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## Training on the Use of GNS3 in Computer Networks Learning for Vocational High School Teachers

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### ABSTRACT

The development of Science and Technology (IPTEK), especially information technology, has had a positive impact on all aspects of human life, including education aspect. The teaching and learning process is the core of the whole educational process. The quality of teaching and learning is determined by the teacher and the students themselves as subjects or actors in the process. Therefore, a teacher is required to always improve skills through learning activities/seminars/training related to their competence field. This Community Service Program (CSP) used mentoring methods in its implementation, while the approaches used were classical and individual approach. This CSP activity has succeeded in providing debriefing and training for teachers to install computer networks using the GNS3 software. The training participants in this CSP were teachers of SMKN 1 Suliki, Lima Puluh Kota Regency and SMKN 1 Ampek Angkek, Agam Regency, West Sumatra. To find out the effectiveness of this CSP activity, a questionnaire was used as an assessment instrument. Based on the tabulation results, it was found that this CSP activity obtained an average value of 82.71% in the good category. Even though this activity has obtained good results from CSP participants, consistent efforts are needed to increase the effectiveness of CSP implementation for the next period. Efforts to increase the effectiveness of CSP implementation are also based on several suggestions and input submitted by CSP participants through an effectiveness questionnaire. The suggestions and input submitted by several participants became evaluation material for the CSP implementation team of the Computer Engineering Study Program, Payakumbuh State Agricultural Polytechnic in the future.

## 1. Introduction

The development of Science and Technology (IPTEK), especially information technology, has had a positive impact on all aspects of human life, including education aspect. Education is an interesting issue to discuss, because through educational endeavors it is hoped that a human being can become a creature of good character and possess knowledge. The knowledge possessed is a gift that will later enable a person to elevate his status and dignity (Khomarudin et al., 2018).

The teaching and learning process is the core of the whole educational process. The quality of teaching and learning certainly will greatly affect the quality of education. The quality of teaching and learning is determined by the teacher and the students themselves as subjects or actors in the process. The importance of maintaining the quality of teaching and learning has consequences for the teacher to improve his/her role and competence, because the teaching and learning process and student learning outcomes are largely determined by the teacher as a facilitator.

There are several elements that must be observed in the learning process, namely learning objectives, learning materials, teaching and learning activities, media and learning resources, teaching methods, and teaching evaluation. Several things that must be considered in selecting teaching materials include accuracy of teaching objectives, support for the content of learning materials, teacher's skills in using them, time availability to use them, and suitability of the material to students' level of thinking (Efriyanti et al., 2021). In this context, the teacher's skills to deliver learning material will have an impact on ongoing learning. Therefore, a teacher is required to always improve skills through learning activities/seminars/training related to their competence field.

One of the productive subjects taught at Vocational High Schools (SMK) is Computer Network Installation. This subject has several competencies that must be met by students, including being able to perform network installations, create network designs, and configure networks with TCP/IP. To fulfill these competencies, theory in class alone is not enough, but must be supported by practice in the laboratory using media that can support the implementation of Network Installation. For this reason, a media is required in the form of a simulation that can describe teaching about Network Installation. One of the media that meets these requirements is *GNS3* (Azhar & Hariyadi, 2017).

*Graphic Network Simulator-3 (GNS3)* is a GUI-based computer network simulation software similar to *Cisco Packet Tracer*. However, the use of the *GNS3* software allows complex network simulations, because it uses the original operating system of network devices, such as *Cisco* and *Juniper* (Tweleifty et al., 2015), therefore we are faced with more real conditions in configuring *routers* directly when compared to *Cisco Packet Tracer*. *GNS3* is an excellent complementary tool for real labs for networks engineers, administrators, and people who want to study for certifications, such as *Cisco CCNA*, *CCNP*, *CCIP*, and *CCIE*, as well as *Juniper JNCIA*, *JNCIS*, and *JNCIE*. The main features of *GNS3* are its high-quality design and complex network topology, supporting multiple *Cisco IOS router platforms*, *IPS*, *PIX*, and *ASA firewalls*, as well as *JUNOS*. The advantages of using *GNS3* are simple *Ethernet* simulation, *ATM* and *Frame Relay* switches, then simulated network connections to the real world, as well as packet capture using *Wireshark* (Prismana & Chilmi, 2015).

