ICMLS version 3.0 as a prototype of bio-communication model for revolutionary human numerical competences on vocational education practices

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Abstract. The research focusing on the development of "ICMLS version 3.0 (Integrated Communication Mobile Laboratory Simulator)" is a study that aims to produce human learning innovations that have shifted from Human Communication to Human Numerical. Prototype ICMLS 3.0 has integrated artificial intelligence with aspects of creativity supported by a model of findings of Bio-communication. Through R & D research and development methods, ICMLS version 3.0 products are produced through the support of industrial partners so that the quality and quantity can be felt by all SMKs in the world. This Prototype can accommodate practicum and student competency test. The results of the experimental results of Vocational students from 8 Vocational Schools have been shown to increase the average student competency test in 10 competency tests from 75.13 to 85.53.

1. Introduction
In Indonesia, there are many SMKs with limited facilities and infrastructure such as special laboratories for practicum. This shows that vocational learning still lacks basic amenities needed for adequate knowledge impartation, therefore, several efforts have been made by researchers, practitioners, industries, and schools towards the establishment of the innovative, cheap and reliable modern laboratory. Integrated Communication Mobile Laboratory Simulator (ICMLS) is a mobile laboratory developed for practical activities of vocational students in Computer and Network Engineering. It can be applied in many activities such as (1) Assembling personal computers; (2) Installing a basic operating system; (3) Applying safety, occupational health and the environment (K3LH); (4) Implementing peripheral functions and PC installation; (5) Diagnosing problems with PC operation and peripherals; (6) Repairing and/or resetting PC Systems; (7) Conducting PC maintenance; (8) Installing GUI operating system and CLI; (9) Installing software; (10) Installing local network devices (LAN); (11) Diagnosing problems with operation of PCs connected to the network; (12) Repairing and/or re-setting network connections; (13) Installing GUI and text-based network operating systems.

Therefore, the purpose of this study was to provide innovative, modern, user-friendly, mobile, practical and inexpensive laboratories in order to effectively prepare vocational graduates of Computer and Network Engineering Study Programs (TKJ) in Indonesia for facing the 4.0 era [1]. Based on these objectives, this research specifically produced a number of concrete solutions that can be immediately applied in schools and they include (1) Mobile laboratory prototype model; (2) Design and development
of prototype Mobile Laboratory which is able to maximally integrate infrastructures owned by Vocational Schools. The ICMLS model found a number of ideas from Educational Technology experts that can be used in learning practical simulation media in computer science and engineering. Likewise, it was practically tested for efficiency in conducting competency tests and speed for students in mastering all components of client and server computers.

This study shows that a number of educational development products in the Industrial Revolution 4.0 era are produced from a combination of 21st century competencies and individual human abilities through Higher Order Thinking Skills such as (a) Digital Economy; (2) Big Data; (3) Artificial Intelligence; and (4) Robotics. The application of these competencies in equipping vocational students is observed in the innovative product of this research.

2. Research methods
The research was conducted for over two years and divided into two periods with the first in 2018 and second, 2019. The University of Education in Indonesia, Bordeaux University, IPI, and Nusantara Vocational High School Laboratories were used for the research with support from the Republic of Indonesia Ministry of Education and Culture. Research and Development method as proposed by Gall was used [2]. This involved ten steps and they include (1) research and information collection, (2) planning, (3) preliminary product development, (4) preliminary field testing, (5) main product revision, (6) main field testing, (7) operational product revision, (8) operational field testing, (9) final product revision, and (10) dissemination and implementation. During the test revision phase, 8 Vocational Schools in the East Priangan region of West Java Indonesia were purposively sampled. After the production of a proven ICMLS prototype, there was a collaboration with "PT. INTI" to produce commercially.

3. Results and discussion

3.1. Mobile laboratory prototype and the requirements of computer and network engineering study programs vocational practice
The results from field studies showed that obtaining laboratory requirements for students in the Computer and Network Engineering Study Program of SMK is quite complex. The 8 Vocational Schools assessed were SMK Negeri 4 Tasikmalaya; MJPS 1 Tasikmalaya Vocational School; SMK Negeri 1 Kedawung Cirebon; SMK Negeri 1 Lemahabang Cirebon; Majalengka YPIB Vocational School; Muhammadiyah Majalengka Vocational School; SMK Negeri 3 Kuningan and SMK Negeri 1 Soreang. They reported that the model to be developed must be able to work digitally, electronically, and online in order to bridge the interaction process between server and client as emphasized by Noroozi et al in their research entitled “Online discussion compensates for suboptimal timing of supportive information presented in a digitally supported learning environment” [3].

