TVET Innovation: The Effectiveness of Digital Peer Assessment for Vocational Education in Bali

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Abstract. This research aimed to develop a digital peer assessment for the Computer Network and Telecommunications Engineering expertise program at the Vocational High School of Bali province. The ADDIE research model included analysis, design, development, implementation, and evaluation used in this study. The assessment rubric that has been implemented digitally has gone through a value of 1 (very high). The analysis yielded an average of 83.29, which was classified as very good. Meanwhile, the response test obtained an average of 77.4 who entered the "very positive" qualification with the category "very practical". Thus, web-based digital assessment is efficiently used in students' learning process.

Keywords: peer assessment, digital assessment, vocational.

1 Introduction

Process assessment planning and learning and learning outcomes cannot be separated from the learning planning itself. The preparation of the assessment plan is a series of educational programs and learning that are complete, chaotic, and a unit that cannot be separated from one another [1]. The assessment plan is prepared to be a reference for teachers in organizing an assessment of the entire learning process. In planning a learning assessment, it is necessary to understand to the teacher that educational learning contains two keywords, namely, learning and educating. The word learning has an active connotation because students actively carry out learning activities in learning situations designed by the teacher. In contrast, the word educate contains the connotation of the process of becoming a student comprehensively, both pedagogically (academically) and personally (personally), professionally (vocational), and socially (citizenship) [2].

Assessment, also known as an assessment, is an application and use of various ways and tools to obtain information about learning outcomes and competency achievement [3]. The learning

assessment results are the results of the analysis of a number of facts about students' performance in mastering the expected competencies. The facts collected, processed, analyzed, interpreted, and concluded are the expected competencies (minimal basic competencies) into a number of sub-competencies and certain indicators and descriptors. Collecting facts or evidence of student performance using instruments prepared based on indicators of competency achievement [4]. Along with the development of digitalization of the learning process, especially accompanied by the Covid-19 pandemic incident, which requires all actors in the world of education to learn online, it also indirectly shifts the process of implementing assessments toward digital assessments [5]. There are several reasons why digital assessment is important to assess student learning outcomes. It can save time, make the learning process more comprehensive and friendly, provide quick feedback, and provide feedback quickly [6]. However, various obstacles are experienced by teachers, especially those who teach productive subjects, where what must be assessed is the product and performance of students, plus the number of students in the classroom is very large. One example is what happens in the Computer Network and Telecommunications Engineering expertise program in Vocational High Schools, where the primary competence that students, in this case, must possess is being able to plan, prepare and implement networks with wires and wireless ones, both on a LAN, MAN and WAN scale.

Based on the initial interviews with partners in this study, schools need clear assessment standardization and need a digital assessment system. Schools can implement peer assessments (peer assessment) to facilitate this assessment process. Each student (or group) will be assessed by another student (or group) [7]. Peer assessment is an innovation in the grading system in the form of students considering other students [8]. The benefits of peer assessment are providing feedback, cognition, and metacognition processes, increasing motivation, collaborative learning processes, self-regulated learning, and improving performance [9].

Based on the above problems, it is necessary to have a web-based digital assessment system (online) for the TJKT expertise program, especially in the Basic Network subject, which is standardized for vocational education. This digital assessment system is packaged with a peer assessment model where each student will become a peer reviewer. This process will cause various positive learning environments, one of which is improving each other's abilities according to other assessors' constructive comments (inputs). In addition, an independent and adult learning process will be created, where students will be directly involved in the learning and assessment processes. Mutual self-introspection is one of the advantages of peer assessment.

2 Literature Review

2.1 Learning Assessment

Assessment is, of course, one of the most important things to do. Because basically, this is done to achieve certain goals. For example, to find out a person's performance during this time. This assessment is carried out in school to know how far students understand various subjects. In essence, an assessment is carried out to determine the results of a person's achievements. Thus, the next various steps can be done using the assessment results as a reference point. Robert M Smith stated that assessment is a comprehensive assessment involving several team members to find out a person's weaknesses and strengths. The results of the assessment carried out will then be the basis for the preparation of a new learning design. Meanwhile, McLoughlin and Lewis

argue that assessment is a process of collecting data that is carried out systematically to see the capabilities and difficulties of a person, as well as find solutions to what they need. According to Chittenden (1994), the assessment's purpose is "keeping track, checking-up, finding-out, and summing-up". The explanation is as follows [10]:

