students' performance, identifying strengths and weaknesses. It then customises feedback and resources to address individual learning gaps. In business-related courses like statistics and economics, the Cognitive Tutor presents problems, guides students through solving them, and offers hints and explanations as needed.

Key steps in the implementation process included:

1. **Curriculum Integration:** Aligning Cognitive Tutor content with course objectives and learning outcomes.
2. **Training Instructors:** Equipping instructors with the skills to effectively use the ITS and interpret its feedback.
3. **Student Onboarding:** Introducing students to the system and its benefits to ensure smooth adoption.
4. **Continuous Improvement:** Regularly updating the system based on feedback and advances in educational technology.

Results:

The implementation of the Cognitive Tutor has produced significant improvements in student performance and engagement. Key outcomes include:

- **Enhanced Learning Outcomes:** Students using the Cognitive Tutor demonstrated higher proficiency in statistics and economics compared to those in traditional learning environments.
- **Personalised Feedback:** Tailored feedback helped students address specific misconceptions, leading to a deeper understanding of the material. The Cognitive Tutor adapts to individual students' learning paces and styles, providing personalised feedback and resources. This personalised approach can be particularly beneficial for ESD, where students come from diverse backgrounds with varying levels of prior knowledge about sustainability. By tailoring content to meet each student's needs, the

Cognitive Tutor ensures that all students can grasp complex ESD concepts at their own pace.

- **Increased Engagement:** The interactive nature of the system maintained student interest and motivation, reducing dropout rates.
- **Efficient Use of Instructor Time:** Instructors could focus on higher-level teaching tasks, as the system handled routine practice and assessment.

Quantitative data supporting these results showed a marked increase in test scores and overall course grades among students using the Cognitive Tutor.

Conclusion:

The Cognitive Tutor represents a significant advancement in the field of Intelligent Tutoring Systems. By personalising learning experiences and providing targeted feedback, the system has improved student outcomes in business-related courses like statistics and economics. The success of the Cognitive Tutor underscores the potential of ITS to transform education by making learning more adaptive and student-centred. As technology continues to evolve, such systems will play an increasingly critical role in shaping the future of education.

Case Study 11: Empowering Negotiation Management Education through VEVOX and AI Integration

***Introduction*:**

Negotiation Management stands as a crucial competence in the collection of business professionals, requiring adeptness in strategy, communication, and decision-making. In response to the imperative of cultivating negotiation expertise among students, this case study explores the innovative utilization of the VEVOX app and AI integration by a Negotiation Management lecturer at the University of Elbasan "Aleksandër Xhuvani" in Elbasan, Albania. Through the strategic use of VEVOX polls and introduction to AI applications in negotiation via the Gamma app, students are engaged in exploring crucial aspects of negotiation in response to the urgent and dramatic challenges the planet faces within the confines of traditional classroom settings.

***Background*:**

As negotiations spread various aspects of organizational life, the importance of equipping students with robust negotiation skills and competencies cannot be overstated. Within the pedagogical context of the University of Elbasan "Aleksander Xhuvani," lectures endeavor to foster a deep understanding of negotiation principles and practices, despite constraints on distance learning initiatives post-COVID-19. Leveraging the TEAMS platform and the online classroom, the lecturer seized upon the opportunity to integrate VEVOX polls into Negotiation Management sessions, complemented by an introduction to AI applications in negotiation via the Gamma app.

***Implementation of VEVOX and AI Integration*:**

The integration of the VEVOX app within the TEAMS platform served as a catalyst for transforming traditional lectures into interactive and immersive learning experiences. Through the strategic use of VEVOX polls, students were prompted to explore key concepts in negotiation, including interests and positions, negotiation planning, stakeholder mapping, inoculation, and BATNA analysis. In addition, the lecturer supplemented these sessions with an introduction to AI applications in negotiation, utilizing the Gamma app to showcase how AI can enhance negotiation preparation and strategy development to promote the concepts of global citizenship, and environmental citizenship.

***Their Experiences with VEVOX*:**

Students' experiences with the VEVOX app were completely positive, with many expressing enthusiasms for its interactive features and real-time feedback. One student remarked, "The live polls were really interesting, and I enjoyed the interaction, both in terms of asking questions and providing answers. It made the lectures much more engaging." Another student added, "The instant feedback from the polls was incredibly valuable. It helped me stay focused and measure my understanding of the material in real-time." From the lecturer's perspective, the use of VEVOX was not only engaging but also provided valuable insights into student engagement and comprehension. "The live poll was such entertainment for me and for my students," the lecturer commented. "I could gather valuable statistics such as the time for each answer, the most difficult questions, and the clearest concepts. The poll results helped me to be more focused on each of

my students, ensuring that I could address their individual needs effectively." Additionally, the lecturer highlighted the utility of VEVOX for creating anonymous online and lives pre- and postevaluations for the negotiation course, further enhancing the assessment process and providing valuable feedback to students.

Engagement and Learning Activities:

The combination of VEVOX polls and AI integration facilitated active engagement and critical thinking among students, as they grappled with real-world negotiation scenarios and dilemmas in terms of an Education for Sustainable Development (ESD) – focused module. VEVOX polls were strategically deployed to solicit student perspectives on negotiation strategies, gauge comprehension of theoretical concepts, and stimulate discussion on practical applications.

Meanwhile, the introduction to AI applications in negotiation planning provided students with valuable insights into emerging technologies and their potential impact on negotiation practices.

***Challenges and Solutions*:**

Despite the success of the VEVOX and AI integration, the lecturer encountered challenges related to technology infrastructure, including missing investment in technology infrastructure. This challenge hindered the seamless implementation of interactive polls and AI applications within the TEAMS platform. However, by leveraging students' smartphones and upgrading to a private VEVOX account, the lecturer was able to mitigate these challenges and ensure continued engagement and participation in online seminars. Additionally, the lecturer's proactive approach to providing guidance and support enabled students to navigate the transition effectively.

***Conclusion*:**

In conclusion, the integration of the VEVOX app and AI applications within Negotiation Management education has emerged as a transformative tool for enhancing student engagement and promoting active learning at the University of Elbasan "Aleksander Xhuvani." It allowed all students to acquire the knowledge, skills, attitudes, and values necessary to shape a sustainable future utilizing an interdisciplinary approach to learning. Despite facing challenges related to

technology infrastructure and the transition to online platforms, the lecturer's proactive approach and students' adaptability enabled the successful implementation of VEVOX polls and AI integration within the TEAMS platform. Moving forward, the continued utilization of VEVOX and AI holds promise for further enriching educational experiences and equipping students with essential negotiation skills to thrive in diverse professional contexts and develop the skills, knowledge, and experience to contribute to an environmentally and ethically responsible society and pursue a career that reflects those values.

Case Study 12: Using AI in a Problem-Based Learning Session: Hunger Hotspots

Introduction:

The integration of artificial intelligence (AI) in education is transforming the way students engage with complex real-world problems. This case study explores how AI tools were used in a problembased learning (PBL) session focused on food insecurity, specifically the "Hunger Hotspots" session, designed for students in a "Sustainability in Practice" module. The session aimed to engage students in generating and critically evaluating solutions to food insecurity using AI, thereby fostering critical thinking and broadening their digital competencies.

Background:

Food insecurity is a critical global issue, affecting millions of people worldwide, including those in developed countries. Addressing this problem requires innovative solutions and a multidisciplinary approach. The "Sustainability in Practice" module, offered to students in Agriculture, Earth and Environment, and Applied Social Sciences Cluster (AESSC), was designed to tackle such complex challenges. The module adopts a problem-based learning approach, encouraging students to engage with real-world issues actively. The "Hunger Hotspots" session was specifically crafted to address food deserts and food insecurity, integrating AI tools to enhance the learning process.

