Fiber Optic Laboratory Development Model to Improve Students and Teachers' Competency in Vocational High School

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Abstract. Technological developments make telecommunications networks through internet access an urgent matter due to the increasing human need for communication. The purpose of this study was to describe the development model of a fiber optic laboratory in order to improve students and teachers' competency. This research used a descriptive qualitative case study method at Dwija Bhakti 1 Public Vocational High School (PVHS) Jombang. The results stated that the fiber optic laboratory development model was used to print graduates with competencies following their fields and were expected to compete in the industrial world. Fiber optic laboratories are the collaboration results between schools and industry, through several stages such as MoU application, obtaining tolls, branding, and mock-ups, to improve those competencies. In addition, there were teacher training and certification activities followed by curriculum implementation, student certification activity evaluation. It can be concluded that the development of fiber optic laboratory procurement at Dwija Bhakti 1 PVHS Jombang the agreement between the Ministry of Education and Culture with PT. Telkom regarding the link and match curriculum in fiber optic industries.

Keywords: Fiber Optic, Students' Competency, Teachers' Competency, Telecommunications Networks, Vocational High School.

INTRODUCTION

Technology development causes the increase of internet access needs. Through fiber optic cables, information from anywhere can be transmitted using telecommunications set called a telecommunication network (Priyoso, 2020). The rapid mobility of modern people nowadays expects everything to be instant, flexible and efficient (Monika, Florian, Markus & Albert, 2020). This makes telecommunications become primary urgent stuff in sustaining life (Seo, Park, & Kang, 2021). With the increasing needs of users in information networks that are used as media for communication, by the time network availability becomes an important factor in order to maintain stable performance (Setiawan, 2018). The government also supports of networks provision as stated in a Presidential Regulation on broadband plans (Presidential Regulation, 2014). In this regulation, the government will provide a high-speed internet network with guaranteed security and information security for each user. These needs are provided through a network called a fiber optic network. Fiber optic network is a new innovation related to high-capacity fiber-based broadband speeds that can transmit information quickly (Sahebali, Sadowski, Nomaler & Brennenraedts, 2021). Fiber optic cable is considered as a faster data saving way than conventional cable (Firdaus, Pradana & Indarto, 2016). Fiber optics as a network medium to transmit light without being affected by electromagnetic waves and radio frequencies with many advantages has made the development of fiber optic-based telecommunications networks increasingly considered (Pitrawati & Buchori, 2018). Therefore, fiber optics as a transmission medium is a breakthrough in the increasing demand for services in technology and information in communication. (Arkadiantika, Ramansyah, Effindi & Dellia, 2020).

According to the Indonesian Internet Service Providers Association (APJII) in 2018, the number of internet users increased from 171.1 million to 27.9 million from last year's 143.2 million. In 2019 and the following year, it was predicted an increase in internet users because of the completed the Palapa RING network project it wasundeniable that connection constraints also continue to increase. Network

users are increasing with the pandemic because this situation makes the transition of life to online-based technology (Islam et al., 2020). It is proven that users of online-based technology can fulfill all needs such as work, education, and health (Rohmah, 2021). Likewise in education, classroom also shifted to online platforms (Xie, Zang & Ponzoa, 2020). The learning system in the network has high benefits in technological development, especially in learning media and information technology facilities (Budiman, 2017). Similar experience also occurred in vocational education in which the orientation is for the world of work and industry through technology development (Naziz, 2019). Hence, vocational education faces challenges in preparing a workforce that is starting to be replaced by technology (Verawardina & Jama, 2018). In addition, graduates from vocational education institutions are expected to have the ability, knowledge and skills following to their field (Azman, Ambiyar, Simatupang, Karudin & Dakhi, 2020). Through the development and use of information and communication technology can improve the quality of education, this is obtained in the competence of computer and network engineering expertise. Computer and network engineering is a science related to technology and information that emerged as a result of rapid developments in the digital era (Kovshov & Kuvshinnikov, 2020).

