Impacting Underprivileged Communities with STEM-Robotics Innovation: The Alan Turing Institute's Public Engagement in Wales and Malaysia

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Abstract. The EUREKA Robotics Centre organises several programs to promote the public understanding and sustainable development of STEM disciplines by showcasing cutting-edge technologies in Robotics and Artificial intelligence. In 2022-2023, the EUREKA Robotics Centre partnered with the Alan Turing Institute to run a special series of public engagement roadshows in Wales and Malaysia, aimed at encouraging participation among traditionally underrepresented groups in STEM, specifically women, girls and minority students. Research has found that public engagement roadshow activities have a positive impact on the understanding and acceptance of STEM disciplines among underrepresented groups and directly affect the career aspirations of participants. These results support the validity of public engagement in STEM, which EUREKA will continue through the proposed PIE-GENIUS (Indonesia and UK Sustainable STEM-AI Gender Equality Network) program to guide future AI and robotics research and policies.

Keyword: STEM, Education, Healthcare, Public Engagement, Gender Equality, Robotics, AI

1. Introduction and Literature Review

In developed countries, STEM (Science, Technology, Engineering, and Mathematics) programs can play an important role in addressing labour shortages caused by aging populations, close skills gaps, and promote economic growth. Similarly, in emerging economies, these programs can take advantage of opportunities brought about by the information technology and Internet revolutions, capitalize on new industries, and drive significant economic growth [7].

In the UK, STEM roles constitute a significant part of the labour market. According to the Office for National Statistics (ONS) Labor Force Survey [6], 2.8 million people were employed in professional scientific, technical, and health occupations between July-September 2022, representing approximately 8.5% of a total workforce of 32.7 million [8]. Notably, a third of the UK's science workforce is composed of non-graduates, underscoring the importance of vocational pathways in meeting the demand for STEM professionals [9]; however, the UK face significant labour and skills shortage, with 43% of vacancies for STEM professionals proving difficult to fill [1].

Despite the need to increase the STEM workforce, underrepresentation of certain demographics remains a persistent issue, particularly among women, certain ethnic minorities, people with disabilities, individuals from lower socioeconomic backgrounds, and the LGBTQ+ community. The Royal Society has reported underrepresentation of these groups in STEM, which has persisted over the years [8].

Gender equality is a fundamental human right and essential for a sustainable world [4]. Research have shown that despite a significant increase in female school enrolment, gender disparities in educational opportunities persist. Biases, social norms, and expectations often impede the quality and subject choices for girls and women. Notably, women remain under-represented in STEM, comprising only 35% of graduates—a figure unchanged for a decade—leading to continued under-representation in STEM careers [10].

To address public understanding and acceptance of STEM, the Alan Turing Institute encourages researchers to engage with the public on topics related to data science and artificial intelligence, and foster transparency and constructive scientific decision-making. Public engagement helps counteract the polarisation of public perceptions, which may be influenced by media hype and misinformation, and fosters a dialogue that aligns scientific research with societal needs. This inclusive engagement can help enhance transparency and public trust in technology, in turn facilitating smoother policy implementation [5]. See Figure 1.