Implementation:

The AI tools used in the session were ChatGPT and Bard, which were chosen for their ability to generate diverse strategies and solutions. The implementation of the PBL session involved several

key steps to ensure an engaging and interactive learning experience for the students. The session began with an in-person introductory lecture covering essential concepts related to food security, including global hunger, food security pillars, measurement of food insecurity, and the effects of food insecurity. This lecture provided students with the foundational knowledge necessary for the subsequent tasks. The lecture aimed to set the context for the problem-solving activities, highlighting the relevance and urgency of addressing food insecurity.

Following the introductory lecture, students participated in a two-hour seminar. Prior to the workshop, students were assigned a short reading related to food security to help them familiarize themselves with the topic. During the workshop, students had the opportunity to discuss the material, ask questions, and seek clarification. This interactive session was designed to deepen their understanding of the issues and prepare them for the problem-based tasks.

The core of the PBL session involved tasks centred around food deserts and food insecurity. Students first explored local "food desert" maps to identify potential factors contributing to food insecurity. Based on the lecture content and additional readings, they categorized these factors under the four pillars of food security: availability, accessibility, utilization, and stability. This exercise encouraged students to think critically about the multifaceted nature of food insecurity and the various factors that contribute to it.

In the next phase, students used AI tools, specifically ChatGPT and Bard, to generate three different strategies to address food insecurity. These AI-generated strategies provided a range of potential solutions, each with its strengths and weaknesses. Students were tasked with critically evaluating these strategies and assessing their feasibility, relevance, and potential impact. This exercise aimed to foster problem-solving skills and an understanding of how AI can be utilized for real-world challenges. Students were encouraged to critique the solutions generated by the AI, developing their critical thinking skills by identifying the strengths and limitations of each strategy. This task emphasized the importance of not solely relying on AI but using it as a starting point for further research and creative problem-solving.

Finally, students logged into NuReflect, using the STARR/SMART template to reflect on their learning experience. They documented the skills and knowledge acquired throughout the session, emphasizing the importance of continuous reflection in the learning process. This reflection exercise helped students internalize the lessons learned and consider how they might apply their

new knowledge and skills in future contexts. The detailed structure of the PBL session ensured that students were actively engaged at every step, from understanding the theoretical background to applying AI tools in practical problem-solving and reflecting on their learning outcomes. By incorporating AI into the PBL framework, the session provided a unique and innovative approach to teaching sustainability in practice.

Results:

The implementation of AI tools in the "Hunger Hotspots" session had several positive effects on students' learning. By evaluating AI-generated solutions, students developed critical thinking skills, learning to analyse and critique information rather than accepting it at face value. This vital evaluation process encouraged students to consider multiple perspectives and think deeply about the complexities of food insecurity. The problem-based tasks required students to apply their knowledge creatively, fostering innovative thinking and practical problem-solving abilities. Engaging with AI tools helped students gain valuable digital skills, preparing them for future challenges in their academic and professional careers. The use of AI tools like ChatGPT and Bard allowed students to explore a range of potential solutions quickly, providing a foundation for further research and discussion.

Additionally, the session raised awareness about food insecurity and its complexities, encouraging students to consider broader social and environmental implications in their solutions. By addressing a real-world problem, the session helped students understand the relevance of their studies to contemporary global challenges. This awareness was further reinforced through the reflective component of the session, where students considered the impact of their learning on their understanding of food security and sustainability. Students reported increased engagement and motivation due to the interactive and hands-on nature of the PBL session. The use of AI tools added an element of novelty and excitement, making the learning experience more dynamic and relevant to their interests and future careers. Furthermore, the session promoted collaboration and teamwork, as students worked together to generate and evaluate AI-driven solutions, enhancing their communication and interpersonal skills.

Conclusion:

The "Hunger Hotspots" case study showcases the use of AI in enhancing educational experiences and addressing real-world challenges. By integrating AI tools into problem-based learning,

students engaged with food insecurity, developed critical thinking and problem-solving skills, and acquired digital competencies. This approach not only improved their understanding of sustainability but also prepared them for future technology use. The success of this session highlights the importance of innovative teaching methods in higher education, particularly in fostering interdisciplinary learning and practical application of knowledge. The implementation plan and positive outcomes provide a blueprint for educators to incorporate AI into their teaching practices.

Case Study 13: Agro-AI Education for Future Farmers

Introduction

The project, "Agro-AI Education: Artificial Intelligence for Future Farmers", leverages advanced AI and Machine Learning tools, particularly Random Forest (RF) classifiers, to train future farmers in precision agriculture. This case study examines the implementation, results, and impact of using AI to enhance agricultural education, aligning with several Sustainable Development Goals (SDGs), including promoting sustainable agriculture and quality education.

Background

Agriculture has experienced a significant transformation with the adoption of precision agriculture, which uses detailed, site-specific information to manage farming practices more efficiently. AI plays a crucial role in this transformation, offering enhanced decision-making capabilities in areas such as crop, livestock, water, and soil management. Despite these advancements, a gap persists in the understanding and trust of AI technologies among farmers. Addressing this gap is essential to prepare the next generation of farmers to leverage AI for sustainable food production. Several universities recognized this need and developed an active learning system to bridge this knowledge gap and build confidence in AI among future farmers.

Implementation

The Agro-AI Education project utilizes several AI tools to create an interactive and educational experience for students. Central to the project is the use of machine learning algorithms, particularly the Random Forest (RF) classifier, known for its accuracy and reliability. The RF classifier constructs multiple decision trees during training and outputs the mode of the classes, making it particularly effective for agricultural applications where precision is crucial.

This project used a comprehensive dataset consisting of 18,000 images of maize plants. These images were annotated with labels indicating whether the plants were healthy or unhealthy, affected by the northern leaf blight disease. A feature extraction process was performed to convert these images into a format suitable for machine learning. This process included various techniques such as colour separation, Hu moments, Haralick textural features, and blight feature detection, ultimately selecting 15 features that provided the best classification accuracy.

The active learning system involved students labelling a subset of these images, which were then used to train the RF classifier. This interactive process allowed students to observe how their inputs influenced the model's predictions and confidence levels. The system provided a transparent view of AI learning processes, enhancing students' understanding of machine learning skills and their application in agriculture.

Results

The implementation of AI tools in this educational project produced several significant outcomes. By engaging directly with the AI tool, students developed a deeper understanding of how AI works and its potential benefits in agriculture. This hands-on experience reduced scepticism and built trust in AI technologies. The project also significantly enhanced students' digital skills by providing them with practical experience in interacting with AI models, understanding outputs, and making data-driven decisions.

The project aligns with several Sustainable Development Goals, demonstrating its broader impact. It promotes efficient and sustainable food production practices, contributing to SDG 2 (Zero Hunger). Through its innovative educational approach, it supports SDG 4 (Quality Education), which is improving technical and vocational skills in AI for agriculture. By fostering innovation in agricultural practices, the project aligns with SDG 9 (Industry, Innovation, and Infrastructure). Additionally, encouraging sustainable management of farming resources supports SDG 15 (Life on Land).

Conclusion

The Agro-AI Education project represents a significant advancement in integrating AI into agricultural education. By providing an accessible and interactive learning platform, the project not only enhances students' digital skills but also promotes sustainable farming practices. The alignment with multiple SDGs highlights the broader impact of using AI tools in achieving global

sustainability goals. Moving forward, such initiatives are essential for preparing future generations of farmers to embrace and leverage AI technologies, ensuring sustainable and efficient food production for a growing population.

The successful implementation of this project underscores AI's potential to transform agricultural education and practices. It serves as a model for other educational institutions aiming to integrate AI into their curricula, demonstrating how technology can be harnessed to address critical challenges in agriculture and sustainability. Through continued innovation and collaboration, projects like Agro-AI Education can play a pivotal role in shaping the future of farming and fostering a new generation of tech-savvy, environmentally conscious farmers.