In using *GNS3* application media, students are not only expected to listen to the teacher's explanation, but to also observe or pay attention when the teacher explains learning material through the *GNS3* application media. On the other hand, teachers should supervise students when they are doing practice. Good learning is obtained when students can gain knowledge and experience. Therefore, teachers should be able to create interactive and diverse learning. Complete learning facilities using the *GNS3* application media in the Network Installation subject can easily be practiced directly with students. Students can easily respond to Network Installation material and other lessons delivered by the teacher.

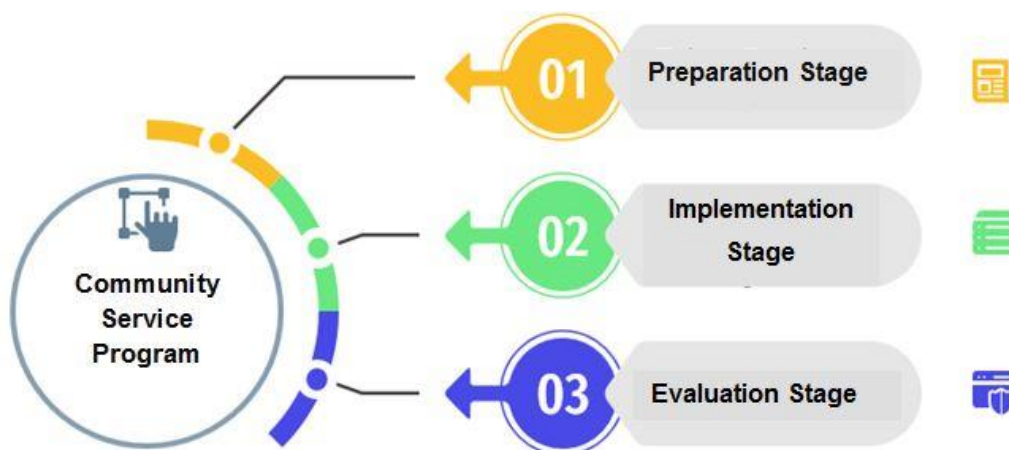
## 2. Methods

### 2.1 The Service Approaches

This Community Service Program (CSP) employed the mentoring method in its implementation (Guseti et al., 2022). The approaches used were classical and individual approach (Efriyanti et al., 2022). The classical approach was provided in the form of training that aim to convey theory or procedures in the use of *GNS3* applications. Furthermore, an individual approach was carried out in mentoring activities that aim to guide teachers in using the *GNS3* application during the training process (Al-hafiz et al., 2022).

### 2.2 Stages of Service

The stages of this CSP activity from start to finish are described in Figure 1 as follows:



**Figure 1.** Stages of CSP Activities

Based on Figure 1, it can be explained that CSP activities were carried out in three stages (Ifroh & Permana, 2021). (1) *The first stage: Preparation*, this stage was carried out by preparing all training requirements, including determining the location or computer laboratory; preparing computer equipment and installation of *GNS3* software; and preparing office stationery (ATK), cocarde, and training kits. (2) *The second stage: Implementation*, three activities were carried out in this stages, namely a) Presentation of material and demonstrations related to the use of *GNS3* application; b) Assignments addressed to training participants regarding computer network design simulations using *GNS3* application; and c) Assistance to training participants, where at least one participant was accompanied by one officer who has been appointed previously. (3) *The third stage: Evaluation*, an evaluation was carried out in this stage to get feedback from the implementation of the CSP activities, which is useful to analyze the effectiveness of the activities that have been carried out (Asnawi et al., 2021).

