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Evaluating the Impact of TechnoVIT 2024 on AI, IoT, and Robotics Education for Global Challenges

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ABSTRACT

This study examines the TechnoVIT 2024 program, hosted by Vellore Institute of Technology (VIT) in Chennai, India, which focused on sustainable technology through AI, IoT, and Robotics. The program aimed to enhance participants' understanding of modern technologies and their application in sustainability, particularly in energy efficiency, waste management, and electric vehicles. Through project-based learning, including classes, workshops, and a hackathon, 50 participants from various countries developed innovative solutions for environmental challenges. Data were collected via surveys, interviews, and project evaluations, with thematic analysis revealing a 25% increase in technical skills and a 30% improvement in collaborative problem-solving abilities. Participants also reported enhanced cultural adaptability and global perspectives, essential for working in diverse teams. Challenges such as language barriers and time constraints were noted. The findings highlight the effectiveness of project-based learning and international collaboration in addressing global sustainability issues. The study concludes that programs like TechnoVIT 2024 are vital for preparing students to tackle future technological and environmental challenges. Recommendations include extending program duration, incorporating industry partnerships, and focusing on specific sustainability challenges. Future research should explore the long-term impact of such programs on participants' careers and compare outcomes across regions to enhance global sustainability education.

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1. INTRODUCTION

In the modern era, the application of AI and advanced technologies for sustainability is increasingly becoming a necessity [1], [2], [3]. However, there are still obstacles in the effective use of this technology in various developing countries. Some of the main challenges include limited access to advanced technologies, lack of understanding of the integration of AI and sustainability, and minimal international collaboration in developing AI-based solutions [3], [4].

Several previous studies have shown that AI has great potential to help achieve sustainability goals. Research by Chauhan and Sahoo (2024) found that AI can optimize energy use in industry [5]. Another study by Adewale et al., (2024) showed that IoT and Embedded Systems can improve the efficiency of resource management [6]. In addition, a book written by Dauvergne (2020) shows that AI-based electric vehicles can significantly reduce carbon emissions [7].

VIT is a leading private university in India with a Top 1001–1200 ranking in the QS World University Rankings 2023. The Chennai campus offers complete facilities, advanced laboratories, and a flexible credit system (FFCS). Chennai is known as the technological and cultural hub of South India, with historical sites like Mahabalipuram and Tirupati Temple. VIT has a program where this program is the main technical festival of VIT Chennai, where innovation meets creativity. This is a program or festival for students to showcase their skills, participate in cutting-edge workshops, and engage in competitive events across various engineering and technology domains. This festival is known as TechnoVIT [8]. Vellore Institute of Technology (VIT) Chennai, India, hosts the TechnoVIT 2024 program which focuses on sustainability-based technologies. This program covers areas like

Artificial Intelligence (AI), Internet of Things (IoT), Embedded Systems, Robotics, Electric Vehicles, and Power Electronics [8]. TechnoVIT 2024 is not a student exchange program, but rather a special invitation for students from various countries to explore the application of technology in the context of environmental sustainability. This program aims to provide an immersive academic experience through project-based learning and multinational collaboration. By involving students from various countries, including Indonesia, Tanzania, Uzbekistan, Mexico, Peru, Uruguay, Bangladesh, Sri Lanka, Japan, Malaysia and others, TechnoVIT 2024 creates a diverse and inclusive learning environment.

Figure 1. TechnoVIT Program Attended by Students from Various Countries

TechnoVIT 2024 adopts a project-based learning approach, where participants learn directly through workshop sessions, hackathons, and interactions with academics and practitioners from various countries. This approach is designed to ensure that participants not only understand the theory but are also able to apply it in real projects. This program offers a new approach to technology learning, namely the integration of AI and sustainability in one academic program. In addition, project-based learning with real-world challenges and cross-country collaboration for technological innovation are significant added values [9], [10].

