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Monitoring water quality using control charts at PDAM Surya Sembada Surabaya

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ABSTRACT

Statistical quality control using control charts is an easy-to-implement method to improve quality. Improvements in the quality of products and services are continuously implemented to meet consumer needs. Products and services must maintain the desired quality with as few defects as possible. Variations in products and services are naturally created to meet needs. Unintentional variation, but the cause can be found. Control charts can be used to monitor production; particularly serving as an early warning index of processes that are potentially out of control. To keep production under control, different control charts are prepared for different cases, created by combining upper and lower control limits. Points plotted on a graph can reveal certain patterns, which in turn allow the user to get specific information. Information on water production is very important in PDAM because water is the main product that meets the needs for the survival of humans, animals, plants, and various other needs. The supply of clean water that meets the requirements of quality standards is always pursued by PDAM Surya Sembada Surabaya. The Statistical control chart training will increase productivity and improve water quality, not only in terms of chemical, physical and biological quality. Good water quality will add value to the trust and community of PDAM.

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1. INTRODUCTION

Statistical quality control has been widely applied in industry and services. In the industrial sector, seven statistical tools have a very important role. Quality is the main consideration in choosing or using a product. One of the statistical tools that are widely used in industry is the control chart. The use of control charts is quite effective for monitoring whether a production process is statistically controlled or not (Berger & Hart, 2020). Patterns that show deviations from normal behavior may occur in raw materials, machine settings or measurement methods, human factors, and the environment, which inadvertently affect product quality. The information obtained from the control chart helps the user to take preventive action. According to Balakrishnan et al. (2017) decision making must be determined when there is a lot

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of information and choices. Wrong decisions can harm the company. Process improvements can be made by eliminating steps, combining steps, or making frequently used steps more efficient (Bernik & Zusnita, 2018).

PDAM Surya Sembada Surabaya is a Regional Owned Enterprise (BUMD) of the Surabaya City Government which is engaged in drinking water treatment. The vision of PDAM Surya Sembada Surabaya is "Becoming a Modern Drinking Water Company" with missions including ensuring transparent financial management for the welfare of the community, building a wise community in water use, providing efficient and sustainable drinking water, and building a working environment that prioritizes integrity and achievement. The water treatment process at PDAM Surabaya includes processing raw water from rivers in Surabaya with quality that can change over time due to several factors. These factors include weather, industrial waste, and domestic waste. Physical, chemical, and microbiological testing of the production water quality at the Water Treatment Plant of PDAM Surya Sembada Surabaya has met the maximum standard. However, statistical quality control has not been carried out. Statistical Quality Control (SQC) or Statistical Process Control (SPC) monitors the production process and detects any out-of-control processes caused by several factors or quality characteristics (Chakraborti & Graham, 2019; Keats & Montgomery, 1997).

Water is a natural material that is needed to meet the needs for the survival of humans, animals and plants and is a source of energy and fulfils various other needs. The supply of clean water is needed by various creatures on this earth, water quality is very important to note (Heinonen, 2000). PDAM Surya Sembada Surabaya always strives to maintain quality following predetermined quality standards. Good water quality will add value to the trust and community of PDAM.

The process used to monitor quality can be divided into two types of control charts. The first control chart is a variable control chart to detect any shift in the mean and process variability. The second control chart is an attribute control chart that is useful for tracking production defects, and why they occur. The attributes used are the number or discrete data such as appropriate or inappropriate; pass or fail; Yes or no. In some cases, more than one quality characteristic is often encountered in a production process and affects each other between quality characteristics. One of the production processes that have more than one quality characteristic and are interconnected is the drinking water production process which PDAM Surya Sembada, Surabaya manage. In conditions of more than one characteristic, the use of a multivariate control chart is more appropriate than a univariate control chart because the univariate control chart does not review the correlation or interaction between quality characteristics so errors or sensitivities (misleading) can occur in determining the presence of an uncontrolled process (out of control). In its application, the multivariate control chart must meet several assumptions, namely the data used must be multivariate, identical, and depend on (interrelated) quality characteristics.

