Design and Development of an Interactive Augmented Reality Educational Application

Airyl Harridzuan Bin, SUAIDI – Supervised by Dr. Nell Baghaei

References / REIT4841 / Affiliations

Background & Problem Statement

Chemistry education often struggles to convey abstract concepts such as molecular structures, reaction rates, and preservation processes especially in schools with limited laboratory access. Traditional textbook methods lack interactivity and visualization, making it difficult for students to connect theory with real-world chemical processes.

This project introduces an Augmented Reality (AR) learning approach that allows students to scan printed visuals to trigger interactive 3D molecular animations. Each topic also includes built-in quizzes and response tracking, enabling teachers to measure student understanding and engagement after every session.

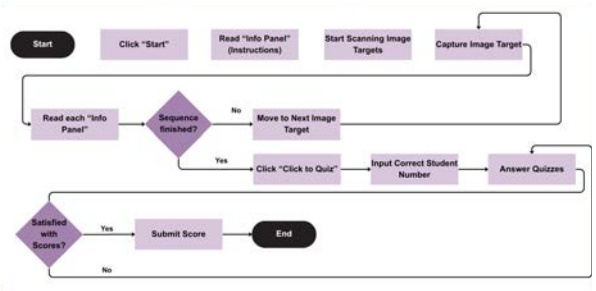

Figure 1: Workflow of the AR Chemistry Educational Application showing the process from scanning printed visuals to displaying 3D molecular animations and collecting quiz responses.

Objective & Scope

The objective of this project is to design and develop an AR-based mobile application that enhances chemistry learning through visualization and interactivity.

Scope includes:

- Visualize molecular structures in 3D
- Demonstrate effects of concentration, temperature, catalysts, and preservation methods on reaction rates and chemical processes
- Support multi-language (English and Bahasa Indonesia)
- Include quizzes and teacher feedback view for performance evaluation

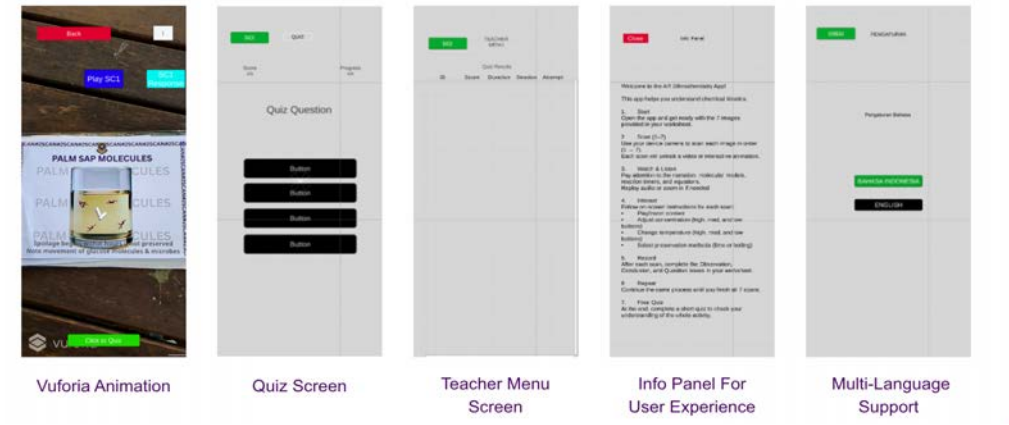

Figure 2: Visuals of the AR Chemistry Educational Application showing the key user interfaces: (from left) Vuforia animation of the palm sap molecular scan, quiz screen for topic assessment, teacher menu for viewing results, information panel for user guidance, and multi-language support (English and Bahasa Indonesia).

Project Methodology

Overview of the development process, technology stack, and evaluation methods used to build the AR chemistry application

The app was built using Unity (C#) with Vuforia SDK for AR image detection and Blender for 3D molecular animations. Data is managed through UQ Cloud Zone to ensure secure and ethical compliance. An iterative Design, Develop, Test approach was applied, and usability was evaluated using System Usability Scale (SUS) and User Experience Questionnaire (UEQ) thru XM Qualtrics.

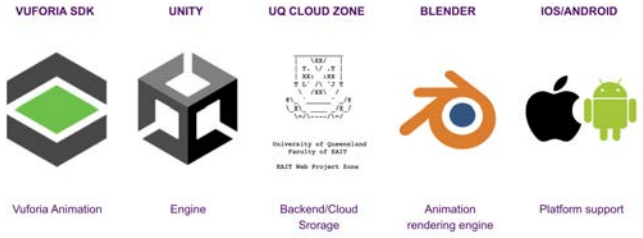

Figure 3: Core technology stack used in developing the Application, integrating Vuforia for AR tracking, Unity for development, Blender for 3D rendering, and UQ Cloud Zone for secure backend management, Also support iOS and Android

Evaluation Results

Summary of usability and user experience results collected from UQ participants through SUS and UEQ

Fifteen UQ students tested the AR application using a Google Pixel 6a under normal lighting conditions & environment. Usability was measured using the System Usability Scale (SUS), producing a mean score of 45.89, indicating marginal usability with a moderate learning curve. The User Experience Questionnaire (UEQ) revealed strong results in Novelty (8.31) and Stimulation (7.35), showing high engagement and positive perception.

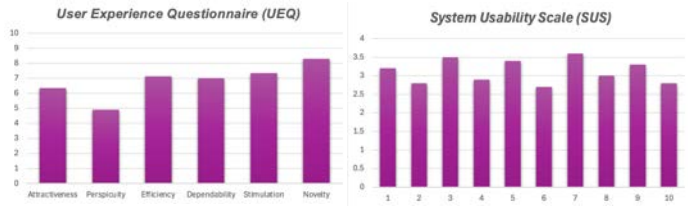

Figure 4: Evaluation results of the AR Chemistry Educational Application. The UEQ chart (left) shows high novelty (8.31) and stimulation (7.35), indicates strong engagement, while the SUS chart (right) shows a mean usability score of 45.89, reflecting a moderate learning curve for new users

a.suaidi@uq.edu.au
Airyl Suaidi
@airylsuaidi
St Lucia, QLD, 4067

School of Electrical Engineering and Computer Science

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