Artificial intelligence (AI) technology has grown rapidly in various sectors, including environmental sustainability. Current global initiatives emphasize the role of AI in addressing environmental challenges and improving energy efficiency. With the increasing awareness of the importance of sustainability, the application of AI in various industrial fields is becoming increasingly relevant [11]. TechnoVIT 2024 aims to deepen students' understanding of the role of AI in sustainability. This program is organized by Vellore Institute of Technology (VIT), Chennai, India, and invites students from various countries [8]. This program provides an opportunity for students to develop technical skills and understand the potential of AI in solving sustainability challenges.

Universitas PGRI Semarang sent two delegations to participate in this activity. The students involved had the opportunity to learn from experienced professors in the fields of AI, IoT, and Robotics. Thus, they gained new insights into the implementation of technology in real life, especially those related to environmental sustainability. This activity consisted of classroom learning, workshops, hackathons, and field visits.

Figure 2. Upgris Students at VIT Chennai

The TechnoVIT program provides participants with the opportunity to apply the theories they have learned to real projects that are oriented towards sustainability. Participants are expected to improve their technological competence through a project-based learning approach. Through the projects they work on, participants can develop skills in problem solving and team collaboration that will be useful in the workplace. Thus, this program not only provides academic benefits but also prepares participants to face challenges in the industrial world.

The TechnoVIT program provides a comprehensive academic experience while improving participants' critical and creative thinking skills. The main objective of this activity is to apply AI to solve sustainability problems. With a project-based approach, participants are given the challenge of developing relevant solutions that can be implemented in real life. This is expected to provide a positive contribution in supporting environmentally friendly technology.

AI has great potential in energy efficiency, waste management, and resource conservation [12]. The application of AI allows various sectors to optimize the use of resources more effectively and efficiently [11]. With the rapid development of AI, it is hoped that more innovative solutions will be applied in various aspects of sustainability.

One of the main focuses of this activity is the implementation of AI in electric vehicles. Electric vehicles are one of the main solutions to reduce carbon emissions and dependence on fossil fuels [13]. By integrating AI, the efficiency of electric vehicles can be improved through optimization of power consumption and real-time monitoring of battery conditions.

TechnoVIT 2024 brings together students from various cultural and academic backgrounds. This diversity provides an opportunity for participants to learn from different perspectives and broaden their horizons regarding global issues. With cross-cultural interactions, students can develop communication skills and international networks that are beneficial for their future careers [14]. The program also emphasizes international collaboration to produce useful innovations. With the collaboration between students from various countries, various creative ideas emerge that can be developed into real solutions to sustainability problems. This initiative encourages the creation of an inclusive and dynamic academic environment [15].

Sustainability-based technological literacy is increasingly important in the era of the 4.0 industrial revolution. Understanding the concept of sustainability and the application of modern technology are key to facing future challenges [16]. Therefore, programs such as TechnoVIT 2024 are very important in equipping students with relevant skills for the future. By participating in this program, students gain valuable academic and cultural experiences. They not only learn about cutting-edge technology, but also understand how it can be used for a greater purpose, namely supporting global sustainability. Through this experience, participants are expected to become agents of change in the fields of technology and sustainability.

This article aims to summarize the implementation, methods, results, and lessons learned in the TechnoVIT 2024 program. With this research, it is hoped that it can be a reference for students and academics who are interested in exploring the role of AI in sustainability. Artificial intelligence (AI) technology has become a key element in industrial transformation and environmental sustainability [17]. The use of AI in various sectors, including renewable energy, smart cities, and waste management, offers innovative solutions to global challenges [18], [19], [20]. The TechnoVIT 2024 program held by VIT Chennai is a platform for students from various countries to learn about the application of AI in sustainability.

Universitas PGRI Semarang sent a delegation to participate in this program as part of an effort to improve the quality of technology education in Indonesia. This participation is expected to have a positive impact on curriculum development and research in the fields of technology and sustainability. This study aims to explore participants' experiences in the TechnoVIT 2024 program and assess its impact on their technical understanding and skills.

This study highlights the importance of cross-cultural academic interactions in building a global perspective on sustainable technology. In addition, previous literature shows that international academic programs provide significant benefits in improving student competencies, especially in STEM (Science, Technology, Engineering, and Mathematics) fields [21], [22]. Several studies also confirm that project-based learning approaches, such as hackathons and workshops, are effective methods in improving understanding of technological concepts [23].