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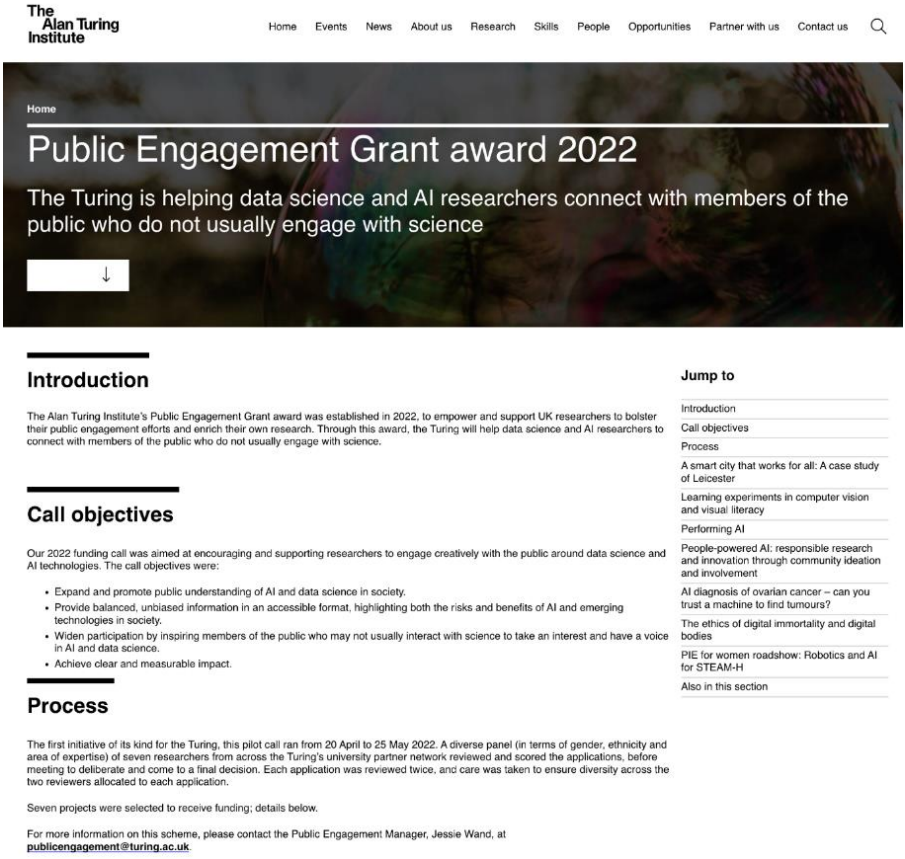

Fig.1 The Alan Turing Institute Public Engagement Grant award 2022 [5]

Sharing the Alan Turing Institute's goal of promoting public understanding of STEM, the EUREKA Robotics Centre has organised approximately 280 events since its inception in 2017, directly involving 27,701 participants. Among these, 231 events focused on STEAM-H (Science, Technology, Engineering, Agriculture, Mathematics and Healthcare) Edu-Social Enterprise, and Healthcare Civil Engagement Workshops, attracting 25,408 participants. Additionally, 50 events were dedicated to STEM Workshops and Public Engagement, engaging 2,293 participants.

The EUREKA Robotics Centre's STEM Lab is dedicated to Science, Technology, Engineering, and Mathematics (STEM) education, and aims to cultivate critical capabilities in students to adapt to future demands, potentially sustaining relevance in their future lives and careers. The PIE (Partnership for Innovation in Employability) Programme is central to enhancing and improving the inclusivity of STEAM-H. It reduces risks associated with activity implementation and increases policy deployment efficiency. By implementing this Programme, the STEM Lab embodies the research philosophy of mass participation in science, grounded in practicality, and intensifies public engagement.