### 2.3 Service Goals and Objectives

The participants of the training in this CSP activity were the teachers of State Vocational High School (SMKN) 1 Suliki, Lima Puluh Kota Regency and SMKN 1 Ampek Angkek, Agam Regency, West Sumatra. The aims of this CSP activity were (1) to help improve the competence of the Subject Teacher Council (MGMP), especially in Computer Network Engineering (TKJ) subject; (2) Make it easier for teachers to deliver subject matter of computer network installation techniques using *GNS3* software tool; (3) Facilitate students in understanding computer network installation techniques using the *GNS3* software tool.

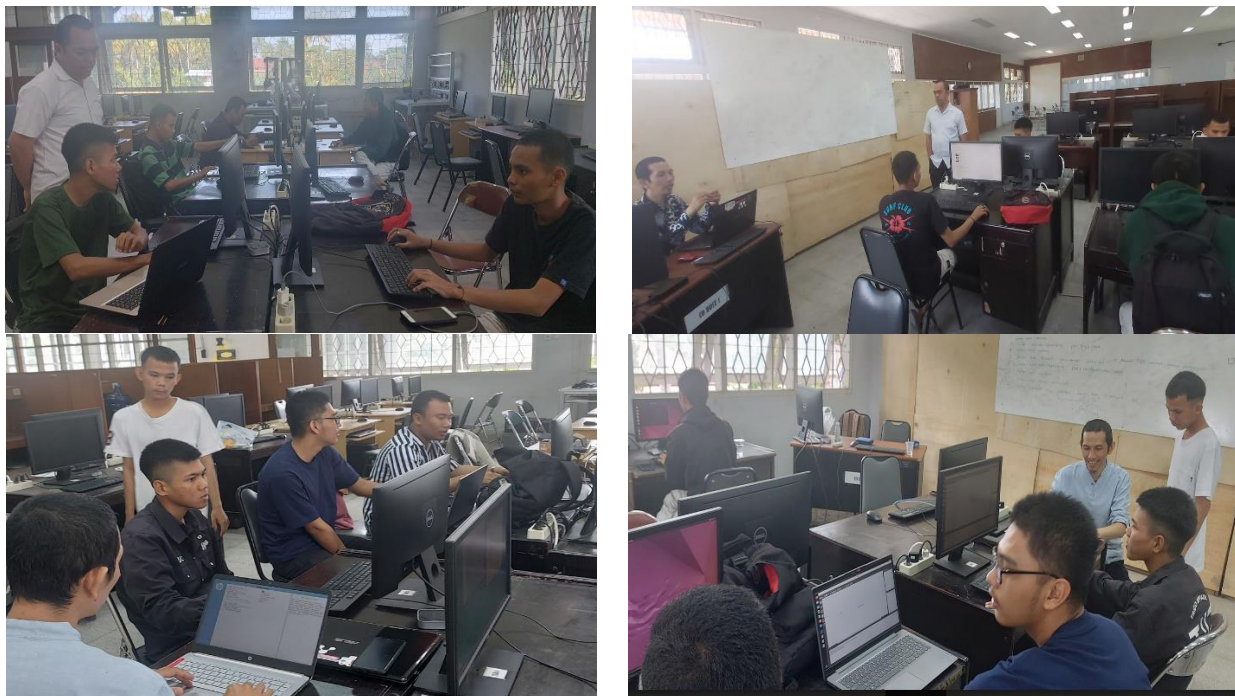
### 3. Results and Discussion

#### 3.1 CSP Results

CSP activities in the form of "Training on the Use of GNS3 in Computer Network Learning" were carried out in three stages, namely preparation for activities, implementation of activities, and evaluation of activities.

##### 3.2.1 Preparation Stage of CSP Activities

The activities at this stage were carried out by preparing all training requirements, including determining a location or computer laboratory, preparing computer equipment, and trialling the *GNS3* software installation, as well as preparing office stationery (ATK), cocarde, and training kits. Determination of computer laboratories, preparation of computer equipment, and testing of *GNS3* software installation were the main activities in this stage. The *GNS3* software used in this CSP activity was *GNS3* version 1.5.2. The documentation of preparation activities is depicted in Figure 2.