As an act of implementing partnerships through the Vocational High School revitalization program, they have the links with stakeholders as stakeholders can help resolve the link between educational institutions and the world of work field that is called link and match (Tamrin, Slamet & Soenarto, 2018). Nowadays, the fiber optic industry is developing a fiber optic laboratory by cooperating with Vocational High Schools with potential IT field. The program aims to create human resources with additional values to match industrial demand which also follows technological developments (Issa, Hatiboglu, Bildstein & Bauernhansl, 2018). As well as preparing for the challenge of a demographic bonus that makes 60% of the Indonesian population of productive age have to look for work, so that competition in the labor market is becoming increasingly fierce (Verawardina & Jama, 2018). Through the development model fiber optic laboratories in vocational high schools, students and educators can increase their competence in the fiber optic field (Pisco & Cusano, 2020). However, in developing a fiber optic-based telecommunications network, a place or place is needed to support learning activities that follow the standards (Fardani, 2019). The laboratory is a place to carry out practical activities to train students in conducting demonstrations for knowledge development (Ayuni, Zunaena, Oktaviani, Kristinah & Yuliyati, 2018). The laboratory has physical requirements including the main requirements standards, equipment standards and room standards (Sun, Wu & Fan 2021). Thus, laboratories in vocational education have similar design with those in industry while still considering occupational safety and health and have a mean for students to understand concepts and improve skills (Yoto, 2015). PVHS of Dwija Bhakti 1 Jombang is the first school in East Java to collaborate with PT Telkom regarding the procurement of fiber optic laboratories. Therefore, it is expected to be a reference for other schools in preparing human resources through mastering the fiber optic technology using the collaboration.

METHODS

This research applied qualitative descriptive approach. Qualitative research was used to identify and describe the laboratory development model of the fiber optic at Dwija Bhakti 1 PVHS Jombang. Sources of data in this study were the vice principal of public relations, the head of the computer and network engineering expertise program, the laboratory assistant teacher of PT Telkom. Data collection techniques used were passive participation observation, documentation and interviews. In this case, researchers conducted observations to determine the development of telecommunications networks within the scope of vocational high schools through collaboration with PT Telkom at Dwija Bhakti 1 PVHS that aim to obtain data and information. The documentation was recording and photos related to the development. Researchers used or free interviews without guidelines yet still contained the

problem's outlines. Data analysis in qualitative research was carried out when data collection was completed because its purpose was to summarize data in a form that is easier to understand and interpret and is able to be carried out interactively, the qualitative data analysis process included: data collection, data reduction by through checking, grouping, and coding, data presentation, and data verification.

RESULT AND DISCUSSIONS

The laboratory is a means of developing innovative learning while adjusting the update to the development era (Muhajarah & Sulthon, 2020). The fiber optic laboratory vocational high school makes the teacher's strategy in fostering courage and providing skills to students through trials related to fiber optic-based networks (Riyadi, 2019). Collaborating with partner industries in developing fiber optic laboratories is the school's strategy in producing graduates with special competencies in the fiber optic field. Based on the results, Dwija Bhakti 1 PVHS Jombang has implemented a fiber optic laboratory development model by cooperating with PT Telkom as an industrial partner. The collaboration has been implemented since 2018, thus the school has produced graduates who work following their fields of experties. In fact, not many students graduated from Dwija Bhakti 1 PVHS Jombang with competence in Computer and Network Engineering skills who have implemented the fiber optic laboratory development model, now working in a subsidiary of PT. Telkom. The discussion on the implementation of fiber optic laboratory development model at Dwija Bhakti 1 PVHS Jombang by cooperating with PT. Telkom as an industrial partner will be describe in Figure 1.

Figure 1 shows that the development starts with school preparation, the school needs to prepare an MoU as a cooperation on paper. Then the school needs to prepare a room as a laboratory procurement. The room and learning facilities were prepared by the school. After the laboratory room is ready and in follows the predetermined standards, the industry will brand and mock-up the room. The next step teacher to attend training and certification tests as included. In the school-industry collaboration procedure with the aim. To make teachers more competent in fiber optics and ready to deliver material to students. After the teacher implements the curriculum for the students. If the curriculum from the industry has been exceeded, then the next step is the training and certification preparation for students. These are carried out to create competent graduates with suitable skills and ready to compete in the job market. Finally, teachers and the industry conduct an evaluation to provide better upcoming implementation.
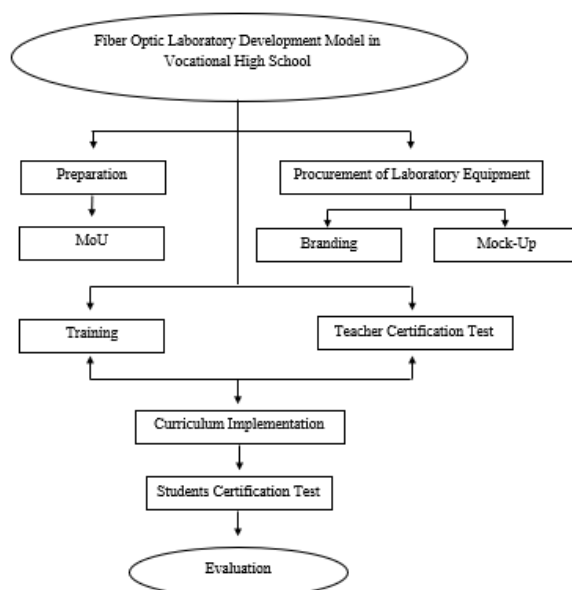