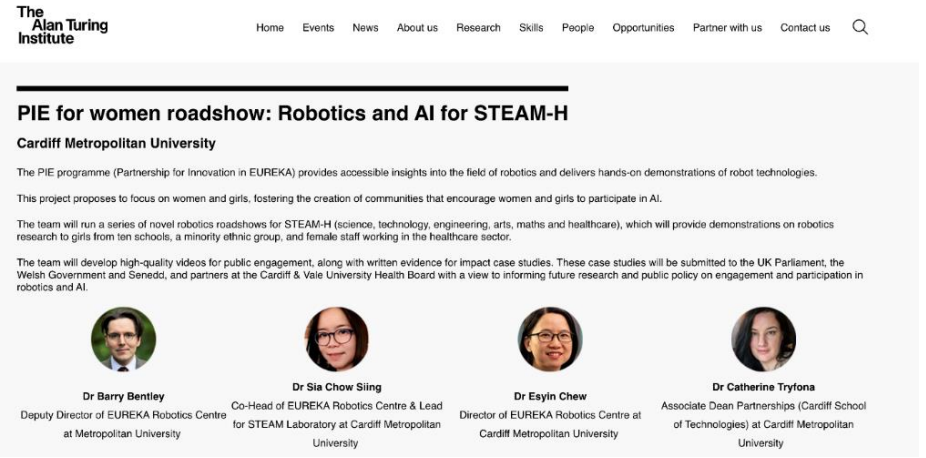

Fig.2 PIE Women roadshow: Robotics and AI for STEAM-H

Table 1. Partner Organizations

Event	Roadshow 1 28/11/2022	Roadshow 2 09/01/2023	Roadshow 3 12/01/2023
Partner Organizations	1. Cardiff Chinese Community	1. Ysgol Pencae 2. Ysgol-Y-Wern Primary School 3. Pantside Primary School 4. Ystrad Mynach Primary School 5. Miskin Primary School 6. St Bernadette's Primary School 7. Cefn Forest Primary School 8. Blaenycwm Primary School 9. Usk Primary School	1. Cardiff Metropolitan University Management Team 2. ALTY Hospital Management Team 3. Duffryn Ffrwd Manor Nursing & Residential Home Management Team

The PIE STEAM-H programme facilitates bidirectional, systematic communication, with a particular focus on and encouragement of traditionally underrepresented groups in STEM, including women, girls, and minorities, disadvantaged groups. In order to help students who are in a critical period of education, we organized two STEM Workshops (Roadshow 1 & 2) for traditionally underrepresented groups in STEM teenagers in grades five to ten, we organised a meeting (Roadshow 3) featuring prominent female leaders from Cardiff Metropolitan University, ALTY Hospital Management Team, and Duffryn Ffrwd Manor Nursing & Residential Home in the STEAM-H field to give presentations.

The PIE STEAM-H project is expected to have a positive impact on underrepresented groups in STEM and healthcare, as it is expected to increase the understanding and participation of female and minority participants in robotics and artificial intelligence and is expected to promote broader social equity and inclusion, reduce gender and racial bias, and improve participants' skills and confidence. These results will also provide a reference for future research and policy making to promote gender equality and diversity in STEM and healthcare. See Figure 2 and Table 1.

2. The Methodology of Alan Turing Public Engagement

2.1 Logic of Public Engagement in Science from the PIE Series Activities

Fiorino[3] delineate public participation in science into normative, instrumental, and substantive logics. In varying contexts of logic, the role of the public in technology governance differs under normative logic, they act as "Laity";

under instrumental logic, as "consumers"; while under substantive logic, they are "stakeholders". These logics offer significant insights into technology governance and public participation [11]. See Table 2.

Table 2. Comparison of public participation in science under the three logics

	Normative logic	Instrumental logic	Substantive logic
Philosophical background	Public republicanism	Neoliberalism	Constructivism
Implementation goals	Participate in the consultation process	Specific results	Macroeconomic policy outcomes
Implementation Results	Preset	Preset	Non-preset
Implementation concept	Top-down	Top-down	Bottom-up
Public trust	Preset	Non-preset	Non-preset
Difficulty of implementation	Relatively complex	Simple	Complex
Public image	Laity	Consumer	Stakeholders
Public roles	Passive	Passive	Active
Degree of local knowledge	Disrespect	Partial respect	Respect

In the context of neoliberalism, policies and projects often emphasize the improvement of individual skills and the maximization of market efficiency. The PIE series of activities reflects this philosophical background by providing STEM-AI courses for ethnic minority communities and girls in Wales and Malaysia. Instrumental logic is applied here to enhance the capabilities of these groups through education, thereby enhancing their competitiveness in the market and social mobility. This is consistent with the characteristics of neoliberalism that focuses on individual empowerment rather than structural change.

The main goal of these roadshows is to increase the participation of ethnic minorities and girls in these fields by providing STEM-AI courses. This goal is "preset" because it is based on clear performance indicators such as the number of participants and learning outcomes. Instrumental logic emphasizes the achievement of quantifiable effects through these courses, such as increasing students' interest in STEM, improving their technical skills, and ultimately increasing the representation and employment opportunities of these groups in related fields.