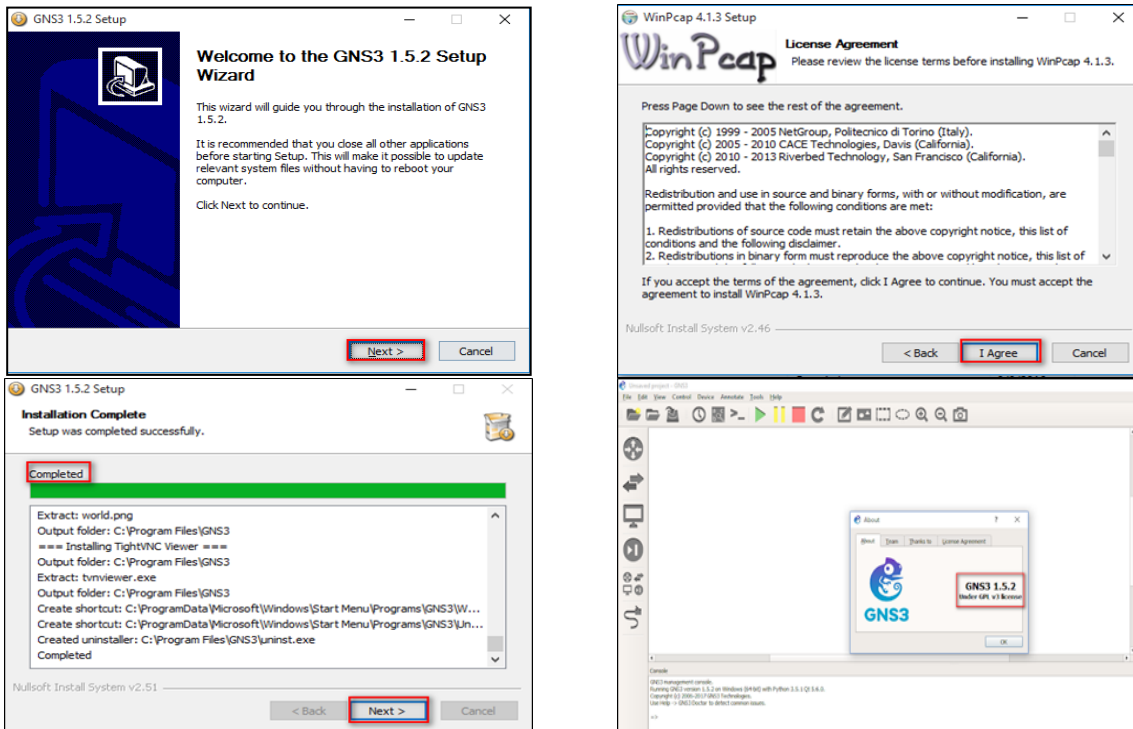


**Figure 2.** Documentation of CSP Preparation Activities

##### 3.2.2 Implementation Stage of CSP Activities

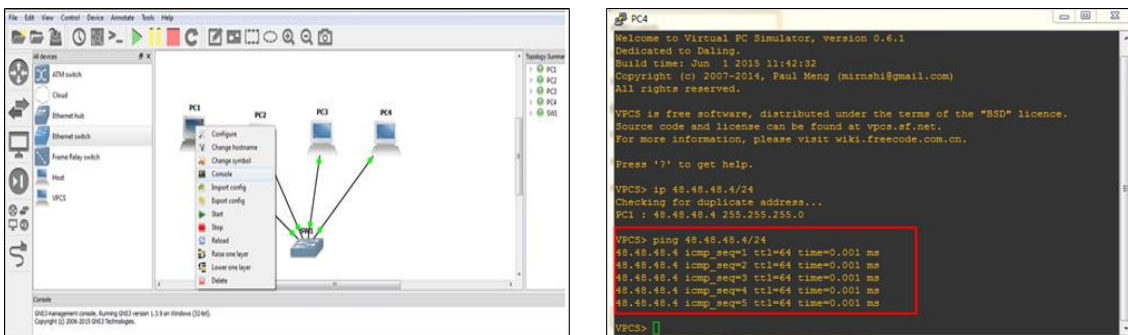
The implementation stage began with the handover of ATK, such as cocardes and workshop/training kits to the participants, in this case submitted by the Vice Rector 1 of the Academic Section, namely Mr. Ir. Harmailis, M.Sc. Furthermore, the implementation stages were divided into three main activities, namely (1) Presentation of material and demonstrations related to the use of the *GNS3* application by Mr. M. Riza Nurtam, M.Kom; (2) Assignments addressed to training participants regarding computer network design simulations using *GNS3* application; and (3) Assistance to training participants, where at least one participant was accompanied by one officer who has been appointed previously, consisting of lecturers and students of Computer Engineering Technology study program.