Considering this background, this study focuses on the experiences of Indonesian participants in the TechnoVIT 2024 program, including the academic and social benefits they gained and the challenges they faced during the program. Through the TechnoVIT 2024 program, students not only gain in-depth technical knowledge but also valuable cross-cultural experiences. This program provides a platform for students to develop innovative solutions to global sustainability challenges, while preparing them to become future leaders in the fields of technology and the environment.

2. METHOD

This study uses a descriptive qualitative approach to document the participants' experiences in attending TechnoVIT 2024. This approach was chosen because it allows for in-depth exploration of the participants' subjective experiences, social interactions, and the impact of activities on their understanding of AI and sustainability [24]. The subjects of the study consisted of TechnoVIT 2024 participants from various countries, including students fromIndonesia. The selection of subjects was carried out using a purposive sampling technique, where participants

were selected based on their active involvement in activities [25].

This study focuses on three main aspects of the participants' experiences, consisting of AI and Sustainability Technology Learning; Hackathon and Workshop and Cultural and Academic Interaction. AI and Sustainability Technology Learning focuses on AI & Machine Learning Classes, IoT & Embedded Systems Classes and Robotics & Electric Vehicle Classes. Hackathon and Workshop focus on Collaboration in multinational teams and Development of AI-based solutions for sustainability. Cultural and Academic Interaction focuses on Adaptation to the Indian academic environment and Experience of living in a hostel and cross-cultural social interaction.

AI and Sustainability Technology Learning, participants attend classes facilitated by VIT professors on AI & Machine Learning, IoT & Embedded Systems, and Robotics & Electric Vehicles. Hackathon and Workshop are collaborative activities in the form of sustainability-themed hackathons, which challenge participants to develop AI-based solutions. Cultural and Academic Interaction is the experience of participants interacting with students from various countries and their adaptation to the academic environment in India.

Data was collected from participant reports, activity documentation, and interviews with TechnoVIT 2024 participants. Researchers conducted direct observations of participant activities, both in class, hackathons, and social interactions. This observation aims to obtain an overview of the social, economic, and academic environment conditions during the program [26]. In addition, observations were made of the teaching methods used by VIT professors, the level of participant participation in discussions and collaborative projects, and the dynamics of cross-cultural interactions between students from various countries. The results of these observations provide insight into how the TechnoVIT 2024 program can improve participants' understanding of AI and sustainability technologies, as well as shape soft skills such as teamwork and global communication [23].

Interviews were conducted with TechnoVIT 2024 participants to explore their experiences in more depth. Interviews aimed to explore deeper data, understand respondents' perspectives, and obtain clarification on the answers given [27]. The interview process was conducted both in person and online, with questions focused on academic experiences, challenges faced during the program, and benefits gained in the application of artificial intelligence and sustainability technologies. The interview results were analyzed thematically to identify patterns in participant experiences and reveal new insights into the effectiveness of the program in improving student competencies in technology and innovation.

Documentation is a data collection method carried out by collecting, recording, and analyzing existing documents or archives [28]. Data was collected from participant reports, presentation materials, video recordings, and photos of activities. During the practice at TechnoVIT 2024, documentation included learning notes during class sessions, project results developed in the hackathon, and participant interactions in various academic and cultural activities. In addition, official documents from the Vellore Institute of Technology (VIT), such as learning modules, activity schedules, and participation certificates, were also used as references to understand the structure and impact of the program more comprehensively.

Data analysis was conducted using thematic methods by identifying initial themes from the collected data. Data grouping based on main themes, such as AI learning experiences, hackathon experiences, and cultural interactions. Data verification was carried out with triangulation by comparing the results of interviews, observations, and documentation. In this way, the study can ensure that each finding is supported by various credible data sources, thereby increasing the validity of the research results.

To ensure the validity of the research results, several validation techniques were used, namely triangulation, member checking, and audit trail. Source triangulation is comparing data from various sources to ensure the consistency of the findings [29]. Member Checking is the results of the analysis discussed again with participants to ensure the accuracy of the interpretation [30]. Audit Trail by providing detailed documentation of the entire research process so that it can be traced and retested [27]. This approach ensures that the research can be traced and retested, thereby increasing the transparency and reliability of the results obtained.