Figure 1. Flowchart of the fiber optic laboratory development model at PVHS

MoU

The MoU is a written document or agreement which is used for guidance and as a basis for conducting a feasibility study (Sopamena, 2021). MoU is considered mandatory because it is a condition in making a cooperation agreement between two parties. It has been stated in Government Regulation No. 28 of 2018 article 6 concerning with cooperation, one of these stages is the preparation and signing of a collective agreement. There is a function of the MoU, namely to take into account the effectiveness and efficiency offered by the parties (Irwanto, 2021). In this case, the cooperation mechanism between vocational high schools and industry is reflected in the agreement between the two parties in an MoU in procuring fiber optic laboratories, fiber optic training, competency tests and obtaining fiber optic certificates for students and teachers. Based on the results of observations and interviews conducted with the deputy head of public relations, the head of the expertise program, and the assistant teacher for the lab. Fiber optic laboratory cooperation in vocational high schools in collaboration with industry, namely through several stages, namely offering proposals by each industry which contains the background of the formation of cooperation between PT. Telkom and schools in the procurement of fiber optic laboratories, duration of work, main requirements for procurement, type of fiber equipment. optics, curriculum plans, price schemes, student certification requirements.

Fiber Optic Laboratory Equipment Procurement

In procuring this tool, schools can choose several types that are offered at different prices by PT. Telkom, in the name of: Basic type with a price of Rp. 247,389,300 and the Pro Type with a price of Rp. 326,568,100 The price does not include VAT and delivery costs. The location of the difference between basic and pro types in the addition of Gigabit Passive Optical Network (GPON) functions with this system, students will get a more complete learning. Based on the results of observations and interviews at Dwija Bhakti 1 PVHS Jombang, choosing the basic type in the procurement of a fiber optic laboratory with the selected basic type, the school will get several facilities, including: 1000 meters of SCRPT 12 Core fiber optic cable, 2 units of optical terminal box (OTB Wall), 1 unit universal closure/ uc 12 core, 1 unit fusion splicer brand shinewaytech, I unit OTDR brand shinewaytech, 1 set power meter brand grandway, 1 unit optical fiber visual, 1 set material and equipment for safety and splicing, 1 raised floor/stage unit, 1 ambalam unit, angle iron finishing. However, in calculating the price for a basic type of fiber optic laboratory, schools can choose to use a fusion splicer or OTR that does not match the material (Soesanto, 2020). If you want to have a fusion splicer with a different brand, an additional fee will be charged (Rumbiak & Tambunan, 2021).

