

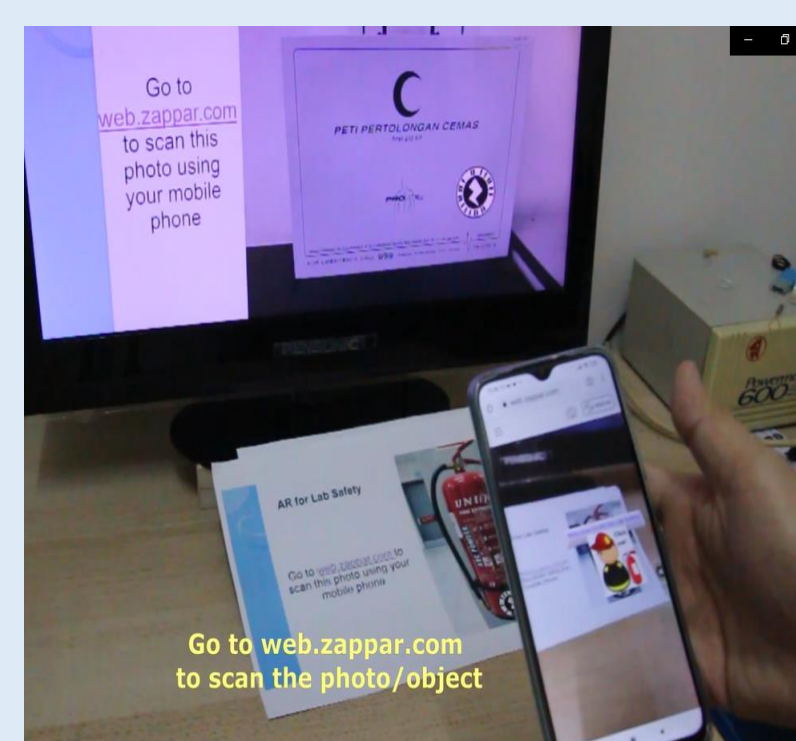
Introduction

Chemical safety and security as well as scientific ethics are important topics to chemists but often neglected due to either lack of awareness or complacency. Two approaches using Augmented Reality (AR) and Choose Your Own E-Learning Adventure scenario-based e-training were introduced in the Undergraduate Chemistry's Ethics and Laboratory Safety module to address these topics. The design of the learning activities is aligned with the FAIR (feedback, activity, individualisation, relevance) principle and mobile-learning concept.

Objectives

- To enhance the interactivity and effectiveness of the teaching and learning activities in the Bachelor of Science (Hons) Pharmaceutical Chemistry's "Ethics and Laboratory Safety" module by integrating AR application and scenario-based e-training.
- To provide students with the opportunity to relate the ethics and laboratory safety knowledge learned in classroom to real-world applications.
- To assess students' learning experience in utilising AR application and scenario-based e-training.

Inventiveness (Part I)