2.2 Ethical Approval

All procedures performed in studies involving human participants were in accordance with ethical standards. This study was approved by the Ethics Committee of Cardiff Metropolitan University. Informed consent was obtained from all participants. Minors signed in the presence of the guardian/teacher and researcher. All research-related data is stored on Cardiff Metropolitan University's OneDrive and will be retained for ten years, until 2032, on request. Sensitive information is securely encrypted in compliance with GDPR and relevant regulatory guidelines.

3. Roadshow 1 & 2: PIE STEAM-H Education for Underprivileged Communities

3.1 Participants and Sampling Methods

Roadshow 1 was an activity for children and teenagers of minority descent. Roadshow 1 utilised convenience sampling, inviting 50 children and young from Cardiff Chinese Community, along with their parents, guardians, and community volunteers. The actual number of children and young people in attendance was 33 (excluding adults). While this method allows for quick selection, it may introduce selection bias and affect the representativeness and reliability of the findings (e.g. anonymous). Ethical compliance was ensured by issuing participant information forms to all participants and guardians of minors prior to the activity.

Roadshow 2 was an activity for girl and young female students. Roadshow 2 employed quota sampling, involving 30 participants: 20 girl and young female students and 10 teachers. The students were selected from nine primary schools, with two or four students from each school selected through convenience sampling to ensure voluntary participation. Although these sampling methods enhance inclusivity, the limited participant number may restrict the representation of all demographic viewpoints, affecting the generalisability of the results. Ethical standards were maintained by obtaining the principal's consent and distributing participant information forms to teachers before the activity commenced.

3.2 Event Steps

The STEAM-H Roadshow was centred around robotics and consisted of three main parts: Robot Showcase, Robot Workshops, and Robot-Human Feedback Sessions.

Fig.3 Robots: EUREKA (Left 1), Nightingale, JD, Drone TT, RoboMaster, RoboMaster EP, PLL (Right 1)

The first part showcased various robots, including Robot EUREKA, Robot Nightingale, Robot RoboMaster, Robot RoboMaster EP, Robot Drone TT, and Robot JD (Figure 3). Through interactive performances and interactions with students.

Fig.4 3D Printer Workshop

The second workshop element provided firsthand learning experiences on various aspects of robotics. These workshops included Robot EUREKA Workshop, Robot RoboMaster and Robot RoboMaster EP Workshop, Robo JD and 3D Printer Workshop, and Robot PLL (POLLYGENIC WELLBEING) Workshop. During these sessions, students were exposed to computing concepts and programming skills through activities such as programming Robot JD, Drone TT and Robot RoboMaster (EP) using Blocky code. In addition, students tried controlling the movements of Robot EUREKA and tasting food prepared by Robot PLL.

Fig.5 Blocky code programming (Participant Design) in Drone TT Workshop & PLL Workshop

In the third part, the Robot-Human Feedback Session, researchers conducted one-on-one interviews with participating students. The questionnaire contents were explained to the students verbally to ensure their understanding. With participants' consent, the entire interview process was recorded for further analysis. Subsequently, the data was meticulously organized and securely stored on OneDrive in compliance with ethical standards.

3.3 Data Collection and Compilation

The researchers designed a questionnaire to understand students' grade levels, their interest in robots, whether they would be willing to befriend a robot, their interest in STEM subjects after the activity, their inclination to pursue higher education, the guidance provided by the activity regarding university subject choices, and their overall rating of the activity. Understanding these nuanced attitudes is crucial for developing effective and engaging robotics education programmes that cater to the diverse needs and preferences of students. This comprehensive analysis aids in understanding students' social needs and psychological states, providing insights for creating compelling and effective robotics education plans that promote holistic student development.
To protect the students' personal information, the researcher assigned random identifiers, RSA1 to RSA33, to the thirty-three minority students participating in Roadshow 1. Consent for participation was obtained from the parents or guardians of all thirty-three students. Of these, seven students declined to participate in the survey, one student refused to have their opinions included in the research analysis, and three students did not complete the survey, resulting in 22 valid responses. Similarly, for Roadshow 2, the researcher assigned identifiers RSB1 to RSB20 to the twenty girl students. Parental consent was secured for all participants in this investigation. However, one student declined to have her opinions included in the research analysis, resulting in 19 valid responses. Thus, the total number of valid responses from both roadshows is forty-one. See Figure 6.