The results of this study are expected to provide insight for international program organizers in improving the learning experience of participants. In addition, this study can be a reference for educational institutions in designing AI-based and sustainability programs. The findings of this study can also help in designing more interactive, project-based, and cross-cultural collaboration-oriented learning methods. In addition, this study can be the basis for broader international cooperation, opening up opportunities for academic exchange, and strengthening networks between students and academics from various countries.

The limitations of this study are the limited number of participants. This study involved only a small portion of TechnoVIT 2024 participants. The data comes from participants' personal experiences, so there is a possibility of subjective bias. The short duration of the activity, as a one-month period, may not be enough to capture the long-term impact of this activity.

3. RESULTS AND DISCUSSION

3.1. Result

The TechnoVIT 2024 program organized by Vellore Institute of Technology (VIT) was a success, attended by delegates from various countries, including Indonesia. This activity aims to improve students' understanding of

modern technologies such as Artificial Intelligence (AI), Machine Learning, Internet of Things (IoT), Embedded Systems, Robotics, Electric Vehicles, and Power Electronics. Through intensive learning, participants not only gain theoretical insights but also practical experience that can be applied in the industrial world.

3.1.1. AI Learning and Sustainability Technologies

TechnoVIT 2024 participants attended a series of intensive classes facilitated by professors from Vellore Institute of Technology (VIT). The learning focused on three main areas, namely AI & Machine Learning, IoT & Embedded Systems, and Robotics & Electric Vehicles. Through these classes, participants not only gained theoretical understanding but also practical experience in applying the latest technologies to support environmental sustainability.

3.1.2. AI & Machine Learning

The AI & Machine Learning class was led by Dr. Rajesh Kumar, who discussed the application of AI in renewable energy. Participants were taught how AI can be used to optimize energy efficiency, such as in an AI-based energy management system that can predict energy needs and automatically regulate the distribution of renewable energy. Participants were reportedly very enthusiastic about the class, especially since the material presented was relevant to global issues related to climate change and the need for sustainable energy sources. Dr. Kumar also gave real-life examples of the use of AI in renewable energy projects in India, such as a weather prediction system for a solar power plant. This gave participants new insights into how AI technology can be a solution to environmental problems.

3.1.3. IoT & Embedded Systems

IoT & Embedded Systems class was led by Dr. Priya Srinivasan, who focused on IoT system design for smart cities. Participants learned about developing IoT devices that can improve the efficiency of urban systems, such as traffic management systems, energy management, and environmental monitoring. Dr. Srinivasan emphasized the importance of hardware and software integration in creating effective IoT solutions. Participants were also given the opportunity to work on small projects involving IoT sensors to monitor air and water quality. Observations showed that participants were highly engaged in discussions and practicums, with many participants able to develop simple IoT-based prototypes.

3.1.4. Robotics & Electric Vehicle

The Robotics & Electric Vehicle session was led by Dr. Anil Sharma, who discussed sustainability-based robotics innovations. Participants were taught about the basic principles of robotics and how this technology can be applied in electric vehicles to reduce carbon emissions. Dr. Sharma also gave examples of robotics projects being developed at VIT, such as a waste-cleaning robot and an autonomous electric vehicle. Participants were given the opportunity to design and test a simple electric vehicle prototype, which involved programming and mechanical design. The results of this session showed that participants were able to understand the basic concepts of robotics and apply them in practical projects.