The prototype designed was aimed at improving the ability of the students to learn more interactively in changing conditions and places. This is in agreement with the results from Fabian et al that mobile technologies could be used to improve performance [4]. The model became a medium of communication between teachers and students, as well as the computer system itself. The teachers may use it to communicate with the server computer systems and students with the client computer systems or partners. These are meant to improve the learning process through the laboratory practicum. Furthermore, the model is a useful way of communicating and learning. This finding is established on three major elements of communication which are senders, receivers and the media. Therefore, the model was designed in such a way that it met the requirements of the intended users and this was found to be in line with the opinions of Ossiannilsson in Blended learning - State of the Nation [5]. The initial prototype had many challenges such as mobility and lack of automatic character. Furthermore, the next phase was designed, revised and developed to be cheap, easy, mobile and have a mini tower that integrates both software and hardware in order to meet up with the requirements of a laboratory. Figure 1 and 2, shows the sketch version of ICMLS 3.0 developed during the research.
This term is defined from several previous research findings where it was termed ‘Mobile Technology’ to be an object with a moving technological character [6]. It is lightweight, moveable and can be used for the benefit of learning anytime and anywhere without having to be in a physical laboratory and also applied for competency test of students [7]. The mobile laboratory is "a place for conducting experiments, investigations, etc. related to physics, chemistry, biology or other fields of science". Furthermore Sukarso in Asia reported that laboratories functions are as follow [8]: (1) As a place to develop intellectual skills through observation, recording and reviewing the symptoms of nature; (2) To develop students' motoric skills in using available media tools to find the truth about a particular thing; (3) To give and foster courage in finding the nature of scientific truth from an object in the natural and social environment.
Based on the above understanding, the mobile laboratory can be interpreted as a set of tools that can be used anywhere because of its movable nature to conduct research or experiments. In this research, it was constructed from the combination of software, hardware, ergonomic systems, architecture, multimedia, mechanic automatics, artificial intelligence, and remote control. This technology has an animated software response for use in learning supported by animated pedagogical agents (APA) as stated by Van der Meij et al [9]. It was particularly designed for the learning process and vocational competency test of computer and network engineering study programs. The evaluation configuration module must provide an effective user interface in assessing the competency of clients.

3.2. Design of mobile laboratories prototype with the ability to optimally integrate the vocational schools infrastructure

The results of this innovation produced an Electronic Simulator which can help students to learn computer network science. Furthermore, it can be said to be an example of Evans et al’s Computer-Mediated Communication used in supporting practical learning activities without worrying about obstacles faced by users, especially the availability of laboratory space [10]. Therefore, it can be established that modern computer, communication, multimedia, and network technologies are aimed at improving human communication and the amount of information currently processed by the new media is far from the traditional media. To protect students individually CMC learning can only be developed in the form of web learning, as developed by Darmawan et al in the form of a Web Electronic Learning System (WELS) [11]. However, the development of hardware has a lot of challenges because most of the components used are imported from overseas.

Therefore, the model developed in this research consists of several computer components and networks which are integrated into one mobile laboratory package and named ‘ICMLS’. However, it is important to note the basic components of personal computers, and they include (a) Processor, the brain of a computer, and a conceptual processor consisting of Arithmetic Logical Unit (ALU), Control Unit (CU) and Memory Unit (MU); (b) Motherboard/Mainboard, the main part of a computer. (c) Memory/RAM (Random Access Memory); (d) Hard Disk, functions as a place to store data; (e) Optic Drive (Optical Disk Drive) such as CD-ROM Drive, CD Writer, Combo Drive, DVD-ROM Drive and DVD Writer; (f) Keyboard; (g) Mouse; (h) Expansion Card (VGA Card, Sound Card, LAN Card) used in expanding the PC's capabilities; (h) Modem, which means Modulator and Demodulator; (i) Monitor, a device to display output from a computer in form of an image (visual); (j) The printer, a peripheral devices used for issuing output through prints on paper; (k) A scanner, a tool used in scanning images from a paper; (l) External storage media, functions like a hard disk, except that it is not fixed; (m) Casing and Power Supply (PSU), which are two important components in assembling a PC [1]. Therefore, it is recommended that the next product should focus on software, networking, and other features in order to fulfill the instructional design model [12].