1. Keeping track, which is to trace and track students' learning process in accordance with the established learning implementation plan. For this reason, teachers must collect data and information over time through various types and assessment techniques to obtain an overview of the achievement of student learning progress.
2. Checking-up is to check the achievement of students' abilities in the learning process and the student's shortcomings during the learning process. In other words, the teacher needs to conduct an assessment to find out which part of the material the learner has mastered and which part of the material has not been mastered.
3. Finding out, which is to search, find and detect the shortcomings of mistakes or weaknesses of learners in the learning process so that teachers can quickly find alternative solutions.

Summing up, which is to conclude the level of mastery of students towards the competencies that have been set. Teachers can use the results of this inference to compile learning progress reports for various interested parties.

2.2 Digital Assessment

Along with the development of digital media both asynchronously and synchronously, the process of conducting assessment activities has also developed. One of the assessment activities carried out in the era of the industrial revolution 4.0 is digital assessment. The form of digital evaluation has many advantages that can be utilized both in the classroom with synchronous and asynchronous modes to help implement a more accurate and efficient assessment. Digitalization in teaching and learning should accompany digitalization in the assessment process. This means that teachers also need to implement digital assessments to evaluate student learning performance [11].

The advantage of developing an online-based learning assessment is that the assessment can be done anywhere, anytime, and practically [12]. This means that anywhere it can be carried out, inside or outside school learning activities, not fixated on space. At any time, it can be interpreted as being able to do it in a specified time and not fixated on a unit of time. Practically it does not require a lot of doubling of question sheets even though many students do it, and it's just that it takes a laptop or computer and the internet. In line with this opinion, e-learning learning also has the following advantages. First, enhance interactivity; second, facilitate learning interactions from anywhere and anytime (time and place flexibility); third, have a wider reach (potential to reach a global audience); fourth, make it easier to refine and store learning materials (easy updating of contents as well as archivable capabilities) [13].

2.3 Peer Assessment

Peer assessment is a process in which a learner assesses a friend's or other learner's learning outcomes at a level (Upa, n.d.). The point of a level is if two or more people are in the same grade level or the same subject of study. Peer assessment can assist learners in developing the

ability to cooperate, criticize other people's learning processes and outcomes (formative assessment), receive feedback or criticism from others, and provide students with a deep understanding of the criteria used to assess learning processes and outcomes and for [14]summative assessment. The advantages of peer assessment are that it encourages students to have a sense of responsibility for the learning process so that students can be independent, train evaluation skills that are useful for lifelong learning, and encourage deep understanding. The peer assessment process begins with discussing the items and criteria for assessment by teachers and students. Then each student assesses their designated friend and also gives feedback. The results of this assessment are usually matched with the results of the teacher's assessment.

Race and Bostock (Rochmiyati, 2013) identified several advantages of peer assessment, including (1) peer assessment could improve the learning process, (2) students can identify weaknesses and strengths they have in learning, (3) encourage students to learn more deeply and meaningfully, (4) encourage students to learn independent of others, (5) students can get to know the assessment criteria, (6) encourage students to analyze each other's performance or work results[15].

Peer assessment is an innovation in the assessment system in the form of students assessing other students. The benefits of peer assessment are providing feedback, cognition, and metacognition processes, increasing motivation, collaborative learning, self-regulated learning, and performance improvement. In the learning process of Computer Network and Telecommunications Engineering, participants need not only to master knowledge but also to perform skills well. With peer assessment, it is hoped that students will become more motivated to learn and improve their skills.

