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International Community Outreach Program: Raising Chemistry Awareness Through STEM Activities

STEM Activities

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Abstract:- The Chembusters group conducted the International Community Engagement Project, which involved 20 students and 2 supervisors from Universiti Teknologi PETRONAS (UTP), Malaysia. This initiative offered UTP undergraduate students a unique chance to participate in an international community outreach project hosted at Universitas Islam Indonesia (UII) in Yogyakarta. The project aimed to address the waning interest in pure science and technology education by raising awareness about chemistry among young students. Activities included educational talks, a chemistry explore-race, workshops, community service, and an industrial visit. The primary event, the chemistry explore-race, engaged 72 local secondary students, fostering teamwork, problem-solving skills, and an increased interest in chemistry, as evidenced by positive feedback from participants and teachers. The university social responsibility project at Panti Asuhan Asy Syafi'iyyah featured simple science workshops, benefiting 96 children from the orphanage, emphasising practical skills, enjoyable experiences, and support for disadvantaged youth. Additionally, Chembusters participants visited Shafaluna to gain insights into essential oil production through lectures, distillation demonstrations, and exploration of eco-friendly practices. The event was covered by "Tribun Cakra News," recognising its focus on industry knowledge and sustainable practices.

Keywords:- *International Community Engagement Project; Undegraduate Students; Applied Chemistry; STEM; Education.*

I. INTRODUCTION

All Universiti Teknologi PETRONAS (UTP) undergraduate students are required to take HEB 1012 Community Engagement Project (CEP), an obligatory course that aims to produce a community engagement project for social improvement and showcase leadership and teamwork skills. The Ministry of Education has authorized this subject as a national requirement within MPU (Mata Pelajaran Umum/General Studies). This course is a project-based operation that emphasizes knowledge, skills, morals, values, patriotism, and towering personalities. The UTP mission to shape a holistically developed student, both physically and mentally, guides the establishment of this two-credit-hour subject. Thus, the community engagement course serves as a rightful platform to support students' personal growth and allow them to implement the diverse knowledge gained over the years while embarking on an exhilarating adventure.

Based on this agenda, a dynamic team of 20 students called "Chembusters" were eager to spend two weeks on a high-impact community engagement project at Universitas Islam Indonesia (UII), which is a distinguished private institution in the city of Yogyakarta, Indonesia, with the intention of addressing the other side's collaborative party request and one of the UTP University Social Responsibility (USR) pillars of education. The team's objectives were to evoke a transformative journey and an invigorating experience, aiming to raise awareness about the importance of pure science and technology among the targeted participants. The planned project focused on the practical application of scientific knowledge, particularly in the field of chemistry, with the goal of expanding participants' perspectives and offering valuable insights into a chemistry-based program.

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The vibrant city of Yogyakarta, located in the northwest of Indonesia, is home to this project. As the fourth-most populous city in Indonesia, it is known for its modern infrastructure, bustling commercial centers, and diverse cultural offerings. Therefore, Chembusters, with the generous support of UII, aimed to create a lasting impact by promoting a collaborative spirit within the Indonesian community and education through various activities. This ultimately resulted in a greater interest in careers in the chemistry sector and active participation in addressing global challenges. In collaboration with UII, the project aimed to stimulate young people's interest in pure science and technology through engaging modules and hands-on activities.

Chembusters aimed to organize and carry out collaborative initiatives with UII to unite various community members while fostering social cohesion and unity. The partnership with UII enriched networking opportunities, providing UTP students with diverse knowledge and strengthening intergenerational support. Feedback from UII highlighted the timely impact and success of the Chembusters project. The community project also focused on enhancing the interpersonal skills and personal growth of its team members through involvement in decision-making, community initiatives, and volunteer activities. It successfully improved students' abilities in communication, teamwork, networking, and entrepreneurship, aligning with UTP's mission of producing well-rounded graduates. Personal development was evaluated through reflection reports and presentations. Chembusters implemented interactive chemistry enrichment modules to engage secondary school students and raise awareness of the significance of pure science and technology. With data from the Student Room Forum showing only 18.4% of students pursuing science due to limited career prospects, Chembusters addressed this issue with impactful modules that showcased science's relevance. Surveys indicated increased student interest, confidence, and knowledge.