Case Study 14: Using AI to inform decisions on the performance of students

Introduction

The integration of Artificial Intelligence (AI) in education has significantly enhanced the ability to monitor, predict, and improve student performance. This case study examines the use of AI in promoting higher education for sustainable development (ESD) and widening access to digital skills. The AI-based tool utilized in this study is a Random Forest (RF) classifier model designed to predict student performance in a first-year Information Technology literacy course.

Background

Sustainable Development Goal 4 (SDG 4) aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." Achieving this goal necessitates innovative approaches to education, particularly through the use of digital technologies. AI has emerged as a pivotal tool in this domain, offering the potential to enhance educational quality and accessibility. This case study explores the role of AI in informing decisions related to student performance, thereby contributing to the broader objectives of ESD.

Methodology and Implementation of iEWS

The study involved developing an Intelligent Early Warning System (iEWS) using a Random Forest classifier model. The dataset comprised complete online interaction data for undergraduate

students enrolled in a fully online first-year course at USP. Key features used for the prediction included average completion rate of online activities, average number of logins, and coursework scores. The RF model was trained and validated using a 10-fold cross-validation technique, achieving an accuracy of 97.03%. The implementation process involved integrating the iEWS into the Moodle Learning Management System (LMS), allowing real-time data collection and analysis. Educators were provided with training sessions to interpret the iEWS outputs and implement timely interventions. This facilitated a seamless transition to AI-driven monitoring and support mechanisms within the existing educational framework.

Engagement and Learning Activities

The AI-based iEWS was implemented in week 4 of the semester, with data collection and feature extraction conducted weekly. The system monitored student interactions on the Moodle Learning Management System (LMS), recording login frequencies, assignment submissions, and forum activities. Educators used the iEWS to identify at-risk students early, enabling timely interventions. This proactive approach facilitated personalized support and enhanced student engagement and performance.

Challenges and Solutions

One of the primary challenges was the class imbalance in the dataset, with a higher number of students passing the course compared to those failing. This was addressed using the k-nearest neighbour technique to reduce redundancy in positive samples. Another challenge was ensuring the model's applicability across different courses with varying online activity levels. The study emphasized the need for course-specific predictive models tailored to the unique interaction patterns of each course.

Conclusion

The implementation of the AI-based iEWS at USP demonstrated the potential of AI to enhance educational outcomes by providing early predictions of student performance. The RF classifier model achieved high accuracy, enabling educators to identify and support at-risk students effectively. This case study underscores the importance of leveraging AI to promote ESD and widen access to digital skills, aligning with the objectives of SDG 4. Future research should explore the applicability of different predictive methods and feature vectors across various educational contexts to further improve the efficacy of AI-driven early warning systems.

Case Study 15: Virtual Assistants and Chatbots

Introduction:

In the evolving landscape of higher education, the use of artificial intelligence (AI) to enhance student services has gained significant power. This case study explores the implementation and impact of an AI-powered chatbot. Designed to assist students with a broad range of queries, Genie represents a significant advancement in student support services, offering 24/7 availability and improving overall student engagement and satisfaction.

Background:

As part of the university's commitment to enhancing student experience and operational efficiency, it sought to leverage AI technology. This led to the development and deployment of Genie, a virtual assistant designed to address various student needs, from administrative tasks to academic support, thereby fostering a more supportive and responsive learning environment.

Implementation:

Genie was developed using advanced natural language processing (NLP) and machine learning techniques to ensure it could understand and respond to a wide array of student inquiries. The chatbot was integrated into the university's digital ecosystem, making it easily accessible to students through multiple platforms. Virtual assistants and chatbots hold significant potential in promoting Education for Sustainable Development (ESD) by leveraging their capabilities to provide personalised, scalable, and interactive learning experiences. Here are several ways Genie can contribute to ESD:

- **24/7 Availability:** Genie provides round-the-clock assistance, ensuring that students can get support whenever they need it. This ensures that students have constant access to information and support, enabling continuous learning and the ability to address queries at any time, which is particularly important for global learners in different time zones.
- **Administrative Assistance:** The chatbot handles administrative queries such as enrolment, timetable scheduling, and fee information.
- **Academic Support:** Genie offers guidance on academic resources, deadlines, and general study advice.

- **Personalisation:** The AI is designed to learn from interactions, becoming more effective over time at predicting and meeting individual student needs.
- **Immediate Feedback and Support:** Virtual assistants can provide instant feedback on assignments and activities related to sustainability. This immediate response helps students understand concepts more quickly and accurately, fostering a deeper understanding of ESD topics.

Results:

The implementation of Genie has led to several notable outcomes:

- **Increased Accessibility:** Students have access to immediate support at any time, reducing the need to wait for office hours or in-person consultations.
- **Higher Engagement:** The availability of instant support has led to increased student engagement with university services and resources.
- **Improved Satisfaction:** Surveys indicate that student satisfaction with support services has improved since the introduction of Genie, as it provides quick and reliable assistance.
- **Operational Efficiency:** By automating routine inquiries, Genie has allowed university staff to focus on more complex and high-value tasks, thereby improving overall efficiency.

Conclusion:

The University's implementation of the AI chatbot exemplifies the successful integration of AI in higher education. By providing 24/7 assistance and handling a wide range of student queries, Genie has significantly enhanced student support services, leading to improved engagement and satisfaction. This case study highlights the potential of AI-powered virtual assistants to transform student services, offering a scalable solution that can adapt to the diverse and evolving needs of the student body. As AI technology continues to advance, its role in higher education is expected to expand, further enriching the student experience and operational capabilities of educational institutions.

Case Study 16: Virtual Laboratories in Tertiary Education

Introduction

The integration of Artificial Intelligence (AI) and Virtual Laboratories (VLabs) in tertiary education has revolutionized teaching methodologies, particularly in Information and Communication Technology (ICT). The onset of the COVID-19 pandemic further accentuated the need for flexible and remote learning environments. This report delves into the case study of using VLabs to understand their implementation, engagement strategies, challenges, and solutions, focusing on the role of educators in promoting education for sustainable development (ESD) and widening access to digital skills.

Background

The increasing demand for flexible and remote learning solutions in higher education, driven by factors such as geographical diversity and varying time zones, has led to the adoption of ubiquitous learning environments. VLabs, which provide online access to laboratory resources without physical infrastructure, have emerged as a pivotal tool in this landscape. VLabs have been employed to teach courses like Cloud Computing and Internet of Things (IoT), providing students with practical, hands-on experiences essential for mastering ICT skills.

Methodology and Implementation of AI Technology

The University's approach to implementing VLabs involves a hybrid model combining physical and virtual setups. This model was developed through partnerships with industry leaders like IBM, enabling access to advanced cloud-based platforms and tools. The virtual lab environment, hosted on IBM Cloud, includes development environments like NodeRED and Watson IoT, facilitating seamless integration with external systems. This setup allows students to engage with virtual sensor networks, write applications, and solve real-world business problems without the need for physical hardware.

For instance, they approached Cengage Learning’s MindTap for a virtual digital forensic laboratory with widely used forensics tools. The MindTap provides a virtual learning environment and labs. They used it on all their forensic units and customised it for their syllabus and implemented it in their teaching. The integration of MindTap VLab into the units’ LMS (Learning Management

System) websites allows students to access it by using their internet connections and a web browser, from anywhere, anytime.

Engagement and Learning Activities

The implementation of VLabs has significantly enhanced student engagement and learning outcomes. Educators designed Problem-Based Learning (PBL) assessments using industry-scale technologies available in the VLab environment. These assessments require students to apply theoretical knowledge to practical tasks, fostering a deeper understanding and skill development.

The flexibility of accessing laboratory tools from any location has also enabled continuous learning beyond the classroom, catering to diverse student needs.

Challenges and Solutions

The primary challenges encountered during the implementation of VLabs included the complexity of setting up virtual environments, ensuring equitable access for all students, and addressing occasional internet connectivity issues. To overcome these challenges, the university leveraged industry partnerships to provide free access to cloud resources and incorporated comprehensive support mechanisms for students. Continuous feedback and iteration helped refine the VLab setup, ensuring it met educational objectives and student expectations.