3 Methodology

This research uses the Research and Development (R&D) method or the research and development method adapted from the ADDIE development model. The ADDIE model is a development model popularized in the 1990s by Reiser and Molenda [16], which consists of analysis, design, development, implementation, and evaluation, as seen in **Figure 1**. The ADDIE model focuses on iteration and reflection so that continuous improvements can be made that focus on feedback [17].
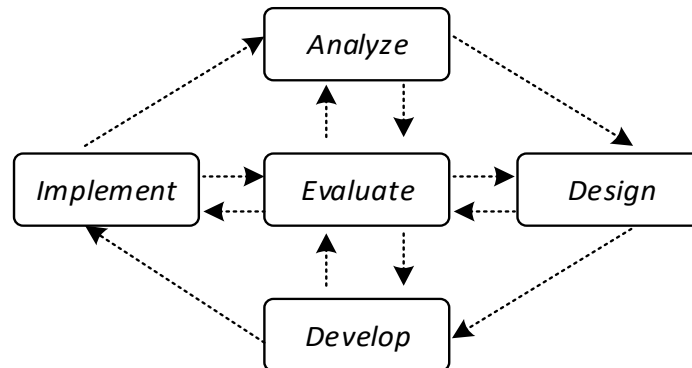
Fig. 1. ADDIE Design Model.

4 Result and Discussion

Based on the ADDIE stages used in this study, the results and discussions were delivered in the ADDIE stage (Analysis, Design, Development, implementation, Evaluation).

1. Analysis
   The stage was to analyze the system's needs and the curriculum's mapping into the instrument grid. System needs analysis included analysis of database needs, operating systems, and hardware used by the system. This system uses 3 tables: user table, value table, and rubric assessment table. The minimum needs of this system are Monitor *with* 1024 x 728-pixel *resolution,* 512 MB RAM, Pentium IV Processor 3.0 GHz, VGA minimum128Mb, 1 GB Free Hard Disk Space, Sound card, and speakers/headset. The mapping of core competencies used included core competencies 3, namely: Understanding, applying, analyzing, and evaluating factual, conceptual, basic operational, and metacognitive knowledge following the field and scope of work of Computer and Network Engineering at a technical, specific, detailed, and complex level, concerning science, technology, art, culture, and humanities in the context of developing self-potential as part of families, schools, the world of work, national, regional, and international citizens. And core competencies 4 were: Carry out specific tasks using tools, information, and work procedures that were commonly carried out and solve problems following the field of work of *Computer and Network Engineering.* Displaying performance under the guidance of measurable quality and quantity following work competency standards. Demonstrated the skills of reasoning, processing, and testing effectively, creatively, productively, critically, independently, collaboratively, communicatively, and selectively in the abstract realm related to the development of what he learned in school and being able to carry out specific tasks under direct supervision. Demonstrated the skills of perceiving, readiness, imitation, familiarization, proficient motion, and making a natural motion in the concrete realm related to the development of what he learned at school, as well as being able to carry out specific tasks under direct supervision.

2. Design

The design stage involves designing and mapping indicators to the digital assessment grid. The mapping of the instrument grid can be seen in **Table 1**.

Table 1. Instrument grid.

Learning Outcomes	Learning Outcomes Indicators
Manufacture of straight type UTP cables	The use of the rj45 connector
	Completion time of straight type UTP cable
	Cable neatness
	Cable testing with LAN tester
Microtech basic configuration	Ip configuration on eth1, eth2, eth3, ethbridge
	DNS isp1 and DNS isp2 configuration and gateway router
	Configuration of nat-firewall on isp1 and isp2
	Ntp and clock configuration
	Web proxy configuration
	Successfully ping google on router or client
DHCP server configuration	Interface configuration eth3 and ethbridge
	Configuration of IP pool (99 clients) on eth and ethbridge
	Local and wireless network client succeeds
	Get DHCP IP and connect to the internet
Hotspot and radius configuration	Configuration of hotspot setup
	Configuring radius server on inbox
	Router configuration in the user manager
	User profile configuration
	Configuring 20 hotspot accounts
	Clients can enter hotspot accounts
Firewall configuration	Configuration and testing of ping blocks to the router
	Configuration and testing of ping-to-client blocks
	Wireless
	Router access log configuration and testing
	Site block configuration and testing
	Configuration and testing of block files
Configuration load balancing and failover	Configuration load balancing and failover by using 2 isps
	Load balancing configuration to local networks and wireless networks
	Testing through speeds test for configuring load balancing
	Testing the login page on the hotspot and ping from the local client to the wireless/fellow client in 1 network
	Testing failover
Access point configuration	Selected mode on wifi router
	Configuration of SSID and disable DHCP