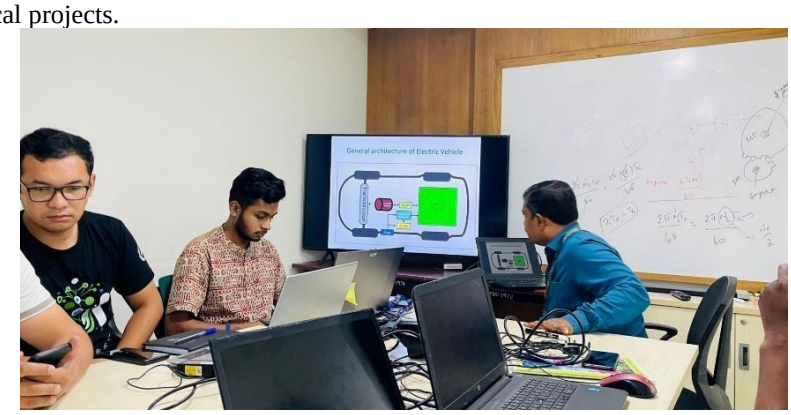

Figure 3. Electric Vehicle Learning

Overall, learning at TechnoVIT 2024 successfully provided a deep understanding of the application of AI, IoT, and robotics technologies in the context of sustainability. Participants not only gained theoretical knowledge but also practical experience through assignments and projects given by the professors. Observation results showed that participants were enthusiastic in attending classes, with a high level of participation in discussions and practical assignments. Documentation collected in the form of learning notes and project presentations showed that participants successfully understood the basic concepts and applications of sustainability technologies.

3.1.5. Hackathon dan Workshop

One of the important parts of the TechnoVIT 2024 program is the hackathon themed "Sustainable Solutions with AI" which will take place on 19–21 September 2024. A hackathon is an event or competition that involves programmers, designers, and other technology professionals to collaborate in developing software projects [31]. This activity is designed to encourage participants to develop AI-based solutions that focus on environmental sustainability

Participants are divided into multinational teams, allowing them to collaborate with students from various cultural and academic backgrounds. Hackathon participants can design an Internet of Things (IoT)-based system to collect real- time pollution data, optimize gas resistance sensors, and increase efficiency in air quality data analysis.

Thus, the hackathon serves as a platform to test practical concepts in a competitive environment that encourages innovative solutions.

Figure 4. Resistance Practicum

3.1.6. Air Pollution Monitoring System

One of the projects produced in this hackathon is the Air Pollution Monitoring System. The team working on this project utilized AI technology to detect and analyze air quality in real-time. The system uses IoT sensors connected to an AI-based platform to process data and provide recommendations on actions that can be taken to reduce air pollution. This project is very relevant to the environmental conditions in India, which often faces air pollution problems, especially in big cities like Chennai.

3.1.7. Smart Waste Management

Another interesting project is Smart Waste Management, which aims to improve the efficiency of waste management through an IoT-based platform. The system uses sensors to monitor the level of bins and sends the data to a waste management center. AI is then used to optimize waste collection routes, thereby reducing carbon emissions from garbage trucks. This project shows how technology can be used to create environmentally friendly and efficient solutions.

The results of this hackathon showed that participants not only improved their technical skills in AI and IoT but also strengthened their cross-cultural teamwork abilities. The main challenges faced by the participants were differences in communication styles and task completion time, which pushed them to improve their project management skills. However, through intensive collaboration, the participants managed to overcome these challenges and produce innovative solutions.

3.1.8. Cultural and Academic Interaction

In addition to academic and technological aspects, the TechnoVIT 2024 program also provided participants with an in-depth cultural experience. Observations showed that cross-cultural interaction was one of the most valuable aspects of the program.

Figure 5. Field Trip to Mahabalipuram Temple

3.1.9. Adaptation to the Indian Academic Environment

Participants admired the discipline of Indian students, especially in utilizing campus facilities until late at night for research and projects. This reflects the high work ethic among Indian students, which is an inspiration for international participants. Participants were also impressed by VIT's complete campus facilities, including state-of-the-art laboratories and the flexible credit system (FFCS) that allows students to design their study schedules according to their needs.

3.1.10. Hostel Life Experience and Cross-Cultural Social Interaction

Participants experienced daily life on the VIT campus, including adjusting to typical Indian food such as biryani, puri, masala dosa, and chai. In addition, participants also participated in various cultural activities, such as international fashion shows and visits to historical sites such as Mahabalipuram and Kull Tirupati. These activities not only enriched the participants' cultural experiences but also strengthened social ties between participants from various

countries.

From the interviews, participants stated that cross-cultural interaction was one of the most valuable aspects of the program. Documentation in the form of photos and videos of activities supports this finding by showing various collaborative activities between participants from various countries. This experience not only broadens the cultural insights of participants but also opens up opportunities to build international networks that can be useful in the future.