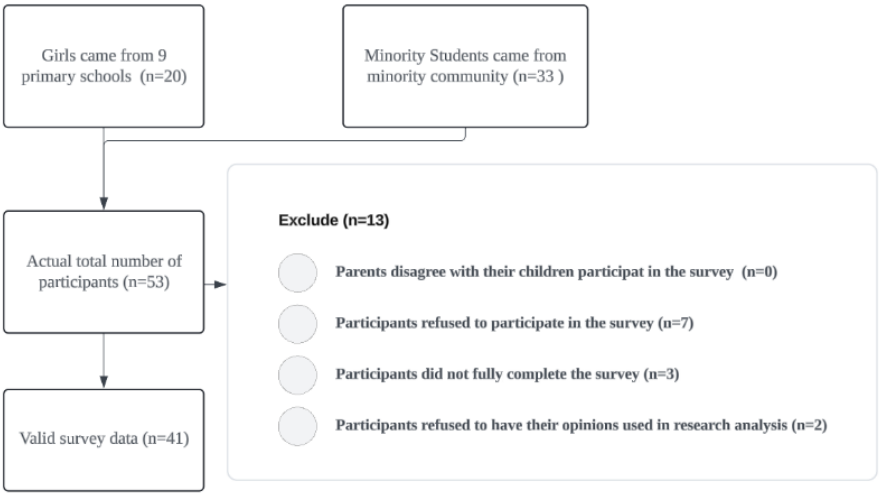

Fig.6 Roadshow 1 & 2 Data Sorting

3.4 Data Analysis

Table 3. Participant grade distribution

Grade	*5*	*6*	*7*	*8*	*9*	*10*
Number	10	16	1	8	2	4

As seen in Table 3, the data from the robotics workshop, which involved forty-one students, illustrated an uneven distribution across different grades. Year 6 students comprised the largest group (16 participants, approximately 39% of the total). Year 8 and Year 5 followed with 20% and 24% representation respectively, suggesting a balanced interest in STEM education between these two years. Conversely, Year 7, Year 9, and Year 10 **contributed** minimally, each representing only around 2%, 5%, and 10% of the total, respectively.

Table 4. Questionnaire Statistics

Question	*Not Sure*	*Yes*	*No*

Do you like robots?	*1*	*40*	*0*
Would you let the robot be your friend/companion?	*5*	*34*	*2*
Did the Robotics sessions today inspire you to be more interested in STEM subjects?	*8*	*32*	*1*
Would you like to go to a university?	*8*	*29*	*4*
Did the Robotics sessions today inspire what you would study at the University?	*17*	*20*	*4*

According to Table 4, forty out of 41 students expressed that they liked the robot, while one student was still unsure about their feelings. In terms of willingness to befriend or partner with robots, 34 students were open to the idea, 5 were uncertain, and 2 declined. The workshop also sparked an interest in STEM subjects in 32 students, though 1 student reported no impact and 8 were unsure. Regarding aspirations for higher education, 29 students indicated a desire to attend university, 8 were uncertain, and 4 were not interested in pursuing further education. Additionally, twenty students acknowledged that the activity influenced their university subject choices, while 17 were uncertain of its impact. Notably, among students planning to attend university, about 54% of minority and female students are more inclined to choose STEM subjects in their college or career planning.

Table 5. Rate your Robotics sessions today（Full score: five points）

Score	***1***	***3***	***3.5***	***4***	***4.5***	***4.6***	***5***	***6***
Number	*1*	*2*	*2*	*9*	*8*	*1*	*17*	*1*

According to Table 5, following the conclusion of the activity, participants rated it on a scale of 1 to 5, with one student providing an exceptional score of 6, deeming the activity to exceed expectations. Seventeen students gave a full score of 5, which means that they were very satisfied with the quality and experience of the event. Some students gave slightly lower scores, including one student who gave 4.6, eight students who gave 4.5, and nine students who gave four. In addition, some participants gave medium to low scores, including two students who gave 3.5 points each and one student who gave one point.