3. Development

The assessment rubric developed at the design stage is integrated into a web-based system (**Figure 2**). This system has three levels: admin, assessor, and student. Admin is the highest system level with full access rights to systems such as user management, rubric management, value management, and others. The assessor (teacher) is the second level after the admin. Teachers can manage assessment rubrics and input grades. Meanwhile, students were at the lowest level in this system, where they could only upload assignments (projects) and give assessments.
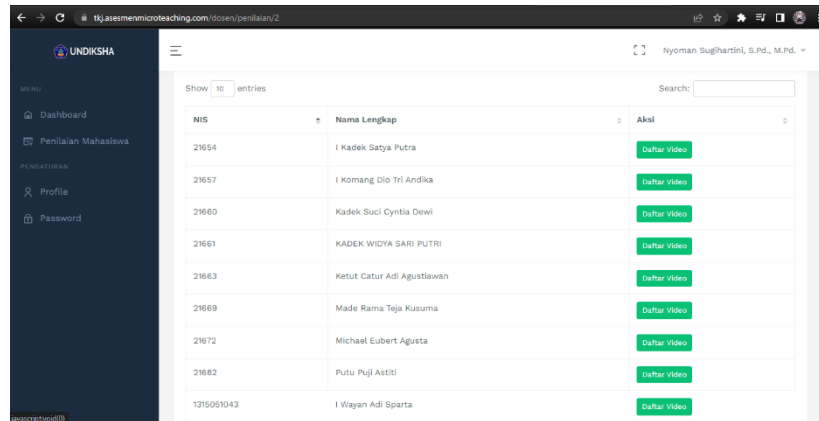
Fig. 2. Digital assessment system.

4. Implementation

In the implementation stage, several stages were carried out, namely the student response test stage that had been carried out and obtained results of 77.46 who were included in the "Very Positive" qualification with the category "Very Practical". Thus, a web-based digital assessment was efficient to use in the learning process by students. The results of the assessment stage of each question item obtained results, namely question number 1, the use of rj45 connectors, which obtained an average score of 3 with a description of being able to use 2 of rj45 connectors in making straight type UTP cables. Question number 2 was the completion time of a UTP cable type straight, which obtains an average score of 3 with a descriptor if the completion time of a straight type UTP cable was less than 5 minutes. Question number 3 was cable neatness which obtained an average score of 3 with a description of the cable skin being peeled and cut evenly, the cable fibers being removed, and the cable skin entering the RJ45 connector. Question number 4 was a table test with the LAN tester obtaining an average score of 3 with the description of the LAN tester indicator light turning on sequentially without anyone turning off. Problem number 5 was the IP configuration on eth1, eth2, eth3, and ethbridge, which obtained an average score of 3 with a description of being able to configure IP on eth1, eth2, eth3, and ethbridge correctly. Problem number 6 is the DNS configuration of ISP1 and DNS ISP2 as well as the gateway router, which obtained an average score of 3 with a description of being able to perform three configurations correctly, namely the DNS configuration of ISP1, DNS ISP2, and configuration of the gateway router. Problem number 7 is the Firewall-NAT configuration on ISP1 and ISP2, which obtained an average score of 3 with a description of being able to configure the NAT firewall with the masquerade action on ISP1 and ISP2 correctly. Question number 8, namely the NTP configuration and clock, obtained an average score of 3 with a description of being able to perform 3 stages of SNTP Client configuration and clock correctly, namely the primary NTP server setting (id.pool.ntp.org or 202.65.114.202), setting the secondary NTP server (asia.pool.ntp.org or 133,243,238,163), for the clock change the time zone name to