II. COMMUNITY ENGAGEMENT ACTIVITIES

The Chembusters project aimed to raise awareness about the crucial role pure science and technology-related graduates play in transforming Malaysia into a research-driven nation. The USR program carried out this effort through project-based teaching activities. Chembusters served as an ambassador of responsibility in the community by encouraging pure science and technology interest. It went beyond common educational bounds, inspiring and educating people about the value of STEM fields in a broader societal context. The project created a sense of social responsibility among the university's faculty and students by providing new and engaging activities and sharing skills and enthusiasm with the larger community [1]. The project sought to not only educate but also inspire our audience, urging them to choose the applied chemistry program at UTP as a stepping stone to realizing their dreams as researchers through engaging discussions and enjoyable workshop sessions. It is believed that by igniting this enthusiasm, a pathway can be paved for a new generation of scientists and researchers to lead into a flourishing era of scientific discovery and innovation [1, 2].

A. Chemistry Explore Race

The community project's main activity was the chemistry exploration "Seeking Secrets of Chemistry." The committees conducted two dry runs before the explorace to ensure the activities were suitable for high school students and to estimate equipment needs. These dry runs helped UTP students to improve their communication in Indonesian, particularly with scientific terminology. The day of the event introduced high school students to the dual degree program between UTP and UII. The explorace included six stations with science and chemistry-related games, which are lava lamp, neutralisation balloon, clay ping pong, elephant toothpaste, ball and stick model, and pink titration [3]. Groups of ten students conducted experiments at each station, fostering engagement, critical thinking, and creativity. Facilitators provided briefings, and students answered related questions to assess their understanding. The event concluded with a prize-giving ceremony, recognising the students' commitment and participation and helping them apply theoretical chemistry concepts from their syllabus through practical demonstrations reflecting daily life. The participants in this explorace include students from both Sekolah Menengah Atas (SMA) Negeri 3 Klaten and Sekolah Menengah Atas (SMA) Miftahunnajah as shown in Fig. 1 and Fig. 2, respectively. The expected outcome for students engaging in STEM activities encompasses the cultivation of a sense of wonder and curiosity about the natural world. It is anticipated that students will develop a deeper appreciation for scientific inquiry and experimentation by actively participating in these hands-on experiments [2]. Moreover, these activities aim to instill confidence in students' ability to engage with and understand STEM concepts, paving the way for continued academic success in science-related subjects [4].

B. University Social Responsibility at Panti Asuhan Asy Syafi'iyyah

Additionally, the university social responsibility (USR) initiative was a cornerstone event of the project, aiming to foster community engagement and social responsibility. This activity encompassed three primary activities: the creation of candles, the production of liquid dish soap, and a demonstration of load distribution using a straw bridge. Prior to the event, meticulous preparation ensured its success, including two dry runs. This initial dry run was crucial for identifying potential issues and ensuring the materials and procedures were well-prepared for the orphanage participants. This also allowed UTP and UII students to collaborate closely, enhancing communication and refining the activities for smooth execution on the event day. On the day of the USR event, the orphanage participants were divided into three large groups based on age. The youngest group, aged 7 to 12 years, engaged in the load distribution demonstration using straw bridges. This activity introduced basic engineering principles through a fun building challenge. The older participants, aged 13 to 17 years, were split into boys and girls. The boys participated in candle making, learning about the materials and processes involved, while the girls engaged in liquid dish soap production, emphasizing sustainability and practical chemistry applications. Following these activities, a prize-giving ceremony recognised the most innovative and sturdy bridge designs, further motivating the participants. These

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activities fostered collaboration and mutual learning, strengthening the bond between university students and orphanage participants and highlighting the project's goal of community empowerment and education [5-7].