The understanding process taught in this training started from how to install the *GNS3* software on a computer by each training participant. An overview of the process of installing the *GNS3* software on a computer from the beginning to the end and ready for use is depicted in Figure 3 as follows:



**Figure 3.** Overview of *GNS3* Software Installation Process

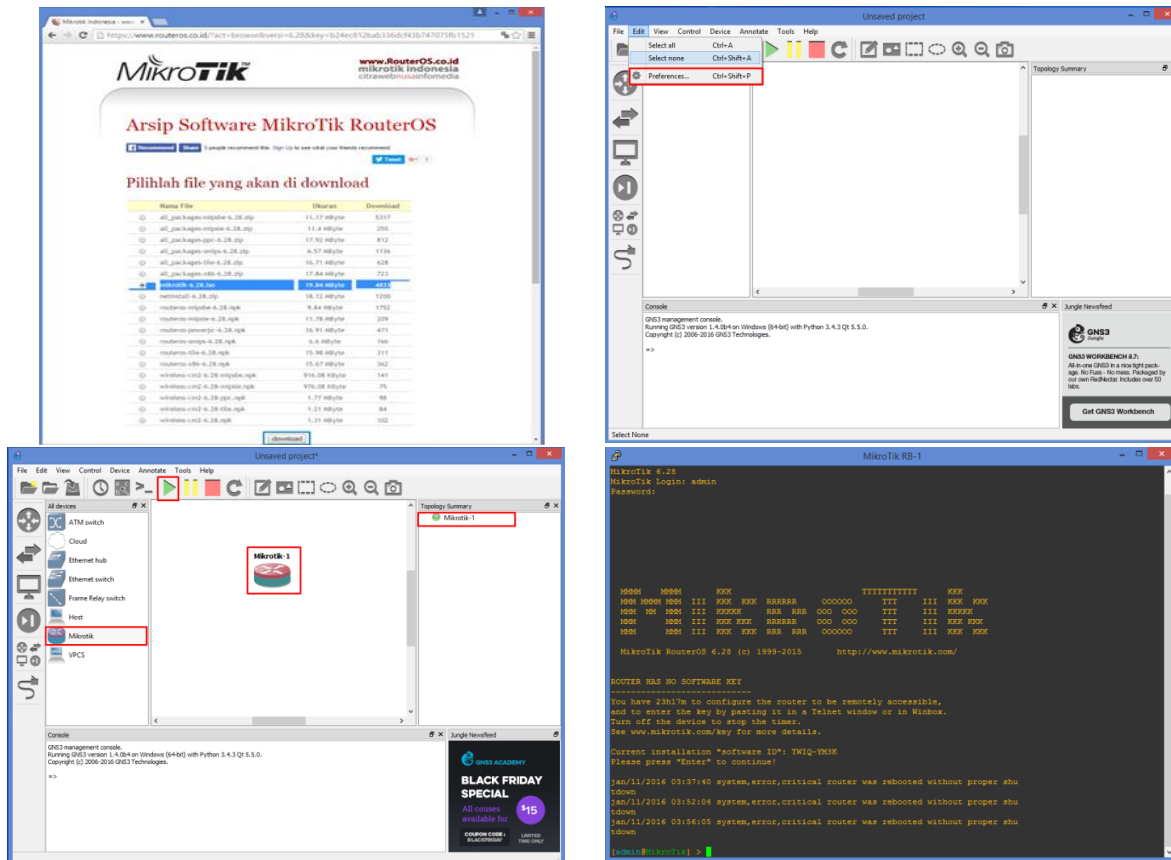
The next training process directed the participants to start a simulation or create a LAN network using *GNS3*. The GUI-based *GNS3* application used the concept of “drag & drop” of selected components into the work area. Some of the components used in making a LAN network include PCs/computers, *Ethernet* switches, and connecting PCs to switches. The next stage was setting up the IP address and testing the connectivity of all PCs (Fitriani et al., 2021). The simulation process for making a LAN network and setting the IP address is shown in Figure 4 as follows:



