I. INTRODUCTION

The implementation of virtual e-learning system nowadays has been an excellent solutions since the pandemic came. E-learning system provides benefits like flexibility and efficiency thanks to its system where lecturers and students use computers and internet to do learning activities and don't have to meet face to face. Also students are free to study at any time by accessing learning materials through the e-learning system [1].

However, to be able to develop a virtual e-learning system, educational institutions such as school, university, etc. they must have at least specialized technicians and expertise not just to develop but also operate and manage the server of virtual e-learning system itself. This method of implementation of virtual e-learning system is called conventional e-learning. From this situations, problems began to arise in the implementation of conventional e-learning such as infrastructure, human resources, and maintenance [2]. And also all of these problems of course requires a big amount of budget, which is not all of educational institutions have it.

There were some previous studies in order to solve this problems by implementing cloud computing technology to e-learning platforms such as Chuang, Chang, and Sung [3], Pocatilu [4], and Nungki Selviandro et al. [1][2]. A research conducted by Nungki Selviandro et al. [1][2] proposed a cloud-based e-learning architecture which consists of six layers, namely: infrastructure layer, platform layer, application layer, server layer, access layer, and user layer [2]. This cloud-based architecture is based on principle of acting as a provider of e-learning services for educational institutions in an effective and at least reducing the cost and time required for developing an e-learning system infrastructre.

Based on that study by Nungki Selviandro et al. [1][2], there was a project that was initiated to create a solution to the problems described earlier. This project is called ANGKASA. ANGKASA project was initiated to help educational institutions to have their own cloud-based e-learning system with less cost, time and skills to develop it by implementing cloud computing system using virtualization technology.

In this study, we aim to do a performance analysis research of cloud-based virtual e-learning system used in ANGKASA project. We are using two methods of virtualization, full virtualization or VM and container virtualization. We are comparing these two methods of virtualizations in terms of performance using Apache Benchmarking tool to determine which method of virtualization is better for cloud-based virtual e-learning system.

This paper is organised as the following. In this section 2 of this paper, we discuss about related works and literature needed for this study such as about virtual e-learning system, cloud-based e-learning implementation, virtualization technology, hypervisor and apache benchmark. In section 3, we explain the design of system of this study from the start to end. In section 4 we present and also explain about the both VM and container virtualization performance analysis experiment and its result. Finally in section 5, we explain the final conclusions of the experiment result and we also discuss about future works.