Virtual access from home

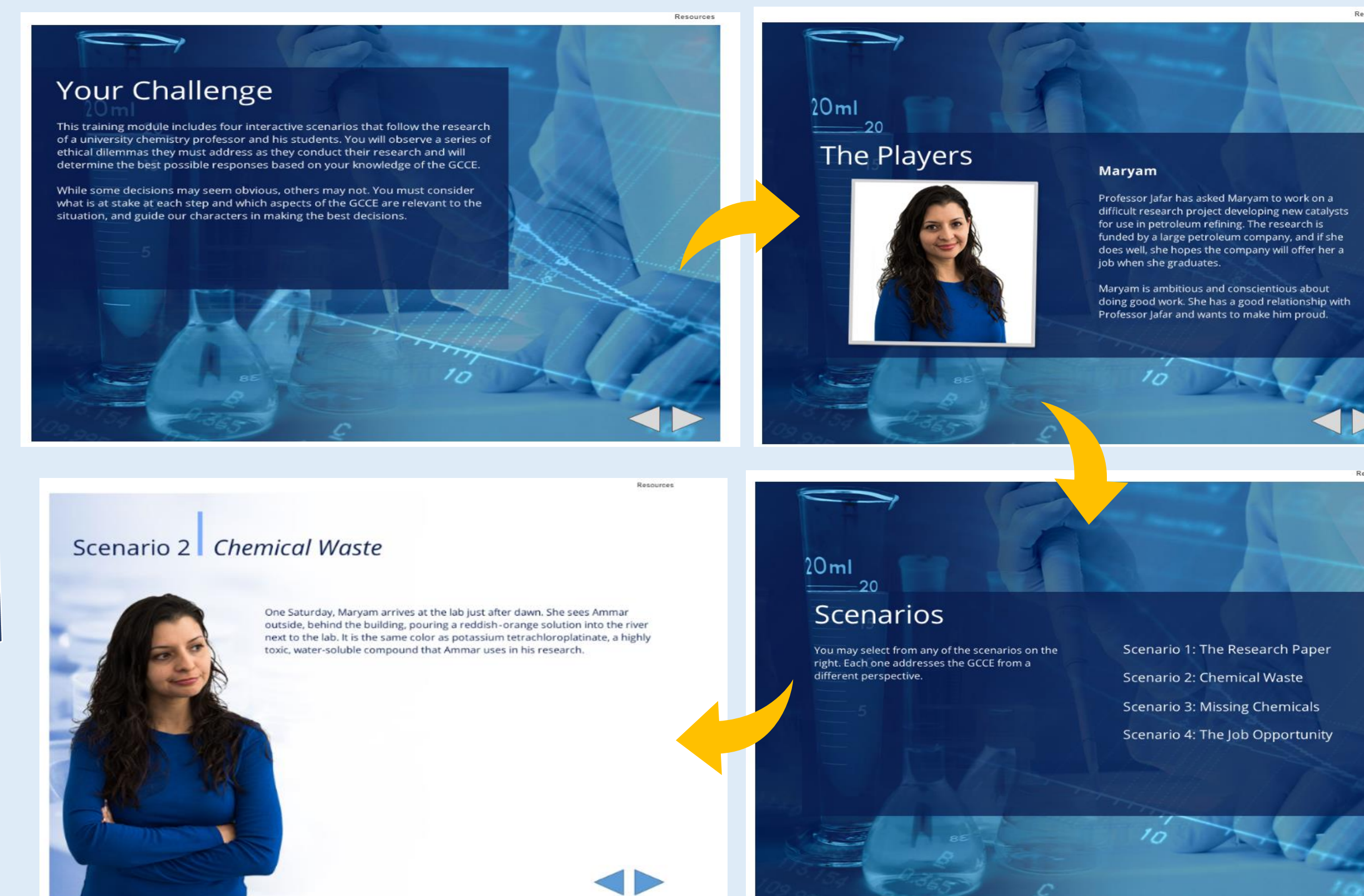
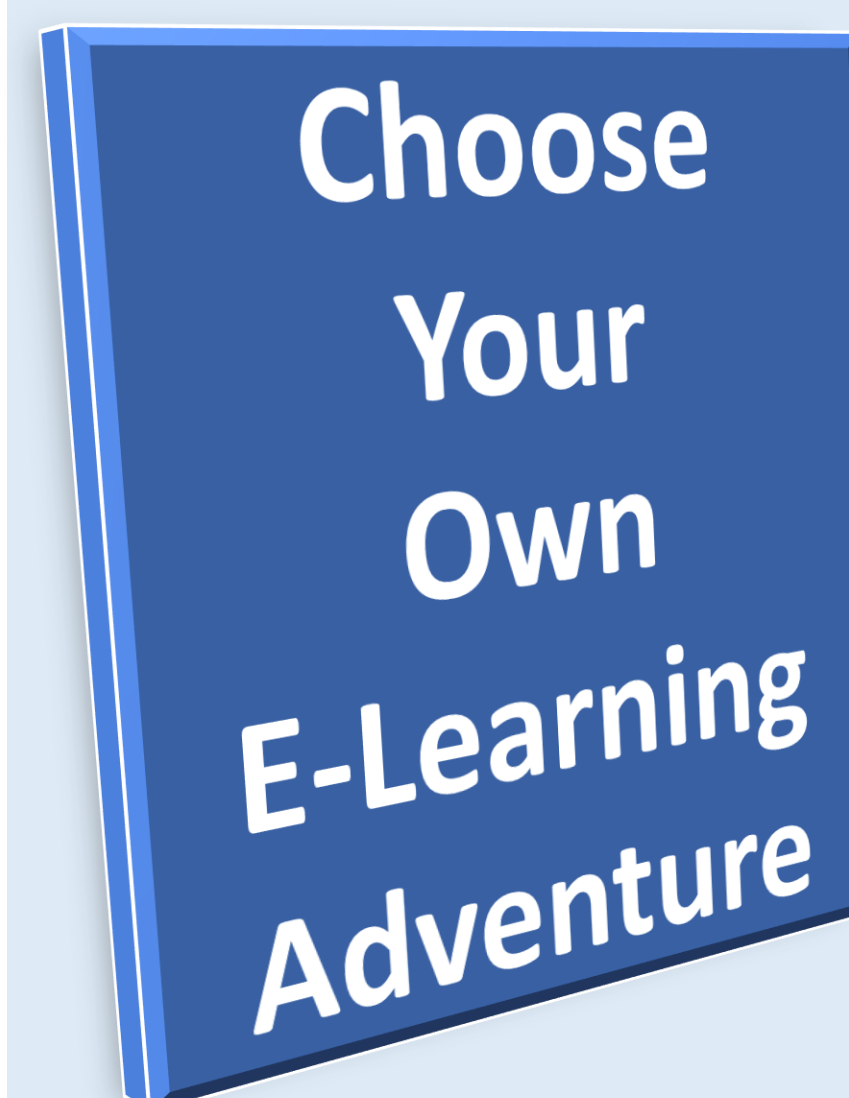


