

This project aims to develop a set of e-learning modules on cellular metabolism and to motivate students' learning using the latest virtual reality (VR) and augmented reality (AR) technologies. In summary, three e-learning modules on mitochondrial energy metabolism were produced in this project. These include the modules on "ATP synthase", "Metabolites and hormones" and "Carnitine Deficiency and Metabolic Control". Each module comprises a freely downloadable mobile app and a set of instruction materials. The mobile apps were designed with either AR or VR technology depending on the nature of the subject content. For example, VR technology was employed to provide an immersive environment for users to learn about the internal cellular structures and mechanisms. AR technology was adopted to provide an instant and interactive learning experience for users to understand the molecular structure of essential biomolecules. Individual e-learning modules were used in different undergraduate biochemistry courses (LSCI1000, BCHE3080 and UGEB2361) to facilitate the teaching and learning of abstract scientific concepts. The mobile apps could be used by teachers for in-class demonstration or used by students for self-learning at home. The questionnaire survey and face-to-face evaluation exercises showed that the e-learning modules have enhanced the effectiveness of students' learning and improve the CTE scores of the courses involved in this project. Based on our existing collection of e-learning materials, this project has further increased the quality of biochemistry teaching and learning in the School of Life sciences.