III. PROJECT OUTCOMES

The Chembusters project achieved its goals, benefiting both the educational community and disadvantaged youth. In collaboration with Universitas Islam Indonesia (UII), the project organised educational talks, workshops, and the chemistry explore race, fostering a strong partnership between UTP and UII and enhancing social cohesion. Team members actively participated, improving their interpersonal skills, including leadership, communication, teamwork, and project management, aligning with UTP's goal of developing well-rounded graduates. Through the chemistry exploration race and workshops, the project engaged 72 secondary school students, sparking their interest in chemistry and providing them with hands-on experience. Fig. 3 shows hands-on one of the experiments under the chemistry explore race. Table 1 listed the questionnaires for post-module, in which clear written instruction was given to the participants and verbally repeated the instruction before the participants fill in the survey to ensure that the feedback received is properly aligned with the purpose of the survey. Post-questionnaires surveys showed increased interest, confidence, and knowledge in chemistry, fulfilling the objective of raising awareness about pure science and technology.

TABLE I. POST-MODULE QUESTIONNAIRES

No	Impact of Chemistry Enrichment Modules on Vision to Pursue Studies in Chemistry
1	What aspects of the program did you enjoy the most?
2	What specific activities or experiences contributed most to your personal growth and interpersonal skills?
3	How effective were the collaborative initiatives between UTP-UII in promoting social cohesion and unity?
4	What suggestions do you have for improving collaboration in future projects?
5	Rate the effectiveness of the chemistry enrichment modules in raising awareness about Pure Science and Technology among school students.
6	Which module did you find most engaging, and why?
7	Were the activities well-organized and efficiently executed?
8	Were there any difficulties with communication or information dissemination? If yes, why?
9	Were there any challenges with obtaining necessary materials or resources for the activities?
10	Describe your experiences with cultural exchange during the activities.
11	Did you gain any insights or perspectives from interacting with students from another country?
12	Rate your overall satisfaction with the inbound activities on a scale of 1 to 5.
13	Do you have any additional comments or suggestions for improvement?
14	Would you recommend this program to others?

To ensure sustainability, the project plans to establish a formal partnership framework between UTP and UII, develop educational materials, and set up regular community service initiatives. The project increased interest in chemistry among students, provided valuable skills to disadvantaged youth, and benefitted orphanage children with donations of groceries, money, and clothing. Feedback was overwhelmingly positive, with students expressing renewed interest in chemistry, educators noting increased enthusiasm, and orphanage staff appreciating the support and positive impact of the workshops and donations. Key achievements include the successful Chemistry Explore Race, USR activities benefiting 96 orphanage children, industry visits, and media coverage in "Tribun Cakra News (https://www.tribuncakranews.com/2024/05/chembusters-universiti-teknologi.html)," highlighting the project's impact and raising public awareness. Overall, the Chembusters project achieved its objectives, ensured its sustainability, and left a lasting positive impact on the community.

The feedback from the overall UTP-UII committees provided a positive review of the overall 14-day event, where their votes were mostly on 4 to 5 out of 5 for their experience in this event. Aspects that they enjoyed the most were exploring local areas and cultures, as well as chemistry explorace and industrial visits to Shafaluna and chemistry labs in UII, where they had a chance to learn about chemistry and the application of chemistry in industries. The experiences that contributed the most to the committees' self-improvement were the ice-breaking slot, discussion on the science team project slot, and USR activities at Panti Asuhan Asy Syafi'iyyah, where they obtained chances to coordinate teams and communicate with people from various backgrounds in terms of academics as well as social cohesion. All the respondents also voted "YES" on gaining insight from interacting with people from another country. Regarding the effectiveness of the collaboration between UTP-UII and the chemistry modules, the respondents overwhelmingly gave it a score of 4 out of 5. The Chembusters event successfully achieved its objectives, but there was still room for improvement. For instance, the committees should have better

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scheduling to prevent last-minute preparations and to gather information about the country's daily life and norms.

The feedback forms from Panti Asuhan Asy Syafi'iyyah provide a positive review of the organized soap-making activity. They strongly agree that it was engaging and enjoyable, and that it helped them understand the chemistry concepts better by allowing them to ask questions during the session. The majority of them voted "agree," indicating that they appreciated the organisers' effective communication regarding the activity's details and found the provided material and equipment to be sufficient. Additionally, the majority voted neutrally about completing the task within the allocated time and would recommend this activity to their peers. Overall, they strongly agreed and expressed satisfaction with their experience participating in this activity. They also extended their gratitude to the organizers at UII and UTP for their efforts.