3.5 Analyse, Achievements and Lessons

In general, the Roadshow 1 & 2 Robotics Workshop provided an opportunity for students in middle and primary schools who liked robots to get close to the innovative technology of STEM-AI. The vast majority of students were very satisfied with this activity. Based on the grade distribution of the students who signed up, we can assume that primary school students were more interested in STEM technology and were more willing to participate in science activities. Therefore, educators should focus on primary school students, and the difficulty of the course should be highly matched with their cultural level. The vast majority of students became more interested in STEM subjects after participating in the Robotics Workshop, which can be attributed to the interactive and practical learning experience of the workshop, giving participants a deeper understanding of the application and value of STEM subjects. From a long-term perspective, researchers should continue to hold STEM-related activities or make this course a fixed subject in the school to continue to maintain students' interest in STEM subjects until the subject choice in university.

4. Roadshow 3: PIE Women in STEAM-H

4.1 Participants and Sampling Methods

The researchers have obtained permission to quote participant comments for our study on HRAAS (Human Robots as a Service) and PIE Women in STEAM-H.

The current activity used purposive sampling, a non-probability sampling method where the researchers' selected participants from the population based on their expertise and judgment. Several women who have made outstanding contributions in the field of STEAM-H were selected as participants for this study. Their experiences and insights are expected to provide valuable perspectives and guidance for the activity.

4.2 Event Steps

Fig.7 Hybrid Meetings

The study was conducted in a hybrid online and offline meeting mode. The management team of Cardiff Metropolitan University represented the STEM education field, the management team of ALTY Hospital represented the STEAM-H field, and the management team of Duffryn Ffrwd Manor Nursing & Residential Home represented the STEAM-H field. The use of the robot EUREKA in Duffryn Ffrwd Manor Nursing & Residential Home is shown in Figure 8.

Fig.8 Robot EUREKA in Duffryn Ffrwd Manor Nursing & Residential Home

All the main participants were women with leadership in the STEM field, and they shared their experiences in their respective fields in turn. The principal researcher then led a structured interview to collect insights on STEM education, medical social services, etc.

4.3 Analysis and Discussion

Participant Profile. The researchers have invited the Head Nurse & Quality & Risk Manager (Female) from Malaysia's ALTY Hospital (Adding Life to Years) for a semi-structured interview. The discussion will focus on the use of robots developed by the EUREKA Robotics Centre at ALTY Hospital, including the service humanoid robot EUREKA, healthcare robot Almeida, and multifunctional service robot Temi.

The participant, a Quality and Risk Manager with a nursing background, oversees the highest standards of patient care across various departments. Key responsibilities include ensuring partner safety, supervising the quality of service provided by ALTY's nursing staff, and conducting comprehensive risk assessments and control measures for ongoing projects. The participant has encountered various robots in her workplace healthcare environment, specifically utilizing the EUREKA, Almeida, and Temi robots at ALTY Hospital in Malaysia, alongside disinfection, delivery, and registration robots. To protect personal information, the research named the participant to RSC1.

Robots in ALTY Hospital. RSC1 works within a privately funded healthcare system. RSC1 expressed confidence that ALTY Hospital would not encounter significant barriers to the adoption of robots. As a member of the management team, RSC1's cheerful outlook towards the adoption of robots determined the cheerful outlook towards robots throughout ALTY Hospital. However, although no staff members expressed opposition to the adoption of robots, there may be underlying concerns or reluctance to publicly express dissent. RSC1 noted that staff key performance indicators (KPIs) include an assessment of their adaptability to recent changes, and the adoption of robots may affect staff salaries. While this policy may motivate staff, it may also increase staff stress as they have to comply with organizational expectations.