The results of a field study conducted on 10 Vocational Schools in West Java region revealed that there is a need for appropriate hardware and software for the model to be effectively implemented by student users. It was also reported that the schools’ infrastructures may also serve as an obstacle to several practical activities. However, the learning resources made available by ICMLS mobile laboratories have embodied the idea of Hilton about the introduction of open educational resources (OER) in acquiring knowledge. Therefore, the initial hypothetical design was produced based on the results of previous researches. Darmawan states that the prototype ICMLS 3.0 will be one of the learning integration models of CAI (Computer Assisted Instruction) in supporting the acceleration of processing student learning messages [13].

The users of this product, both teachers and students, focus on their existence through the application of the concept of Human Communication Interaction [10]. It also gives them the opportunity of communicating various learning activities in depth.
Table 1. List of practical materials by using ICMLS.

| No | Computer and Network Engineering Study Programs of Vocational Schools in Indonesia |
|----|-----------------------------------------------------------------------------|
| 1  | Assembling a Personal Computer                                             |
| 2  | Installing the Basic Operating System                                       |
| 3  | Applying Safety, Occupational Health and the Environment (K3LH)              |
| 4  | Implement peripheral functions and PC installation                          |
| 5  | Diagnosing problems with PC operation and peripherals                       |
| 6  | Repair and/or reset PC System                                                |
| 7  | Performing PC Maintenance                                                    |
| 8  | Installing the GUI Operating System and CLI                                  |
| 9  | Installing Software                                                          |
| 10 | Installing a Local Network Device (LAN)                                     |

The development of the mobile laboratory was founded on the assumption that innovative learning requires the preparation of modern education media. In support of this, Evans et al emphasized that media education should lead to positive, critical and differentiated attitudes in making active choices and offer knowledge in three areas including (1) communication or communication-mediating means, (2) reception, and (3) content analysis [10]. Furthermore, Darmawan discussed the application of mobile technology in online and offline learning through the use of a concept known as mobile learning [14]. The result of the tests conducted is shown in Figure 3.

![Figure 3. Condition of achievement value 8 vocational school of computer engineering study program.](image_url)

The results obtained from field testing were continuously improved to rectify the weaknesses observed before the products would be commercially produced [15]. It is important to state that one of the industries that are interested in producing the product is PT. INTI in Bandung Jawa Barat, Indonesia. This condition from result like on figure 4 was as expectation as human numeric and human competences. The ability of humans to think and learn as observed in the 21st-century will soon be renewed through the introduction of various disruptive innovations [16]. This will help in creating new markets by disrupting or destroying the existing ones through the replacement of old technologies with the latest. It also helps in developing products or services in an unpredictable manner. This theory was popularized in the globalization era after innovators experienced several dilemmas in producing good products. However, several researchers in education has developed different innovations different from previous ones by combining disruptive innovations with scientific products of Educational Technology, Communication Education, ICT, Learning Revolution and Mobile learning with the aimed of implementing an effective vocational practicum. Supriadie reported that the program was designed to
make learning more flexible and mobile [17]. Therefore, this prototype is expected to be a response to the submission of Michael B. Horn and Heather Staker Foreword [18] about using disruptive innovation to improve schools as reported in Clayton M. Christensen [19].

4. Conclusion
ICMLS is a digital learning prototype developed in the form of a mobile laboratory that can be used to improve competence in practical activities of Computer and Network Engineering Study Programs students. The use of this tool is easier, more concise and fun with a variety of futuristic and innovative features to increase student learning motivation. Furthermore, schools are no longer burdened with having to add space to a laboratory because ICML is portable, light and easy to carry. The result of the analysis conducted on 8 Vocational Schools showed a very significant increase in the average competency skill of students and all the score achievements. The application of ICMLS provided several advantages and competencies for vocational students of Computer and Network Engineering Program. This should be further implemented until the product can be easily and cheaply fabricated with the help of industrial partners.

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