Branding

Laboratory procurement is related to management, use and facilities (Basthoh & Hayati, 2020). Because the laboratory is proof of PT. Telkom's commitment to supporting education, providing connectivity, and encouraging digitalization in the education sector. In this case, fiber optic laboratory facilities from PT. Telkom that require a branding process include: hollow frame backdrop, red paint finish, room painting, fiber optic laboratory name sticker, acrylic sign name, design. In this case, the estimated duration of the process is 60-90 days. The estimate includes delivery time and the installation process. However, before carrying the process, schools need to provide classrooms with predetermined conditions from PT. Telkom.
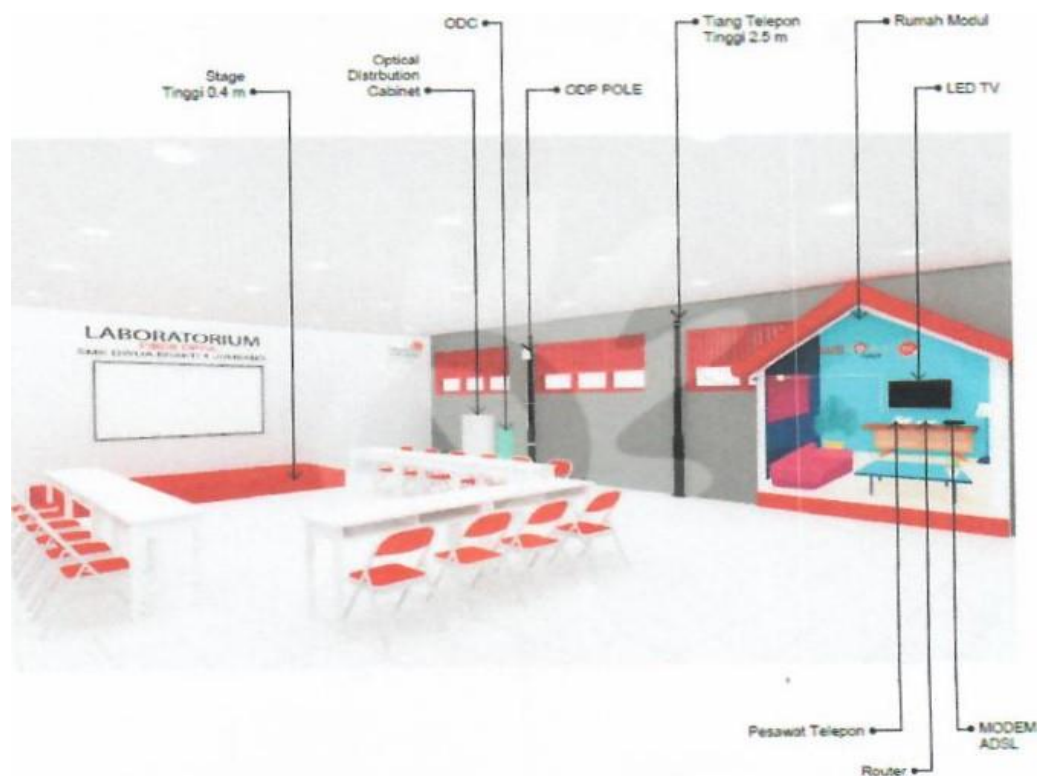
Mock Up

Figure 2. Mock-up - Laboratory

Figure 2 shows that the materials and media layout has been designed in such a way by the industry. All materials, branding, and mock-ups followed the standards of PT Telkom and the submitted proposals by the industry to the school. Mock-up was carried out after the laboratory room was completed at the branding stage. At this stage it is important to do it carefully because it must measure accurately and as needed (Yanuari & Lidyawati, 2018). There was several equipment that needed a mock-up, the name is: DC Pole/hang 48 ports 1pcs, ODP Pedestal 1pcs, ODP Solid 1pcs, ODP Closure 1pcs, Pole t7 2 sticks, KU 12/12 T 15m, 1pcs Riserpipe, 1pcs Spliter 1: 4, 1pcs Spliter 1: 8, 25m Dropcore, 3m Duct Cable, 10m HDPE, 1unit OTP, 25m Indoor Cable including Clip on, 1 unit Rosette 2 pigtall and termination ports, 1 unit ONT, 1 piece housing module, 1 set Design. So, all the tools were brought in, installed complete with terminations and tested by telkom technicians because they were already in one package. The mock-up is designed like the real world but in a miniature form located in the lab. The following is an overview of the layout and mock-up.

TOT and Teacher Certification

The training aimed to improve the teachers' quality through experts' presenters or mentors in the fiber optic (Sungkar, 2021). Because the training and certification are part of the basic type package chosen by the school, the training was divided into two, the first was carried out for teachers after the MoU, and the second was done for students training before students took the certification test (Hasanah, Syamwil & Sudana, 2017). The difference in teachers' and students' trainings was the additional material given to the teachers on how to teach and teachers were required to attend training and certification before providing learning. The material was provided by Telkom Access a subsidiary of PT Telkom. There were several stages before the certification test, the name is: (1) the information stage, the prospective participant or assessment will get information from the TPCC LSP regarding the internal process and scheme to be tested, (2) the assessment preparation stage, prospective participants are required to prepare administrative requirements in the form of photos, photocopy of ID card, CV with portfolio, (3) pre-assessment stage, at this stage an examination of the files that have been collected