**Figure 4.** Description of LAN Network Simulation Process and IP Address Settings

The next training discussed the installation of *MikroTik* on *GNS3*. *MikroTik* is an operating system used to turn a computer into a network *router*. MikroTik is commonly used to manage computer and internet networks in offices, internet cafes, and other places that want to distribute the internet properly. By installing *MikroTik*, your computer will get all the features that a *router* has, including a *firewall*, *hotspot gateway*, and *bandwidth management*. The functions of *MikroTik* are (1) As a device that manages internet access in a network; (2) As a network authentication device, so that it can restrict the person who is permitted to use the office’s computer and access company’s confidential

information; (3) A device that manages a *firewall*, as well as a *WiFi access point* (Budiman et al., 2021). The process of installing *MikroTik* on *GNS3* is described in Figure 5 below:



**Figure 5.** Overview of *MikroTik* Installation Process on *GNS3*

### 3.2.2 Evaluation Stage of CSP Activities

The evaluation stage was carried out to obtain a feedback regarding the implementation of this CSP, which is useful to analyze the effectiveness of the CSP activities that have been carried out. This evaluation was carried out by distributing a questionnaire regarding the effectiveness of the implementation of CSP activities to the participants, in this context, namely the teachers of SMKN 1 Suliki, Lima Puluh Kota Regency and SMKN 1 Ampek Angkek, Agam Regency, West Sumatra.

The questionnaire on the effectiveness of implementing CSP activities contains 10 assessment aspects related to the implementation of CSP activities. Questionnaires on the effectiveness of the implementation of CSP activities that have been filled out by teachers or participants were then processed using a number processing application, such as *Microsoft Excel*. Table 1 below describes the tabulation results of the effectiveness questionnaire in detail.

**Table 1.** Tabulation Results of Effectiveness Questionnaire

No.	Indicator	Results (%)
1.	CSP activities carried out were in accordance with the expectations of partners	83.33%
2.	The way the presenters deliver the CSP material was interesting	85.42%
3.	The CSP material was delivered in a clear and easy way	81.25%
4.	The time allotted was appropriate for the delivery of the material	77.08%

No.	Indicator	Results (%)
5.	Partners were interested in participating in CSP activities as long as they met the partner's needs	87.50%
6.	CSP members who were involved in activities provided services according to the needs	83.33%
7.	CSP activities were carried out on an ongoing basis	81.25%
8.	Every complaint/question/problem raised by the CSP participant was followed up properly by the resource person/CSP member involved	85.42%
9.	Partners benefited directly from the CSP activities carried out	81.25%
10.	In general, partners were satisfied with CSP activities	81.25%
	Average	82.71%
	<b>Category</b>	<b>Good</b>

It is revealed in Table 1 that the tabulation results of questionnaire regarding the effectiveness of the CSP activity obtained an average value of 82.71% in the good category. Thus, it can be concluded that the effectiveness of this CSP activity obtained good marks from the training participants, in this context, namely the teachers of SMKN 1 Suliki, Lima Puluh Kota Regency and SMKN 1 Ampek Angkek, Agam Regency, West Sumatra.