Advantages of Robots in ALTY Hospital. RSC1 noted that in hospitals, in addition to direct patient care roles, there are a variety of non-clinical positions. These roles include customer service and administrative tasks. These tasks are repetitive, boring, and do not require technical skills.

Fig.9 Robot EUREKA in ICU and Reception at ALTY Hospital

ALTY Hospital has used the EUREKA robot to assist with patient admission and orientation. This EUREKA robot is used for self-service check-in and payment processing, providing voice or graphical interfaces to enable patients to easily complete these processes. It can resolve common complaints and escalate issues to human staff. It provides navigation assistance, guiding patients, and their families to required locations, such as parking areas, visiting areas, and dining facilities. It communicates valuable information, including visiting hours, smoking policies, and exercise reminders, through voice or screen display. It plays a vital role in reminding and explaining key medical procedures to patients, such as fasting or disinfecting showers before surgery, thereby reducing the likelihood of forgetting or ignoring medical instructions. See Figure 9.

Fig.10 Disinfection Robot

Disinfection robots are used for nightly cleaning and disinfection of rooms in medical facilities. They are equipped with various sensors and devices to ensure that rooms are thoroughly cleaned, and proper disinfection methods are used to reduce the risk of cross contamination. See Figure 10.

Fig.11 Healthcare Robot Almeida

During COVID-19, the medical robot Almeida has proven to be especially useful, entering patient rooms and facilitating remote interactions, addressing nurses' concerns about limited contact, especially when they have

children or elderly parents. Almeida can perform basic observations on patients, such as blood pressure and temperature checks. See Figure 11.

Fig.12 Robot Temi in Ward at ALTY Hospital

Humanoid robots like Temi provide an interactive communication channel outside of work hours. Temi provides a friendlier or more reassuring experience than a recorded phone message. Currently, Temi is used to consult with nurses in other departments to communicate treatment status. See Figure 12.

Robots reduce workload by performing tasks that doctors or nurses do not like, such as providing safety briefings on the use of electronic devices and microwaves. Nurses' task preferences vary by patient and situation; while dispensing medication may be simple, dealing with difficult or contentious patients can be challenging. Additionally, if nurses are afraid of patients, they may avoid interacting with them, which can lead to oversights, such as forgetting to ask if a patient needs pain relief. Robots do not encounter this problem and can perform tasks effectively without hesitation.

Robots Issues and Challenges in ALTY Hospital. There are several challenges to using robots in healthcare settings. First, their unpredictable uptime and high integration costs pose a significant barrier to integrating them into hospital systems to provide personalized information. Additionally, robots require automatic doors to enter rooms, which is problematic, especially for COVID-19 situations that require double doors or negative pressure rooms equipped with airlocks. Additionally, having openings or holes in the robots poses significant problems because viral particles could enter, and there is no effective way to thoroughly sterilize them. This is especially true in operating rooms and intensive care units. Hardware challenges include battery failure, maintenance requirements, and connectivity issues. There are also concerns that robots could cause harm to patients, such as accidental collisions, leading to injuries and legal consequences for hospitals.

While robots can perform simple observations, such as blood pressure and temperature checks, nurses still need to fully assess patients, as vital signs and respiratory rates may appear normal despite potential issues such as cyanosis. RSC1 also pointed out issues with the robot's camera functionality. In one case, a nurse had difficulty using the robot to take pictures during surgery due to the camera angle and lack of adjustability. While the voice-operated camera helps keep it clean, the inability to verbally reposition and zoom the camera limits its usefulness. The speed of the robot was cited as a limiting factor, especially as the EUREKA robot needs to be pushed manually to keep up with the nurses, which could slow down workflow. The time required to train patients on how to use the robot was cited as a potential drawback. Providing operating instructions could help address this. There are risks in using robots for dietary choices, as some patients may have dietary restrictions or special needs that currently require personal questioning. Doctors at ALTY Hospital praised Temi's facial recognition feature, which simplifies user identification. However, there were concerns about the complexity of registering facial information. Visually impaired people may find it challenging to interact with the robot via a touchscreen.