Conclusion

The case study of VLabs underscores the transformative potential of AI-powered tools in higher education. By enabling flexible, remote, and practical learning experiences, VLabs have proven to be an effective solution for promoting ESD and widening access to digital skills. The successful implementation of these tools, driven by innovative pedagogical practices and robust industry partnerships, offers valuable insights for other institutions aiming to adopt similar approaches. The continuous evolution of VLabs, supported by educator feedback and technological advancements, promises to further enhance the learning landscape in higher education.

Case Study 17: Personalising Education with the Cognitive Tutor

Introduction:

In the rapidly evolving educational landscape, the demand for personalised learning experiences has become more pronounced. Intelligent Tutoring Systems (ITS) have emerged as a powerful tool to address this need. One notable example is the Cognitive Tutor which tailors learning experiences to individual students' needs. This case study explores the implementation and impact of the Cognitive Tutor on student learning, particularly in business-related courses such as statistics and economics.

Background:

The University has long been at the forefront of educational innovation. Recognising the limitations of traditional, one-size-fits-all teaching methods, the university developed the Cognitive Tutor. This ITS leverages cognitive science principles to create a dynamic learning environment that adapts to each student's unique pace and style. Initially designed for mathematics education, the Cognitive Tutor has been expanded to various subjects, including business courses.

Implementation:

The Cognitive Tutor system integrates seamlessly into the existing curriculum, providing an interactive platform where students can engage with course material. The system collects data on students' performance, identifying strengths and weaknesses. It then customises feedback and resources to address individual learning gaps. In business-related courses like statistics and economics, the Cognitive Tutor presents problems, guides students through solving them, and offers hints and explanations as needed.

Key steps in the implementation process included:

1. **Curriculum Integration:** Aligning Cognitive Tutor content with course objectives and learning outcomes.
2. **Training Instructors:** Equipping instructors with the skills to effectively use the ITS and interpret its feedback.
3. **Student Onboarding:** Introducing students to the system and its benefits to ensure smooth adoption.

4. **Continuous Improvement:** Regularly updating the system based on feedback and advances in educational technology.

Results:

The implementation of the Cognitive Tutor has produced significant improvements in student performance and engagement. Key outcomes include:

- **Enhanced Learning Outcomes:** Students using the Cognitive Tutor demonstrated higher proficiency in statistics and economics compared to those in traditional learning environments.
- **Personalised Feedback:** Tailored feedback helped students address specific misconceptions, leading to a deeper understanding of the material. The Cognitive Tutor adapts to individual students' learning paces and styles, providing personalised feedback and resources. This personalised approach can be particularly beneficial for ESD, where students come from diverse backgrounds with varying levels of prior knowledge about sustainability. By tailoring content to meet each student's needs, the Cognitive Tutor ensures that all students can grasp complex ESD concepts at their own pace.
- **Increased Engagement:** The interactive nature of the system maintained student interest and motivation, reducing dropout rates.
- **Efficient Use of Instructor Time:** Instructors could focus on higher-level teaching tasks, as the system handled routine practice and assessment.

Quantitative data supporting these results showed a marked increase in test scores and overall course grades among students using the Cognitive Tutor.

Conclusion:

The Cognitive Tutor represents a significant advancement in the field of Intelligent Tutoring Systems. By personalising learning experiences and providing targeted feedback, the system has improved student outcomes in business-related courses like statistics and economics. The success of the Cognitive Tutor underscores the potential of ITS to transform education by making learning more adaptive and student-centred. As technology continues to evolve, such systems will play an increasingly critical role in shaping the future of education.

Case Studies for Students

Case Study 1: AI in Academic Writing Wordtune by Chinese International Students

Introduction:

Academic writing poses significant challenges for international students, particularly those grappling with language barriers. This section delves into the rising adoption of AI-powered writing aids, with a spotlight on Wordtune, as a potential remedy for these challenges. Despite the promising benefits of such tools in enhancing writing skills and productivity, concerns linger regarding their potential for dependence and misuse. Nonetheless, they offer avenues for language learning and broader access to digital skills, especially crucial for students facing language-related obstacles in higher education.

Challenges in Academic Writing for International Students:

Navigating academic writing proves to be a daunting task for international students, compounded by linguistic nuances and unfamiliarity with academic conventions. Despite the provision of institutional support like language courses and writing tutorials, students continue to grapple with expressing ideas effectively in English. This study aims to dissect the role of digital tools, particularly AI-powered writing assistants such as Wordtune, in mitigating these challenges and enhancing the academic writing experience for international students.

AI-Powered Writing Assistants in Higher Education:

The landscape of higher education is witnessing a surge in the adoption of AI-powered writing assistants, offering a gamut of functionalities from Automated Writing Evaluation (AWE) to Intelligent Tutoring Systems (ITS). However, their utilization is not solely dictated by necessity but also by students' digital readiness, encompassing factors like technological expertise, skills, knowledge, goals, expectations, and attitudes toward technology. Research suggests that these tools hold the potential to facilitate English language learning, reduce cognitive barriers, and uplift writing quality for non-native speakers.

Wordtune: An AI-Powered Writing Assistant:

Wordtune emerges as a standout among AI-powered writing assistants, providing users with a plethora of rewrite options to enhance their original phrases or sentences. Leveraging machine learning technologies such as natural language processing, Wordtune offers features ranging from basic rewrites to advanced options, catering to diverse user needs. Notably, it presents significant language learning opportunities for English as a Foreign Language learners, empowering them to strengthen their writing skills through self-directed learning.

Methodology: Design and Implementation Overview:

Employing a qualitative approach, this study delves into the experiences of Chinese international students in UK universities, focusing on their interaction with Wordtune as an AI-powered writing assistant. A meticulous recruitment process, facilitated by snowball sampling, ensured the inclusion of a diverse group of 30 participants. Interviews conducted in Mandarin Chinese, later translated into English, provided nuanced insights into participants' experiences. Thematic Analysis guided the interpretation of data, shedding light on writing challenges and patterns of tool utilization.

Results and Evaluation:

The results section presents a comprehensive overview of the study findings, categorized into four key areas aligned with the project objectives. It encapsulates participants' perspectives on writing challenges, prior digital tool use, the relationship between tool usage and self-assessed English language proficiency, and participants' utilization and evaluation of Wordtune.

Insights from Engagement and Learning Activities:

This section unveils how Chinese international students in UK universities harnessed digital tools, with a specific focus on Wordtune. It highlights the academic writing challenges students faced and underscores the pivotal role of Wordtune in enhancing formality and clarity in writing. Furthermore, it explores how users' education level and English proficiency influenced their digital tool usage patterns, emphasizing the significance of tailored support mechanisms.

Addressing Challenges and Solutions:

Participants shared insights into the challenges encountered in academic writing and their utilization of Wordtune, accompanied by concerns about its usage. While acknowledging Wordtune's efficacy in improving fluency and accuracy, concerns were voiced regarding reliance on online access and the absence of an extensive academic text database. Participants suggested augmenting Wordtune's features to better align with educational needs, thereby optimizing its utility for international students.

Conclusion:

In conclusion, this study offers valuable insights into the utilization of Wordtune by Chinese international students in higher education. It illuminates the challenges inherent in academic writing and delineates the diverse usage patterns of digital tools, with a particular emphasis on Wordtune. By delineating the beneficial aspects of Wordtune's rewriting features and delineating differences in tool utilization between novice and proficient English learners, the study contributes significantly to understanding how international students navigate digital aids in their writing processes. This understanding not only promotes wider access to digital skills but also lays the groundwork for future research endeavors in this domain.

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Case Study 2: AI-Driven Contextual Virtual Teaching Assistant Using RASA

Introduction

The integration of Artificial Intelligence (AI) in education has revolutionized the way students interact with learning materials and receive support. This case study examines the implementation of a Contextual Virtual Teaching Assistant (CVTA) using the RASA framework. The CVTA aims to enhance the learning experience and improve access to digital skills for students, offering continuous support and fostering a more effective educational environment which is aligned with the Quality Education as a Sustainable Development Goal.