### 3.2 Discussion

This CSP activity has succeeded in providing debriefing and training for teachers to install computer networks using the *GNS3* software. Computer network installation is one of the productive subjects taught at Vocational High Schools (SMK). This subject has several competencies that must be met, including students are expected to be able to perform network installations, create network designs, and configure networks with TCP/IP. This CSP activity is expected to help improve the competence of the Subject Teacher Assembly (MGMP) in using *GNS3* software, especially in Computer Network Engineering (TKJ) subject and Computer Network Installation subject.

*Graphic Network Simulator-3 (GNS3)* is a GUI-based computer network simulation software similar to *Cisco Packet Tracer*. The selection of *GNS3* software was based on the advantages and disadvantages of the software, which has the main features of high-quality design and complex network topologies, supports many *Cisco IOS router platforms, IPS, PIX and ASA firewalls, and JUNOS*. The next advantages are simple *Ethernet* simulation, *ATM* and *Frame Relay* switches, and simulated network connections to the real world, as well as packet capture using *Wireshark*. The selection of *GNS3* software is based on previous research, that *GNS3* software is superior to other computer network simulation software, namely *packet tracer* (Surahmat & Sum, 2019).

The training participants of this CSP activity were the teachers of SMKN 1 Suliki, Lima Puluh Kota Regency and SMKN 1 Ampek Angkek, Agam Regency, West Sumatra. To find out the effectiveness of this CSP activity, an assessment of the activities was carried out, namely through a questionnaire instrument. Based on the tabulation results, it was found that this CSP activity obtained an average value of 82.71% in the good category.

Although this activity has obtained good results based on the evaluation of CSP participants, consistent efforts are required to increase the effectiveness of CSP implementation for the next period. Efforts to increase the effectiveness of CSP implementation are also based on several suggestions and input submitted by CSP participants through questionnaires. Among the inputs and suggestions for the effectiveness of the CSP implementation that have been collected are as follows: (1) In terms of implementation location, participants suggested that it should be carried out at a location or computer

laboratory in schools so that it will directly help the application in the learning process at schools. (2) In terms of implementation time, most of the teachers who were enthusiastic about the implementation of this CSP suggested that the time for implementing CSP can be increased. (3) In terms of material, most of the teachers suggested that this CSP activity can be continued in the future using different materials so as to support the improvement of the teachers' competence in the field of Information Technology.

The suggestions and input submitted by several CSP participants described above became evaluation material for the CSP implementing team of Computer Engineering Technology study program, Payakumbuh State Agricultural Polytechnic for improvement in the future implementation of CSP. The documentation of CSP implementation activities is shown in Figure 6 below.



**Figure 6.** Documentation of CSP Implementation Activities

#### 4. Conclusions

The development of Science and Technology (IPTEK), especially information technology, has had a positive impact on all aspects of human life, including education aspect. The teaching and learning process is the core of the whole educational process. The quality of teaching and learning will certainly greatly affect the quality of education. The quality of teaching and learning is determined by the teacher and the students themselves as subjects or actors in the process. Therefore, a teacher is required to always improve skills through learning activities/seminars/training related to their competence field. This CSP activity used the mentoring method. The approaches used in this activity were classical and individual approach. This CSP activity has succeeded in providing debriefing and training for teachers to install computer networks using the *GNS3* software. The training participants in this CSP activity



were the teachers of SMKN 1 Suliki, Lima Puluh Kota Regency and SMKN 1 Ampek Angkek, Agam Regency, West Sumatra. To find out the effectiveness of this CSP activity, an assessment was carried out, namely through a questionnaire instrument. The tabulation results show that the CSP activities obtain an average score of 82.71% in the good category. Although this activity has obtained good results based on the evaluation of participants, consistent efforts are required to increase the effectiveness of CSP implementation for the next period. Efforts to increase the effectiveness of CSP implementation are also based on several suggestions and input submitted by CSP participants through questionnaires. The suggestions and input submitted by several CSP participants became evaluation material for the CSP implementing team of the Computer Engineering Study Program, Payakumbuh State Agricultural Polytechnic for improvements in the future implementation of CSP.

## 5. Acknowledgments

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