Access in the physical lab

- Real objects of laboratory safety equipment available the lab
- Real people in university settings
- Very relatable for students
- Anytime, anywhere accessibility using mobile devices
- Open-source platform (ZapWorks/Zappar)



Inventiveness (Part II)



- Four real-world scenarios available at ACS repository (collaboration with ACS)
- Students are required to guide the characters in making the best decisions
- Students receive immediate feedback based on the decision selected

Impact on Learning

Technology Acceptance Model (TAM)	AR		Scenario-based e-training	
	Mean (Likert scale)	Positive response (%)	Mean (Likert scale)	Positive response (%)
Perceived usefulness	4.27	82	4.33	80
Perceived ease of use	4.00	67	4.30	83
Perceived enjoyment	4.23	83	4.27	80
Attitude towards use	4.20	80	4.47	90
Intention to use	4.30	83	4.33	83

*Likert scale: 1 Very unlikely/in disagreement; 2 = Slightly unlikely/in disagreement; 3 = Neutral/not unlikely-likely/in disagreement/in agreement; 4 = Slightly likely/in agreement; 5 = Very likely/in agreement **Only responses with Likert scale of 4 and 5 are counted as positive response*** Total students, n=15

Examples of students' comments:

"It is a step in the right direction towards more interesting learning methods"

"Helps in understanding better the topics and increase students' interest"

Practicality and usefulness

Challenges of current traditional teaching approaches:

- X Lecture – Difficult to visualise and apply knowledge learned in real world scenarios.
- X In-person training – feasibility issues in classroom settings due to cost, time and logistics.

Strengths of AR and scenario-based e-training:

- ✓ Viable platform to relate the ethics and lab safety knowledge learned in classroom to a variety of real-world applications/situations
- ✓ Free online resources
- ✓ Convenient, easily adopted, accessed and utilised using smart phone/mobile devices
- ✓ Great interest to our current, technology-savvy generation of students

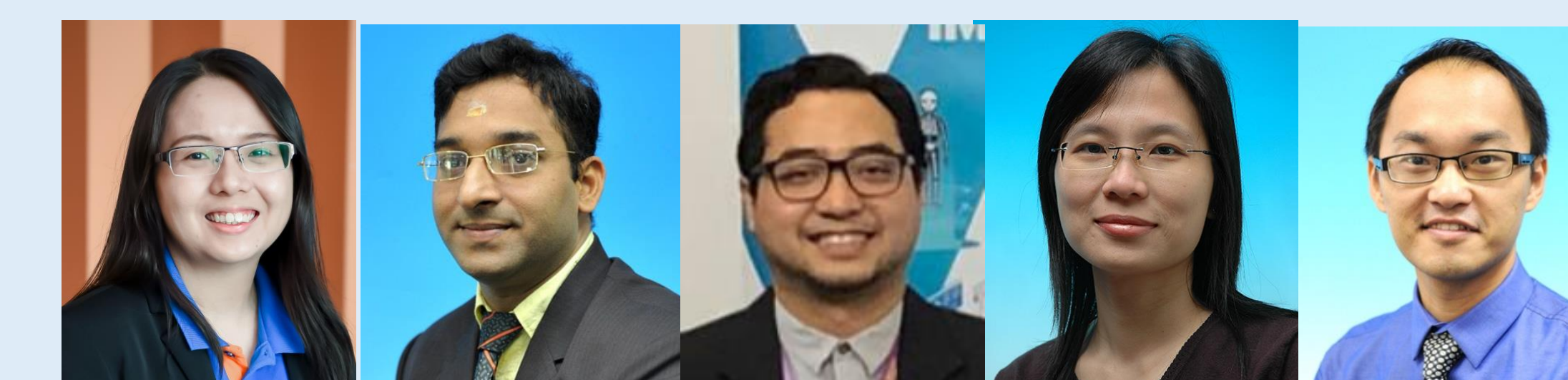
Conclusion:

The AR and scenario-based e-training tools create learning environments that enable students to link theory to practice in real world. They promote student-centered learning in an interactive and engaging manner.

Awards

- ❖ Silver medal award in Teaching and Learning Innovation Congress and Competition (Malaysia)
- ❖ Silver medal award in IMU Learning Resources Festival (Malaysia)

Team members



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