Asia / Makasar. Question number 9, namely theWeb Proxy configuration, obtained an average score of 3 with a description of being able to perform 4 stages of web proxy configuration correctly, namely check to enable, tick anonymous, cache administrator filled in according to the provisions of the question and check the cache on disk. Problem number 10, namely the result of google PING on the router or client obtaining an average score of 3 with a description if successfully PINGing google.com on the router or client computer. Problem number 11, namely the configuration of the eth3 and ethbridge interfaces, obtained an average score of 2 with a description of they could configure the eth3 and ethbridge interfaces, the IP was given correctly. However, the subnet mask that was given was still wrong. Problem number 12, namely the configuration of the IP Pool (99 clients) on eth3 and ethbridge obtained an average score of 3 with a description if they could configure the DHCP Server with an IP Pool of 99 clients on eth3 and ethbridge correctly. Problem number 13, namely, the local and wireless network client managed to get a DHCP IP and connect to the internet, obtained an average score of 3 with a description of the local and wireless network clients managed to get a DHCP IP and connect to the internet. Problem number 14 was that the hotspot setup configuration obtained an average score of 2 with a description that it could configure the hotspot setup quite correctly; namely, the hotspot interface was chosen correctly, but the DNS name was wrong. Problem number 15, namely the server radius configuration on Winbox, obtained an average score of 3 with a description if it can configure the server radius on Winbox correctly; namely, the selected service checks the hotspot, and the address was filled in the same as routers, the shared secret was filled the same as the router's settings, the incoming radius packet was activated by ticking accept. On the profile server, check the use radius, login menu tab unchecks cookies. Problem number 16, namely routers configuration in the user manager, obtained an average score of 3 with a description if it was able to configure the router on the user manager correctly, namely naming the router, router IP address, and shared secret filled in according to the provisions, the time zone was adjusted. Question number 17, namely the user profile configuration, obtained an average score of 2 with a description if it could configure the user profile quite correctly, namely 2 stages were carried out. Problem number 18, namely the configuration of 20 hotspot accounts, obtained an average score of 3 with a description that they could configure 20 hotspot accounts correctly, namely creating 20 users who differed automatically with the same username and password. Problem number 19, namely client can enter a hotspot account, getting an average score of 2 with a description if the client is successful/biased to enter the hotspot account. Question number 20, namely the configuration and testing of the ping block to the router, obtained an average score of 3 with a description of the configuration and testing, namely IP 192.168.100.2 - 192.168.100.50 successfully could not PING the router. Problem number 21: The configuration and testing of ping blocks to the wireless client obtained an average score of 3 with a description of the configuration and testing, namely IP 192.168.100.51- 192.168.100.100 successfully could not PING to the wireless client. Problem number 22, configuration and testing of router access logs obtained an average score of 2 with a description if the test was correct, but the configuration was still wrong/ wrong. Problem number 23, namely the configuration and testing of the site block, obtained an average score of 2 with a description if the test was correct. However, the

configuration was still incorrect/ incorrect. Problem number 24, namely the configuration and testing of the file block, obtained an average score of 2 with a correct test description. However, the configuration was still incorrect/ incorrect. Problem number 25, namely Load Balancing and Fail Over Configuration using 2 ISPs, obtained an average score of 3 with a description if they can configure load balancing and failover using 2 ISPs correctly, namely chain input configuration 2 ISPs, chain output configuration 2 ISPs, rerouting chain configuration 2 ISPs with accept action, PCC configuration on 2 ISPs. Problem number 26 was that the configuration of load balancing to the local network and the wireless network obtained an average score of 2 with a description if it can perform one of the load balancing configurations (local networking / wireless network) correctly. Question number 27, the assessment through the speed test for the load balancing configuration, obtained an average score of 2 with a description if the test through the speed test for load balancing configuration ran balanced on 2 ISPs on one of the networks only (local network / wireless network). Question number 28, namely testing the login page on the hotspot and PING from the local client to the wireless/fellow client in 1 network, obtained an average score of 3 with a description of the login page on the hotspot and PING from the local client to the wireless / sesame client in 1 network was successfully carried out. Question number 29, namely the failover test, obtained an average score of 2 with a description of the failover test through a speed test successfully carried out, disproportion one of the ISPs and other ISPs backing up the connection. Question number 30, namely the mode selected on the Wi-Fi router, obtained an average score of 2 with a description if you can choose the mode on the Wi-Fi router correctly, namely the Access Point. Problem number 31, namely the SSID and Disable DHCP configurations, obtained an average score of 3 with a description if they could configure the SSID and Disable DHCP correctly, namely, the SSID was made according to the provisions of the question. Unchecked enable DHCP Server (disable DHCP Server) [18].