Figure 6. Indian Social and Cultural Interaction

3.2. Discussion

The TechnoVIT 2024 program has a significant impact in various aspects, both academic, technical, and social. In terms of academics, this activity equips participants with the latest technological skills that are highly relevant to the needs of modern industry. The practice-based learning method applied at VIT allows participants to understand the implementation of theory in the real world. Participation in hackathons also improves problem-solving skills and collaboration in multinational teams, which are essential skills in today's industrial world. Research conducted by Yousef (2024) states that cross-cultural teamwork experience can increase the effectiveness of communication and innovation in technology-based projects [32].

In terms of social adaptation and cultural interaction, this program provides valuable experience for participants in dealing with a multicultural environment. Indian students are known to have high discipline in studying and research, which inspires participants to improve their work ethic. In addition, life in the dormitory and interaction with students from various countries broaden participants' horizons regarding cultural diversity and academic habits in other countries. A study by Kattiyapornpong and Almeida (2021) showed that students with international experience tend to be more adaptable and have a broader global perspective in solving problems [33].

The experience of living in India also taught the importance of flexibility in adapting to a new environment. Differences in language, diet, and education systems are challenges that must be faced, but at the same time provide opportunities for participants to develop cross-cultural communication skills and resilience in dealing with new situations. In a study by Presbitero (2020), it was stated that exposure to different foreign environments significantly improves cognitive skills, flexibility of thinking, and tolerance for differences [34].

In addition, this program provides new insights into the field of renewable energy through the use of AI to improve the efficiency of resource utilization. Recent studies have shown that the integration of AI technology into energy systems can increase production efficiency by up to 20%, thus having a direct impact on global environmental sustainability. TechnoVIT 2024 participants applied this concept in their projects, showing that AI-based approaches can be a real solution to today's environmental problems.

Furthermore, the hackathon that participants participated in provided real-world experience in developing technology projects with limited time and resources. A study by Preiksaitis et al., (2022) stated that the hackathon experience improves participants' critical thinking skills, project management, and adaptation to rapid change [35]. Success in completing challenges in a short period of time is an indicator of increased participant competence during the program. Overall, TechnoVIT 2024 proves that international academic programs can provide very broad benefits, both in terms of improving academic competence and in terms of developing soft skills. The success of this program shows that collaboration between educational institutions in Indonesia and abroad is very important in building human resources who are ready to face global challenges. Therefore, in the future, similar programs need to be expanded and developed so that more students can benefit from this extraordinary academic and cultural experience. The development of programs like this can also be supported by further studies that compare the effectiveness of international-based learning with conventional methods applied in local institutions.

4. CONCLUSION

The TechnoVIT 2024 program organized by Vellore Institute of Technology (VIT), Chennai, India, has successfully achieved its intended objectives. The program provides participants with an in-depth academic and practical experience in understanding and implementing cutting-edge technologies, particularly Artificial Intelligence (AI), Internet of Things (IoT), Embedded Systems, Robotics, Electric Vehicles, and Power Electronics, in the context of environmental sustainability. Through project-based learning, participants gain not only theoretical knowledge but also practical skills that can be applied in the industrial world. The results of the program show that participants have

successfully enhanced their understanding of AI and sustainability technologies, and developed innovative solutions through hackathons and workshops. In addition, cross-cultural interactions and adaptation to the Indian academic environment provided valuable experiences for participants in developing global social and communication skills. The program also demonstrated that international collaboration in technology and sustainability can produce relevant solutions to global challenges. The success of the TechnoVIT 2024 program shows that international academic programs like this have great potential for further development. In the future, similar programs can be expanded to involve more students from different countries, thereby providing broader benefits in improving academic competency and social skills. In addition, further research can be conducted to evaluate the long-term impact of this program on the career development of participants and their contributions in the field of technology and sustainability. Thus, the TechnoVIT 2024 program not only provides direct benefits to participants but also opens up opportunities for further development in the field of technology and sustainability education. Collaboration between educational institutions in Indonesia and abroad, such as VIT, needs to be continuously improved to build human resources who are ready to face global challenges in the future.

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