Background

In response to the growing demand for continuous academic support, the University introduced a CVTA designed to assist students with contextual inquiries and provide tailored answers based on

instructor materials. By leveraging the capabilities of RASA, an open-source conversational AI framework, the CVTA seeks to refine academic quality through automated responses, thus facilitating seamless and immediate student support.

Methodology and Implementation of CVTA

The implementation of the CVTA involves several critical steps, focusing on the integration of RASA's advanced features to ensure effective and efficient operation. RASA's key component, the Dialog Engine, enables the CVTA to remember the context of conversations, allowing for a continuous and coherent interaction with students. This feature is crucial for the assistant to ask leading questions and understand the specific needs of each student.

The NLU (Natural Language Understanding) model within RASA plays a pivotal role in interpreting student messages by recognizing the intent behind the input and identifying relevant entities that provide context. When students interact with the CVTA through a web or mobile application, their messages are processed by RASA Core, which determines the appropriate responses based on predefined domain configurations. The assistant is trained using materials provided by instructors, ensuring that its responses are accurate and relevant to the course content. Additionally, it can be configured to search the internet for supplementary information, further enhancing its ability to provide comprehensive answers.

Engagement and Learning Activities

The CVTA engages students by offering immediate and accurate responses to their academic queries, significantly reducing wait times, and minimizing miscommunication. It serves as a reliable source of information, particularly in remote learning environments where timely human interaction may be limited. The assistant also sends reminders about assignment deadlines and important dates, helping students manage their schedules more effectively. Through its interactive capabilities, the CVTA identifies students who may be struggling with certain topics, providing instructors with valuable insights that can be used to adjust teaching methods and materials.

Challenges and Solutions

The implementation of the CVTA faced several challenges, including ensuring the accuracy of its responses, engaging students effectively, and addressing technical limitations related to AI's understanding and context retention. To overcome these challenges, the project team focused on continuously updating and training the AI on new academic materials and incorporating student

feedback to refine its responses. Additionally, educating students on how to interact with the CVTA effectively helped to increase engagement and utilization of the tool.

Conclusion

The implementation of a Contextual Virtual Teaching Assistant using RASA highlights the significant potential of AI in enhancing education for sustainable development. By providing round-the-clock support, the CVTA helps to widen access to digital skills and promotes an inclusive learning environment. The success of this project underscores the importance of continuous AI training and user engagement in achieving effective educational outcomes. Additionally, the project's alignment with multiple SDGs demonstrates the broader impact of AI-driven tools on sustainable development, showcasing their role in advancing quality education, innovation, inclusivity, and global partnerships.

Case Study 3: Brainly, Democratizing education by giving students worldwide access to expert study help using Google Cloud's Vision AI

Introduction

The integration of Artificial Intelligence (AI) in education is revolutionizing the way students learn and access information. One notable example of this transformation is Brainly, a collaborative online learning platform that leverages AI to provide students worldwide with instant access to expert study help. This report examines Brainly's implementation of AI technologies, particularly its "Snap to Solve" feature, to enhance education for sustainable development and widen access to digital skills.

Background

Brainly, a Kraków-based technology company founded in 2009, serves over 350 million students, parents, and teachers across more than 35 countries. The platform allows users to ask questions and receive answers in real-time, fostering a collaborative learning environment. The company's mission is to democratize education by providing accessible and inclusive educational support. One study shows that how using Brainly as a learning resource and motivator, broadly impacted the

achievement of IPS economics students at SMAN 1 Pegajahan (Indonesia) during the 2022/2023 academic year.

Methodology

Brainly employs Google Cloud's Vision AI to develop its "Snap to Solve" feature, enabling students to find answers by taking photos of their questions. This methodology involves Optical Character Recognition (OCR) to analyse images and extract text and Machine Learning algorithms, including TensorFlow's Multilingual Universal Sentence Encoder, to match queries with relevant answers. It requires continuous optimization of search algorithms to improve accuracy and user satisfaction.

Implementation of AI Technology

The "Snap to Solve" feature allows students to take photos of their questions using the Brainly mobile app. Vision AI's OCR capabilities analyse the content and provide instant answers from Brainly's extensive knowledge base. If an exact match is not found, the system falls back on a fulltext search to deliver relevant answers.

Given Brainly's global reach, supporting multiple languages is crucial. Vision AI's multilingual capabilities enable the platform to serve students in their preferred languages, enhancing accessibility and inclusivity. The use of Google Cloud ensures that Brainly can handle peaks in traffic without compromising performance. This scalability was particularly beneficial during the COVID-19 pandemic when user numbers surged dramatically.

Engagement and Learning Activities

Brainly's AI-driven features significantly enhance student engagement and learning activities by providing instant answers so that students receive immediate support for their homework and study questions, reducing frustration and improving learning efficiency. Moreover, it facilitates multimodal learning; beyond photo queries, Brainly also offers voice search capabilities, catering to different learning preferences. Additionally, it is promoting independent learning as the platform empowers students to seek help independently, fostering self-directed learning habits.

Challenges and Solutions

Supporting a vast array of languages presents a significant challenge. Brainly addresses this by continually optimizing its text recognition algorithms for different languages. Also, the pandemicinduced surge in users posed challenges in maintaining service stability. Brainly mitigated

this by leveraging Google Cloud's automatic scaling features, ensuring consistent performance. Maintaining high satisfaction rates for AI-generated answers is another challenge which requires constant algorithm improvements. Brainly uses user feedback and machine learning to refine its solutions continually.

Conclusion

Brainly exemplifies how AI can democratize education and promote sustainable development by providing equitable access to digital learning resources. Through innovative features like "Snap to Solve," the platform enhances student engagement and supports independent learning. Despite challenges related to language diversity and scalability, Brainly successfully leverages AI to offer a reliable, multilingual educational resource. As the platform continues to evolve, it remains committed to its goal of making quality education accessible to all students, thereby fostering a more inclusive and sustainable educational landscape.

Case Study 4: ChatGPT, Midjourney, and Stable Diffusion for Sustainable Design

Introduction

The integration of artificial intelligence (AI) in design education is revolutionizing how students approach creativity and sustainability. This case study investigates how students utilized AI tools like ChatGPT, Midjourney, and Stable Diffusion to develop sustainable product-service systems. The focus of the study is on how these tools can enhance educational experiences, promote sustainable practices, and broaden access to digital skills, aligning with the Sustainable Development Goals (SDGs).

Background

Sustainable design is essential in contemporary education due to the pressing need to address global environmental challenges. Education for Sustainable Development (ESD) provides a framework for integrating sustainability into education, emphasizing the development of skills, values, and knowledge necessary for sustainable living. In design education, incorporating sustainability requires innovative methods that address social, economic, and technological

factors. AI tools like ChatGPT, Midjourney, and Stable Diffusion have significant potential to enhance sustainable design practices and expand students' access to digital skills by processing vast amounts of data and generating creative solutions. This study aims to empower future designers with the skills needed to create sustainable solutions using these AI tools.

Implementation

A group of 34 students participated in a two-week design workshop as part of their curriculum, which integrates sustainability principles and practices. The workshop was structured using the Double Diamond Model and the Human-AI Co-Creation Model, divided into four sessions: discovery, defining, developing, and delivering sustainable designs.

In the first session, the students began with a pre-recorded introduction to how to interact with ChatGPT, an AI chatbot based on GPT-3.5. They used ChatGPT to create an initial overview of the SDGs and filter out sub-topics related to sustainability through dialogues. This session helped the students collect and analyze vast amounts of information efficiently, generating keywords and concepts related to their chosen topics. The usability of ChatGPT was assessed through a questionnaire, focusing on its ability to provide accurate, rich, and readable content that inspired new perspectives and thinking directions.

