

Immersive Visualization of Python Coding Using Virtual Reality

Abdulrazak Yahya Saleh^{a,*}, Goh Suk Chin^a, Mohd Kamal Othman^a, Fitri Suraya Mohamad^a,
Chwen Jen Chen^a

^a Faculty of Cognitive Sciences and Human Development, University Malaysia Sarawak (UNIMAS), Kota Samarahan, Sarawak, Malaysia
Corresponding author: *ysahabulrazak@unimas.my

Abstract— The main goal of this study is to develop a mobile Virtual Reality (VR) application to conduct basic Python coding skills for university students who are struggling to learn to code. This study employs a quasi-experimental method to examine the difference in the efficiency of VR and traditional learning methods by evaluating the students' performance. Thirty students between 18 to 22 years old participated. The participants were divided into two control groups, in which one group used the conventional python learning method while another implemented the VR application in python learning. Unity 3D was used as the application development tool with Mobile Application Development Lifecycle (MADLC). The developed VR application was employed using Google cardboard to create an immersive VR experience. Usability tests, hypothesis tests, Presence Questionnaires (PQ) and system usability scale (SUS) are used as evaluation tools. Findings illustrated how learning through VR has yielded better performance than the conventional learning method. In hypothesis testing, the VR learning method suggested more effective learning with t -statistic value of 4.992, a more considerable value than $t_{critical}=2.76$. 73% of the participants rated above 68 out of 100, which indicated high levels of satisfaction with the use of the mobile VR application to learn Python. In short, the VR method is perceived to be useful and convenient to help students learn at any place and time.

Keywords— Education; immersive virtual reality; programming learning; Python coding.

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I. INTRODUCTION

Learning to code using Python is a struggle for many students enrolled in technology-based courses in universities and institutes [1]-[3]. Globally, coding skills are in high demand, and it is increasingly becoming an essential skill for multiple industries in the 21st century [4]-[7]. According to a 2018 Pew Research Centre survey, since 1990, jobs in science, technology, engineering, and mathematics have grown by 79 percent [8]. They are expected to increase to an additional 13 percent by 2027. The ability to associate and adapt to the solving skills can be enhanced through various teaching and learning techniques suitable to the students [9]-[14]. The idea of creating a virtual reality (VR) environment as a new learning media was formed [15]. Applying mobile VR to language learning is promising because it is affordable, engaging, and less likely to be explored in Malaysia yet, and VR at this stage could be a useful tool for visual communication in a true-to-scale environment [16]-[19].

Virtual reality, also known as Virtual Environment, Artificial Reality, Virtual Worlds, and Artificial Worlds, provides a 3-dimensional interface for displaying and controlling the interactive computer graphic. VR typically refers to a simulated environment creator with the help of high-performance computer technology in which its virtual environment simulation is getting indistinguishable from the real world [20]-[22]. Over the past decade, many researchers have widely studied it in various aspects [23]-[26]. "VR is the biggest brain tool that we have," says Kevin Kelly, founding editor of Wired magazine [27]. An artificial environment created by this emerging technology immerses into many fields, especially education and training [28]-[32]. For instance, VR can be used in medical studies to help the students better understand the structure of the human body or in scientific studies to facilitate the scientist for research analytics [33]-[36].

Based on the statistical analysis done by Emsi, a labor market insight company from January 2016 until February 2017, there were 115,058 software developer recruitments each month. Still, the average monthly hires were only