Improvements and Suggestions for Robotics. RSC1 recommend equipping the robot with disposable protective covers to reduce the risk of infection. Medication verification, which usually requires two nurses, could be streamlined if the robot assists. By utilizing the existing ID tag and barcode system for patient identification and medication confirmation, the robot can efficiently verify key details such as administration time, route, dosage, medication type, and number of pills.

Robot also has potential advantages in monitoring patients' movements, such as breathing exercises or fall prevention exercises, and in addressing common causes of falls, like the inability to lift the bedside railing. Currently, the Almeida robot collects basic observational data such as blood pressure and temperature, but there is potential for it to collect more comprehensive information, including real-time warnings of patient falls or behaviours that could lead to falls.

Additionally, there is a need for the robot to offer more advanced functionalities beyond simple photography, such as identifying the severity of infections or injuries and suggesting appropriate treatments. Currently, these tasks require consultation with specialized wound nurses.

5. Impact achievements and lessons learned from the PIE Women's Roadshow

PIE - Women's Roadshow has raised awareness of female leadership in STEM by showcasing the successful experiences of female leaders in STEM at Cardiff Metropolitan University, ALTY Hospital and Duffryn Ffrwd Manor Nursing & Residential Home. In particular, the use of the EUREKA Robot in the hospital shared by ALTY hospital managers demonstrated the practical application of STEM technology in medical care and promoted the popularization and recognition of the technology. This roadshow provides a platform for communication and cooperation between different organizations, promotes knowledge sharing and resource integration, and further promotes the cooperation and development of women in the field of STEM. By showcasing successful female leaders and concrete STEM applications, the roadshow inspires young women's interest in and confidence in STEM fields, encouraging them to pursue STEM-related fields in their academic and career advancement.
In terms of experience and lessons, we first need to share more practical cases, like the application display of the EUREKA Robot Centre at ALTY Hospital, which is intuitive and convincing, showing the successful application of STEM technology in different fields. Secondly, although the roadshow has raised awareness of female leadership, more systematic ways are needed to increase the visibility of women in STEM, such as setting up female leadership awards, holding regular seminars, etc.

6. Conclusions and Future Work: PIE-GENIUS

The EUREKA Robotics Centre's STEAM-H (Science, Technology, Engineering, Arts, Mathematics, Health) education program, with support from the Alan Turing Institute, education programme has achieved certain results in increasing public understanding and acceptance of robotics and artificial intelligence. Through public engagement roadshows in Wales, UK, the events highlight innovative research and practical applications in healthcare and education. PIE Women is part of the wider PIE (Partnership for Innovation in Employability), ensuring that traditionally underrepresented groups, particularly women and girls, participate equally in discussions on robotics and artificial intelligence. This is consistent with the United Nations' emphasis on gender equality and women's empowerment to achieve sustainable development. The PIE series uses both qualitative and quantitative research methods to uncover key topics such as educational effectiveness, psychological dimensions, technical challenges, administrative issues, and healthcare considerations. The findings suggest that the PIE programme has a positive impact on the understanding and acceptance of robots among underrepresented groups. Refer to 1 and 3.5.
Building on this success, the next PIE-GENIUS programme aims to allows Indonesia and U.K. partners to establish links with one another which it will enable through funding for short term industrial and academic mobilities and collaborative opportunities, and real-field projects deliveries aimed at developing new cross-disciplinary relationships. The GENIUS programme means Gender Equality Networks for Indonesia and UK in Sustainable STEM-AI [2]. The PIE-GENIUS programme will connect experienced professionals with young learners from underrepresented groups, foster cross-cultural exchange through the PIE-GENIUS program, share best practices and promote collaborative research, and continue rigorous research to evaluate education Long-term effects of the intervention. Additionally, the programme will collaborate with policymakers to advocate for policies and funding that support inclusive STEAM-H education and create scalable, sustainable models that can adapt to a variety of contexts. The PIE-GENIUS initiative is a crucial step in promoting STEAM-H education and public engagement, driving progress toward a more inclusive and technologically literate society.

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