5. Evaluation

In the evaluation stage, a limited trial was carried out on 8 research samples from networking students (**Figure 3**). The student was given a project related to network design from three different buildings. Each building has several rooms, and each room has several computers. The computers were requested to be interconnected. After the student had designed the network, the student was asked to analyze the related tools and materials needed to design the network. After students make a project frame, students are asked to present the results of their design, and then the video is uploaded to the digital assessment system. Each student will provide an assessment of the other students (peer assessment) based on the rubric assessment that the system provided. This activity aimed to train each student to provide an immersive learning experience [19]. For example, in assessing other friends' projects, students will reflect on their work. So the process of creative and critical thinking will begin to appear at this stage [20].
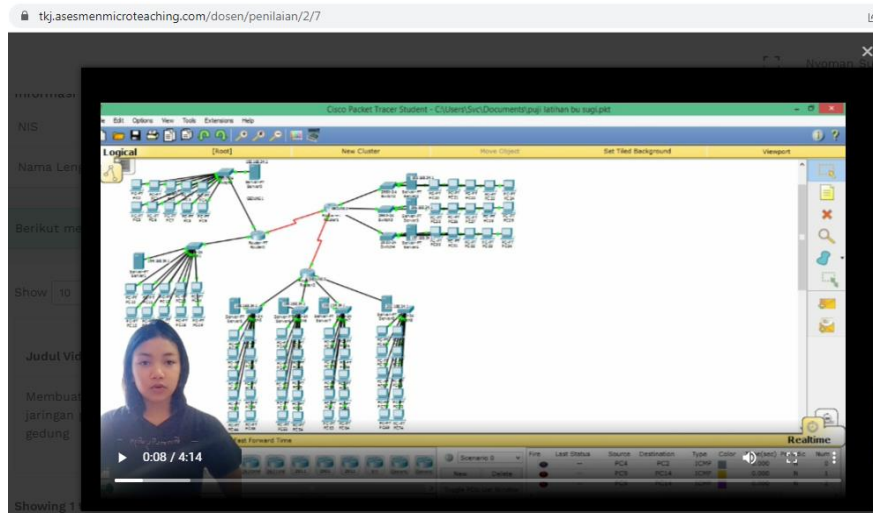
Fig. 3. Product video.

Teachers' results of peer and project assessments were searched on average to determine student learning outcomes. So data on student learning outcomes are obtained based on **Table 2**.

Table 2. Student learning outcomes.

Respondent	Score	Category
1	87.26	Very Good
2	82.15	Very Good
3	82.74	Very Good
4	81.99	Very Good
5	80.70	Very Good
6	80.82	Very Good
7	85.70	Very Good
8	84.95	Very Good

Based on the analysis that has been carried out, an average student learning outcome above 80 was obtained, which shows the "Excellent" category. The result of the value acquisition can be seen in **Figure 4** below.
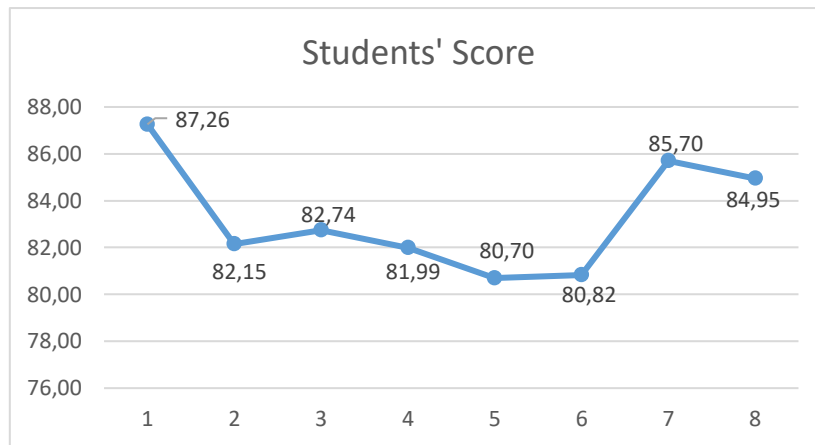
Fig. 4. Chart students score.

5 Conclusion

Based on the results and discussion of this study, peer assessment using web-based digital assessment was very effectively used in assessing the level of vocational education. The project questions carried out and recorded in the video were then analyzed and assessed by colleagues and teachers. In addition to values in the form of numbers, the system also provides facilities in the form of text that aims to provide input for improving the project [4]. The average learning outcome score of 83.29 was obtained from the calculation of learning outcomes, which was classified as very good. Meanwhile, the response test obtained an average of 77.46 who entered the "Very Positive" qualification under the "Very Practical" category.

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