In the second session, the students used ChatGPT to translate the selected sustainable topics and keywords into prompts recognizable by Midjourney, an AI tool for creating visual content. This session included a hands-on demonstration of Midjourney, followed by an exercise where each team generated a mood board with 16 images representing their design concepts. This stage facilitated brainstorming and visualization, allowing the students to explore creative directions and refine their ideas. The usability of Midjourney was evaluated based on the accuracy of prompt-image pairing, relevance to the design theme, and the richness and style of the generated images.

The third session focused on using Stable Diffusion, another AI tool, to develop initial design concepts. The students received a tutorial on using Stable Diffusion's WebUI interface and various parameters for generating images. They were encouraged to modify prompts and generate conceptual images that aligned with their design ideas. This session aimed to provide the students with hands-on experience in manipulating AI tools to create detailed and precise visualizations.

The usability of Stable Diffusion was assessed based on its creative flexibility, image style alignment, and overall satisfaction with the generated concepts.

The final session introduced advanced techniques for fine-tuning designs using Stable Diffusion, including localized redrawing and model adaptation. The students applied these techniques to refine their concepts, ensuring the final designs met aesthetic and functional requirements. This session emphasized the iterative nature of design, where continuous refinement and adjustment are crucial. The usability of Stable Diffusion in this phase was evaluated based on the consistency of the redrawn images, the ease of learning and controlling the tool, and the overall quality and creativity of the final designs.

Results

The implementation of AI tools in the design workshop yielded several positive outcomes. They reported high levels of engagement and motivation, appreciating the efficiency and creativity enabled by ChatGPT, Midjourney, and Stable Diffusion. The use of ChatGPT in the discovery phase provided a robust foundation for generating and refining design concepts. Midjourney facilitated effective brainstorming and visualization, helping the students explore diverse creative directions. Stable Diffusion proved instrumental in developing detailed and precise design concepts, although it required significant manipulation to achieve the desired outcomes.

By engaging with ChatGPT, Midjourney, and Stable Diffusion, the students gained practical experience in utilizing advanced digital technologies, enhancing their technical proficiency. This exposure to AI tools equipped them with essential digital competencies, preparing them for the increasing demand for technological skills in various industries. The ability to interact with and manipulate these tools not only improved their design outcomes but also empowered them with the digital literacy necessary for their future careers.

Moreover, the study's quantitative assessments, through structured questionnaires, revealed strong correlations between the usability of these AI tools and the quality of the design outputs. For example, ChatGPT's ability to generate rich and readable content strongly influenced the novelty and relevance of the design concepts. Similarly, the accuracy and style of images generated

by Midjourney and Stable Diffusion were crucial in shaping the students' design ideas and their satisfaction with the final outputs.

Discussion

The findings highlight the potential of AI tools like ChatGPT, Midjourney, and Stable Diffusion in enhancing design education, particularly in promoting sustainable practices. These tools can significantly augment human creativity, providing students with new ways to approach complex design challenges. Additionally, the use of AI tools helps widen access to digital skills, preparing students for digital transformation in various industries. However, the study also identified several challenges, including the need for adequate training and guidance in using AI tools effectively. The controllability and learnability of AI tools emerged as critical factors influencing their successful integration into the design process.

The study underscores the importance of balancing AI-generated content with human creativity and critical thinking. While AI tools can generate numerous design solutions quickly, the ultimate value lies in the ability of human designers to refine and adapt these solutions to meet specific needs and contexts. This co-creative approach ensures that AI serves as a powerful enabler rather than a replacement for human ingenuity.

Conclusion

This case study provides valuable insights into the integration of AI tools like ChatGPT, Midjourney, and Stable Diffusion in sustainable design education. The research demonstrates how these tools can enhance the creative process, promote sustainable design practices, and equip students with essential digital skills. By leveraging AI tools, educators can create dynamic and impactful learning experiences that prepare students to tackle complex global challenges.

The success of this workshop highlights the need for continued exploration and refinement of AI tools in educational contexts. Future research should focus on improving the usability and accessibility of AI tools, ensuring they complement rather than overshadow human creativity. Incorporating Education for Sustainable Development (ESD) principles ensures that students not only gain technical proficiency but also develop a deep understanding of sustainability, ultimately

contributing to a more sustainable world. Moreover, by fostering a collaborative and iterative design process, AI can play a crucial role in shaping a sustainable and innovative future.

Case Study 5: Estimation of the Extent and Vulnerability of Climate Change on Agriculture Using CNNs

Introduction

In response to the growing threat of climate change on agriculture, students studying agricultural and environmental sciences for sustainable development, conducted an in-depth study utilising advanced AI tools. They utilised analytical and deep-learning techniques, specifically convolutional neural networks (CNNs), to assess the extent and vulnerability of climate change impacts on agriculture. This study not only provided critical insights into how climate change affects agricultural productivity but also significantly enhanced the students' digital skills in tackling complex environmental challenges with innovative solutions.

Background

Agriculture supports the livelihoods of a significant portion of the population. However, some agricultural areas are particularly vulnerable to climate change due to their unique climatic and topographical conditions. Extreme weather events, shifting precipitation patterns, and increasing temperatures threaten agricultural productivity, impacting crop yields, soil health, and water availability.

Traditional methods of predicting climate impacts often need more precision for effective decision-making and resource allocation. This gap motivated the students to leverage advanced AI tools, integrating analytical and deep-learning methods into their research to provide more accurate and actionable forecasts. Their education in agricultural and environmental sciences equipped them with the foundational knowledge needed to understand the complexities of these interactions. The students' approach involved using deep learning methods, specifically convolutional neural networks (CNNs), to process and analyse extensive datasets, including historical climate data, soil health records, and crop yield statistics. The project served as a bridge between their academic learning and real-world applications, preparing them to address environmental challenges with cutting-edge solutions.

Implementation

The study utilised a combination of analytical methods and deep-learning techniques, with a focus on convolutional neural networks (CNNs), to process and analyse extensive datasets. The implementation process was methodical and comprehensive, involving several critical stages.

Initially, students gathered historical climate data, soil health records, and crop yield statistics from multiple sources, including governmental and non-governmental organisations, research institutions, and agricultural databases. This data provided a robust foundation for analysis. The data collection phase was extensive, ensuring the inclusion of diverse datasets to capture a holistic view of the climatic impacts on agriculture.

The collected data underwent rigorous cleaning and organisation to ensure its suitability for AI analysis. This involved removing inconsistencies, filling gaps, and standardising data formats, which is crucial for the accuracy of AI models. The preprocessing stage was labour-intensive but essential to prepare the data for accurate analysis. Students learned to handle real-world data issues such as missing values, outliers, and data normalisation.

Using CNNs, students trained models on the pre-processed data to recognise patterns, anomalies, and correlations between climate variables and agricultural outputs. The CNNs were specifically chosen for their ability to handle complex, high-dimensional data and their efficacy in capturing intricate relationships within the data. This training phase involved iterative testing and refinement of models to enhance their predictive accuracy. Students had to adjust various hyperparameters and CNN architectures to achieve optimal performance.

The trained models were then validated and tested using a separate subset of data to assess their accuracy and reliability. This step ensured that the models could generalise well to new, unseen data and provide reliable predictions. Validation involved statistical techniques to measure the performance of the models, such as confusion matrices, precision, recall, and F1 scores. Students had to ensure that their models were balanced and could perform well on unseen data.

The final models were deployed to generate real-time predictions and insights. These predictions identified vulnerable areas and crops, enabling targeted interventions and resource allocation to mitigate the adverse effects of climate change. Deployment included integrating the models into decision-support systems that policymakers and farmers could use to make informed decisions.

Results

The use of deep learning models provided highly accurate predictions of climate change impacts, which were instrumental in identifying the most vulnerable areas and crops. These insights allowed for the development of targeted mitigation strategies, helping farmers adapt to changing conditions and maintain agricultural productivity. The study highlighted the regions and crops that were most at risk, allowing for strategic planning and resource allocation to minimise damage and improve resilience.