in the previous stage, then conducted an interview and an exam schedule will be set, (4) stages of implementing the certification test, a written test, practice/demonstration and a combination of these methods. The certification test was carried out by assessors from the TPCC LSP using Competency Test Materials which are prepared based on the relevant Indonesian National Work Competency Standards (INWCS) following the certification scheme, (5) stages of assessment, the TPCC LSP assessors conduct an assessment of the competencies in the tested assessors and submit the results of the assessment to the Certification Committee, and (6) the decision stage, after the results are submitted, the TPCC LSP certification committee makes a decision on the test participants who are declared competent. Certificates are awarded to competent assessors.

Curriculum Implementation

Hvrivnak (2019) the implementation of the curriculum contained in the proposal has been prepared by PT Telkom for Vocational High Schools in accordance with the decision of the Director General of Primary and Secondary Education Number 330/D.D5/KEP/KR/2017 concerning national content subjects: (a) Regional content, (b) Basic fields expertise (C1), (c) Basic skill program (C2), and (d) Skill competency (C3) the materials and plans for implementing learning are as follows:

1. Fiber optic technology materials: (a) fiber optic communication system (SKSO), (b) fiber to the x (FTTx) network, (c) fiber optic cable splicing, and (d) fiber optic cable network measurement.
2. Network administrator materials: (a) network topology design, (b) network addressing design, (c) determination of network device specifications, (d) network cabling, (e) wireless network installation, (f) network switch configuration, (g) configuration routing on network devices in one autonomous system, and (h) routing configuration on network devices between autonomous systems. The following Table 1 display the basic competencies that must be exceeded by students.

Table 1.

Basic Competencies

Knowledge	Skills
3.1 Analyzing broad-based networks	4.1 Designing a broad-based network
3.2 Evaluating the wireless network	4.2 Configuring a wireless network
3.3 Evaluating wireless network problems	4.3 Repairing the wireless network
3.4 Understanding fiber optic network	4.4 Studying fiber optic network
3.5 Identify the types of fiber optic cables	4.5 Showing fiber optic cable
3.6 Applying the function of fiber optic work tools	4.6 Using fiber optic working tools
3.7 Evaluating fiber optic splicing	4.7 Performing fiber optic connection
3.8 Evaluating passive fiber optic network devices	4.8 Configuring fiber optic network passive devices
3.9 Evaluating fiber optic network problems	4.9 Repairing fiber optic network

(*Source: Proposal of PT. Telkom*)

Students Certification

Certification is conducted by students is the final stage, where the certification is carried out at the end after going beyond learning in accordance with the curriculum (Hikmawan & Fauzi, 2019). The certification test for students is divided into 2, the first was for young network administrator with the INWCS for computer networks, the second was for fiber optic installation technicians with the INWCS for fiber optic installation. However, before conducting certification, the teacher brought in guest teachers from PT. Telkom to provide training and help students to carry out the certification test properly and smoothly. The provided material was related to FTTH network technology, fiber optic network measurement, fiber optic cable splicing, cable termination and fiber optic network interference analysis. Due to the long distance between training and student certification, the teacher helps students

to review the material again so that students do not forget and it is expected that many of them will pass the certification test.

Evaluation

Evaluation is conducted to find out how far the learning achievement has been carried out. Febriana (2019) stated that evaluation is a process that is conducted continuously in formulating information in order to obtain the answers to improve the applicable learning system. In this case, the evaluation is conducted by PVHS of Dwija Bhakti 1 Jombang in implementing the fiber optic laboratory development model is related to the synchronization of the curriculum provided by the industry with the curriculum set by the government. Graduates from vocational education have demands to adapt to the needs of the industrial world (Cahyanti et al., 2018). Hence, it is necessary to align the curriculum which was developed in accordance with the needs of the industry but still according to the government curriculum (Subijanto & Sumantri, 2020).

CONCLUSION

It can be concluded that the development of fiber optic laboratory procurement at Dwija Bhakti 1 PVHS Jombang is in accordance with the agreement between the Ministry of Education and Culture and PT. Telkom regarding the link and match curriculum in the fiber optic field. The model requires several stages. However, each of these stages can work well if the school prepares periodic communication and evaluation with industry and teachers hence the learning using this model can run as expected and produce competent graduates according to their fields.

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