Fig. 1. Participants of Chemistry Explore Race from Sekolah Menengah Atas (SMA) Negeri 3 Klaten

Fig. 2. Participants of Chemistry Explore Race Sekolah Menengah Atas (SMA) Miftahunnajah

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Fig. 3. Hands-on Activity of Chemistry Explore Race experiment

Fig. 4. UTP and UII Teams Visited Panti Asuhan Asy Syafi'iyyah to Conduct USR Activities.

Fig. 5. The USR Activities Benefitted 96 Orphanage Children, Providing Practical Skills and Enjoyable Learning Experiences.

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IV. CONCLUSION

The community engagement project aimed to enhance students' leadership, teamwork, and community engagement skills. At Universitas Islam Indonesia (UII) in Yogyakarta, a team of 20 students known as "Chembusters" carried out a two-week project with the aim of promoting awareness about pure science and technology, specifically chemistry. The key activities included a chemistry-themed explorace, involving 72 secondary school students in interactive science stations and experiments. The group also conducted a USR initiative at the Panti Asuhan Asy Syafi'iyyah orphanage, with workshops on candle making, soap production, and engineering principles. These activities benefitted 96 orphanage children, providing practical skills and enjoyable learning experiences (Fig. 5). The collaboration included essential oil studies at UII's Centre of Essential Oil Studies, industrial visits, and cultural exchange activities. Highlights included hands-on distillation sessions, a visit to Shafaluna Atsiri for essential oil production insights, and a cultural exchange day with traditional dances and musical performances. These activities provided practical skills and fostered mutual cultural appreciation.

The Chembusters project met its objectives of promoting pure science and technology awareness, enhancing interpersonal skills, and fostering community engagement. The initiative significantly impacted the local community, increasing students' interest in science education, as evidenced by positive feedback from educators and orphanage staff. The project aligned with Sustainable Development Goals (SDGs) 4 (Quality Education) and 17 (Partnerships for the Goals), promoting quality education and international collaboration. In conclusion, the project achieved its objectives and contributed to community empowerment and educational enhancement. Its outcomes include long-term benefits through a formal partnership framework, educational material development, and sustained community service initiatives, setting a precedent for future collaborative efforts.

V. RECOMMENDATIONS

To ensure the continued success and improvement of future community engagement projects, several recommendations are proposed. Firstly, it's essential to strengthen communication channels between UTP and UII, facilitating clearer logistical planning and coordination. Regular virtual meetings, supplemented by comprehensive documentation of responsibilities, can enhance communication efficacy, ensuring all stakeholders are aligned on event objectives and timelines. Additionally, conducting multiple dry runs involving committee members and external volunteers is crucial. These simulations replicate actual event conditions, enabling the identification of potential issues and the refinement of activities to better suit participant needs and preferences.

Furthermore, to enhance participant engagement and diversity, it's recommended to introduce a wider range of interactive activities that cater to different interests and age groups. Alongside traditional lectures and demonstrations, incorporating multimedia presentations, interdisciplinary workshops, and practical skill development sessions can enrich the overall event experience. Moreover, expanding the cultural exchange component is vital. This can be achieved through hands-on workshops, traditional dance lessons, and language learning sessions, providing participants with immersive cultural experiences and fostering mutual understanding and appreciation.

To ensure ongoing community engagement and support, efforts should be made to involve local experts and leaders in event activities. This not only enriches the learning experience but also strengthens ties between the academic institutions and the broader community. Moreover, post-event analysis and impact assessments are critical for evaluating the success and effectiveness of activities. These assessments can inform future planning efforts and guide decision-making to maximize the positive outcomes of projects. Detailed planning and budgeting can help avoid logistical issues and ensure smooth event execution.

By implementing these recommendations, future community projects can continue to achieve their objectives effectively, providing participants with valuable learning experiences and fostering deeper connections between academic institutions and the communities they serve.

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