Moreover, the study enhanced the students' practical digital skills in using advanced AI tools and techniques. This hands-on experience equipped them with the knowledge and expertise required to tackle complex environmental challenges. The project also helped them prepare for future careers in environmental science, agriculture, and AI. Students learned valuable skills such as data analysis, machine learning, and model deployment, which are highly sought after in the job market.

They saw the direct impact of their work on improving agricultural practices and sustainability.

Conclusion

This case study underscores the transformative potential of AI tools in addressing critical environmental issues in sustainable agricultural and environmental education. By leveraging deep learning techniques, students generated valuable insights that can inform sustainable farming practices and policies. This initiative not only provided students with essential digital skills but also contributed to the broader effort to combat the impacts of climate change on agriculture. The success of this project highlights the importance of integrating AI into higher education curricula, empowering the next generation of researchers and practitioners to develop innovative solutions to global challenges.

The insights generated from this study are expected to aid in developing sustainable agricultural practices and policies to combat the effects of climate change. The experience and skills gained by students through this project underscore the value of hands-on learning and the application of advanced technologies to solve real-world problems in terms of ESD.

Case Study 6: Generative AI in Sustainable Design Course

Introduction

Architectural education, as a crucial aspect of sustainable development in higher education, faces the challenge of professional knowledge and many skills needing to be improved for students upon graduation. Students in an architectural programming and design course leveraged generative AI tools to become competent in both design and creative abilities and develop innovative, sustainable design solutions. By utilizing advanced AI tools such as ChatGPT for problem analysis and model design, Midjourney and Stable Diffusion for creative design, and DALL-E for image generation, students were able to enhance their digital skills significantly. This comprehensive approach to architectural education fostered their literacy in fields such as digital and information sciences, humanities and social sciences, and sustainable development, preparing them for future challenges in the field of architecture.

Background

Architectural education has evolved to address the increasing complexity and diversity of the construction industry. Initially focused on imparting fundamental design skills and construction knowledge, it now emphasizes interdisciplinary learning. It aims to equip students with competencies in digital and informational technologies, humanities and social science analyses, and sustainable design. The integration of AI tools into this educational framework represents a significant advancement, allowing students to explore innovative solutions and improve their creative and analytical capabilities. In the context of sustainable design, students in the architectural programming and design course sought to address environmental challenges through intelligent and efficient design practices. They recognized that traditional methods often fall short in managing the vast amount of data required for such tasks, making the use of AI an invaluable enhancement to their educational experience.

Implementation

The implementation of AI tools in the architectural programming and design course was a comprehensive and immersive experience for the students. Initially, they were introduced to ChatGPT. Using ChatGPT, students conducted structured interviews with decision-makers, clarifying tasks and requirements. This helped them streamline the initial stages of their projects,

ensuring that their design proposals were well-aligned with the project's goals. As they delved deeper into the creative design process, students employed Midjourney and Stable Diffusion as generative AI tools. These tools allowed them to generate a wide array of conceptual design prototypes rapidly.

Students could explore multiple design possibilities efficiently by inputting various design parameters and constraints into these AI systems. They constantly refined and adapted the generated designs to meet the specific needs of their projects. In addition, students utilized DALLE and other image-generation technologies to create detailed visualizations of their designs. This step was crucial in helping them communicate their ideas effectively to stakeholders and peers. The AI-generated images provided realistic and detailed representations of the proposed designs, facilitating better understanding and feedback. Students learned to manipulate these tools to enhance the visual appeal and accuracy of their presentations, which was essential for gaining approval and support for their projects. Throughout the implementation phase, students used AI to process and analyse large datasets related to environmental impact, sustainability metrics, and user requirements. This data-driven approach allowed them to make informed decisions, ensuring that their designs were not only innovative but also sustainable and responsive to environmental considerations. This practical application of AI in their coursework provided them with valuable insights into the potential of technology to transform architectural practices. By working on realworld projects, students also developed a deeper understanding of the challenges and opportunities associated with sustainable design.

Results

The use of generative AI tools in the architectural programming and design course yielded significant positive outcomes. The students developed innovative and sustainable design solutions that were informed by data and responsive to environmental and social considerations. The AI tools enhanced the students' ability to analyse complex problems, generate creative solutions, and communicate their ideas effectively.

Moreover, the integration of AI into the course significantly enhanced the students' digital skills. They gained practical experience in using advanced AI technologies, which are becoming increasingly important in the field of architecture. This hands-on experience prepared them for future careers in which they will be expected to leverage technology to address complex design

challenges. The focus on sustainable design ensured that the students' projects were aligned with the broader goals of environmental stewardship and social responsibility. The AI tools enabled them to explore innovative ways to reduce the environmental impact of their designs, promoting sustainability in the built environment.

Conclusion

This case study illustrates the transformative potential of AI tools in architectural education. By integrating generative AI technologies into the architectural programming and design course, students were able to enhance their learning experience, develop innovative design solutions, and prepare for future challenges in sustainable design. This approach fostered comprehensive literacy in digital and informational technologies, humanities and social sciences, and sustainable development, equipping students with the skills and knowledge needed to lead in the evolving field of architecture. The success of this case study underscores the importance of incorporating advanced technologies into educational curricula to prepare students for the future of sustainable design.

Case Study 7: Promoting Online Learning Communities using Natural Language Processing (NLP)

Introduction

The advent of online education has transformed the landscape of higher education, offering accessible and flexible learning opportunities. This case study examines the design and implementation of a virtual agent developed to foster community among online learners by connecting students based on shared identities. The use of a virtual agent in online learning environments aims to enhance the educational experience by promoting a sense of belonging and engagement among students. It is well aligned with the Quality Education as a Sustainable Development Goal.

Background

This virtual agent is designed by a Design & Intelligence Lab. The agent operates on the Piazza class discussion forum, identifying and connecting students with shared interests, locations, and

schedules. This initiative addresses the need for community-building in online education, where the lack of in-person interactions can lead to feelings of isolation and decreased engagement. By leveraging Natural Language Processing (NLP), the agent extracts relevant information from students' self-introductions and provides personalized recommendations to help students connect with their peers.

Methodology and Implementation

The implementation of the agent within the Piazza discussion forum provided a practical and user-friendly interface for students to engage with the virtual agent. At the beginning of each semester, students were introduced to the agent and given the option to participate by including a specific hashtag (#connectme) in their self-introduction posts. This opt-in process ensured that only students who were willing to participate had their information processed by the virtual agent, respecting their privacy and consent.

Once students opted in, the agent utilized natural language processing to analyse the self-introduction posts, extracting key pieces of information such as hobbies, geographic locations, time zones, and classes currently being taken. This data was then aggregated to create a comprehensive profile of the class, which included summaries of class demographics and interests. These aggregated statistics were posted on Piazza, helping students understand the overall composition of their class.

In addition to aggregated statistics, the agent provided personalized recommendations to students. The agent sent individualized messages suggesting peers with similar interests or geographic proximity, facilitating the formation of study groups and peer connections. This personalized approach aimed to help students build meaningful connections and foster a sense of community within the online learning environment.

Engagement and Learning Activities

The agent aimed to facilitate community-building by highlighting shared identities among students. The agent's functionalities included posting aggregated class statistics and providing personalized recommendations. Students reported using these recommendations to form local study groups and connect with peers in similar time zones or with shared interests. The initiative was particularly effective in promoting a sense of belonging, as students felt more connected to their classmates through the agent's interventions.

Challenges and Solutions

The primary challenge encountered was the difficulty in translating the information provided by the agent into actionable steps for students. While the agent successfully identified commonalities among students, many did not know how to proceed with the connections. Additionally, time constraints and the demanding nature of online courses limited students' ability to engage with the recommendations.

To address these challenges, future iterations of the agent could include features that facilitate initial interactions, such as automated ice-breaker activities or scheduled virtual meetups. Providing more explicit instructions on how to use the recommendations and integrating the agent more seamlessly into the course workflow could also enhance its effectiveness.

Conclusion

The agent represents an innovative approach to enhancing community-building in online education. By leveraging AI to connect students with shared identities, the virtual agent addresses a critical gap in online learning environments. The agent contributes to multiple SDGs by enhancing the quality and inclusivity of online education, promoting innovation, and fostering global partnerships. As educational institutions adopt similar AI-driven solutions, the impact on sustainable development goals will continue to grow.

Case Study 8: The Letrus Writing Skills Program, leveraging Artificial Intelligence (AI) to enhance the writing skills of students

Introduction

The Letrus Writing Skills Program is a pioneering initiative leveraging Artificial Intelligence (AI) to enhance the writing skills of students. Implemented by Letrus (Centro de Autoria e Cultura LTDA), this program addresses the challenge of functional literacy in the country by providing an adaptive online learning platform that offers personalized feedback on students' essays. This report examines the Letrus Writing Skills Program from the perspective of its impact on students.

Background

HEI have made significant strides towards universal literacy, but functional literacy remains a challenge, with only 2% of students achieving the highest marks in literacy on the 2018 Programme for International Student Assessment (PISA). The Letrus Writing Skills Program, launched in 2014, seeks to bridge this gap by improving writing skills among primary and university students through an AI-powered platform that provides immediate, formative feedback on their essays. The Letrus has proven to be a powerful AI-based tool, enhancing the social sustainability of millions of students. Its broad acceptance and use by universities is a testament to its effectiveness.

The Letrus Methodology

The program utilizes a hybrid AI-human feedback loop to provide comprehensive support for students' writing development. The AI component, known as the Automated Writing Evaluation (AWE) algorithm, analyses essays and offers instant feedback on various aspects such as adherence to formal written norms and paragraph structure. This is followed by additional feedback from human graders who align their evaluations with the criteria used for Brazil's universities. This methodology ensures that students receive both immediate, machine-generated feedback and more nuanced, human insights, enhancing the overall learning experience.

Implementation of AI Technology

Letrus employs deep neural networks and feature engineering to build its AI platform. The AWE algorithm processes textual elements to score compositions based on predefined text indicators. These indicators include word count, use of connectors, spelling errors, and the presence of social agents and interventions. This AI-driven approach allows for the rapid assessment of essays, providing students with detailed feedback that highlights specific strengths and areas for improvement. The platform's ability to operate at scale is demonstrated by its reach across schools and universities.

Engagement and Learning Activities

Students engage with the Letrus platform by responding to writing prompts and receiving immediate feedback from the AWE algorithm. This process helps them understand their performance in real-time and encourages iterative improvement. Lecturers play a supportive role by accessing dashboards that track student progress, identify common errors, and facilitate targeted instruction. The program's design fosters an interactive and responsive learning

environment, where students are motivated to enhance their writing skills through continuous practice and feedback.

Challenges and Solutions

Despite its success, the Letrus Writing Skills Program faces challenges such as ensuring consistent internet access and device availability for all students, particularly in low-resource and public universities. To address these issues, Letrus collaborates with various stakeholders to secure funding and expand infrastructure. Another challenge is the initial resistance from educators and students towards adopting new technologies. Letrus mitigates this by providing comprehensive training and ongoing support to lecturers, helping them integrate the platform into their teaching practices effectively.

Conclusion

The Letrus Writing Skills Program exemplifies the potential of AI to transform education by enhancing functional literacy and promoting equitable access to digital skills. By combining AI with human expertise, the program offers a scalable and effective solution to improve students' writing abilities. This initiative not only supports individual learning outcomes but also contributes to broader educational goals, aligning with the mission to ensure inclusive and quality education for all.

Case Study 9: AI-Driven Remote Control of Greenhouse Vegetable Production

In an effort to explore the potential of artificial intelligence (AI) in sustainable agriculture, a group of students participated in a Research competition. The students, studying agricultural sciences and environmental sciences, used advanced AI tools to optimize greenhouse management. Their work focused on enhancing the efficiency and sustainability of vegetable production through precise control of greenhouse climate and irrigation. The initiative provided students with handson experience in AI applications, aligning with Education for Sustainable Development (ESD) by incorporating sustainable practices into their studies. Through this project, students developed critical digital skills essential for modern agricultural challenges, preparing them to integrate sustainability principles into their future careers.

Background

Greenhouse vegetable production is a critical component of modern agriculture, allowing for the cultivation of crops in controlled environments to maximize yield and quality. However, managing the complex interactions between climate, irrigation, and crop production requires sophisticated techniques. Traditional methods often need to improve in optimizing these variables, leading to inefficiencies and increased resource consumption. Recognizing these challenges, students from diverse academic backgrounds—including horticulture, agriculture, environmental sciences, and artificial intelligence—embarked on a project to leverage AI to improve greenhouse management.

The international competition on "autonomous greenhouses" provided an ideal platform for these students to apply their theoretical knowledge to practical scenarios and enhance their digital skills. The competition aimed to explore innovative solutions for autonomous greenhouse control, promote sustainable practices, and efficiently use resources.

Implementation

The implementation of AI tools in this project involved several critical stages, providing students with a comprehensive learning experience. Initially, students focused on understanding the key variables affecting greenhouse climate, irrigation, and crop production. They gathered extensive datasets from various sources, including historical climate data, crop yield statistics, and real-time sensor data from the greenhouses.

Using these datasets, students employed a variety of AI tools to develop and refine their models. The AI algorithms used in this study included Convolutional Neural Networks (CNN) for image recognition and analysis, Recurrent Neural Networks (RNN) for predicting future climate conditions, Bayesian Reinforcement Learning (BRL) for optimizing decision-making processes, and Deep Deterministic Policy Gradient (DDPG) for continuous control tasks. These tools were chosen for their ability to handle complex, high-dimensional data and their efficacy in capturing intricate relationships within the greenhouse environment.

The development phase involved iterative testing and refinement of the AI models. Students adjusted various hyperparameters and model architectures to achieve optimal performance. They trained the models on historical data and validated them using separate subsets to ensure accuracy and reliability. This rigorous approach allowed students to create robust models capable of providing precise control over greenhouse conditions.

Once the models were finalized, students implemented them into the greenhouse control systems. The AI models generated setpoints for climate and irrigation parameters, which were then executed by process computers connected to the greenhouse actuators. This setup enabled real-time monitoring and control of the greenhouse environment, ensuring optimal conditions for vegetable production.

Results

The use of AI tools in this project yielded significant positive outcomes. The AI-driven control systems provided highly accurate predictions and optimizations for greenhouse climate and irrigation, leading to improved crop yields and resource efficiency. Students were able to identify and implement targeted interventions that reduced water and energy consumption while maximizing crop productivity. The project significantly enhanced the students' digital skills. Students developed proficiency in machine learning, data analysis, and model deployment by working with advanced AI tools. This hands-on experience equipped them with the knowledge and expertise required to tackle complex environmental challenges. The project also reinforced the principles of Education for Sustainable Development (ESD), emphasizing the importance of sustainable practices and innovative solutions in agriculture.

Through their participation in the competition, students gained a deeper understanding of the potential of AI in transforming agricultural practices. They witnessed firsthand the impact of their work on improving greenhouse management and promoting sustainability. This experience underscored the value of integrating AI into educational curricula, fostering a new generation of skilled professionals capable of addressing global challenges.

Conclusion

This case study demonstrates the transformative potential of AI tools in agricultural education and practice. By leveraging advanced AI techniques, students were able to enhance their digital skills, develop innovative solutions, and contribute to sustainable development. The success of this project highlights the importance of integrating AI into higher education curricula, empowering students to become leaders in the fields of sustainable agriculture and artificial intelligence. This initiative not only provided essential skills but also contributed to the broader effort to combat the impacts of climate change on agriculture, demonstrating the critical role of AI in fostering sustainable development.