It is necessary to introduce statistical methods related to quality control for producers, including aquatic products. The related party in this case is the staff of the Process Control and Planning section. One of the ways to introduce these statistical methods is through training to be able to measure and analyze production or monitor water production for several water quality parameters being measured. Quality control staff will be introduced to statistical methods related to quality measurement, namely training on seven statistical tools, with emphasis on control charts for monitoring water quality before being distributed to the community and measuring process capability. A process is said to be good if it has the high capability, which is statistically controlled and has high precision and accuracy.

Refreshment of theory and developments between campuses and new issues in the field can be integrated and discussed as training for staff controlling the water production process so that they can monitor the quality of water products with appropriate and sustainable methods. The four materials presented in community service through this training are the role of statistics for quality improvement, seven statistical tools, variable control charts, and attribute control charts. The training in community

service provided can provide a refresher on quality theory, new developments on campus and discussions of real applications/cases in the field.

The purposes of refresher activities through this training is to improve data analysis and processing skills, as well as being able to carry out monitoring processes effectively and efficiently by utilizing statistical methods that are suitable for staff in the planning and process control department. By continuously monitoring water quality, it will result in fast action if there is contaminated raw water, leaking pipes or equipment, adding, or treating water treatment materials according to standards and so on. Good water quality will have minimum variability, usually resulting in lower quality costs and increased levels of competitive position and no customer complaints. According to Mrugalska & Tytyk (2015), customer satisfaction and high quality determine the success of the product itself. A higher quality has a positive influence on customer satisfaction (Blanco-Encomienda et al., 2018; Giovanis, 2015).

This community service activity is expected to be able to provide information and recommendation materials to statistically monitor the quality of the production water produced at each IPAM PDAM Surya Sembada Surabaya, in addition to monitoring the chemistry, biology and physics that have been implemented. Statistical quality control or Statistical Quality Control (SQC) is to monitor the production process and detect any out-of-control processes caused by several factors or quality characteristics. SQC has been widely applied in industry and services. In general, based on the process used to monitor quality, there are two types of control charts, namely control charts to detect mean shifts and process variability.

2. METHODS

The method in this training begins with an understanding of statistical quality literacy, training using production data and planning for the next period. The materials provided in the refresher and training are: (1) Introduction to Statistics Process Control (SPC); (2) Seven statistical tools, consisting of observation sheets (recording all findings in observations and measurements); (3) Pareto diagrams, scatter diagrams, cause and effect diagrams and control diagrams; (4) Variable control chart; (5) Attribute control chart. This community service activity is described in the stages in Figure 1.

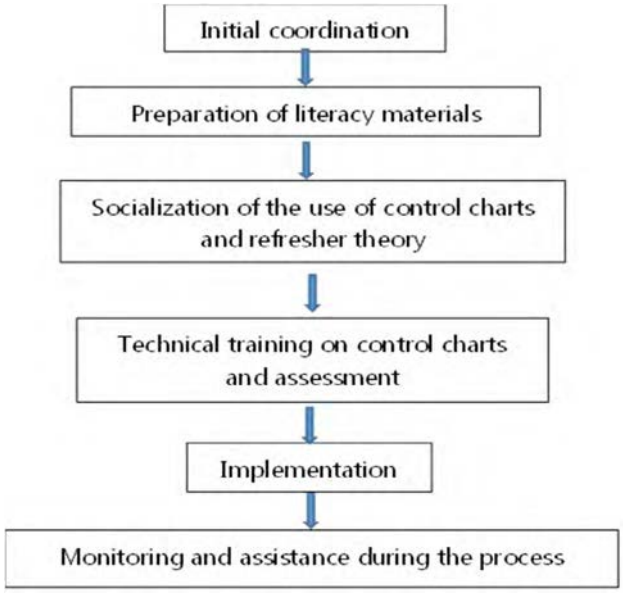

Figure 1. Stages of training in community service

Literacy Refresher

The training team and representatives of the partner team for process control and planning held a meeting to explain the water quality process in the field. The training team aligns the necessary theory so that it can adapt to existing conditions. Before the implementation of the training, materials in the form of materials have been given in advance to the participants of the quality control staff, to obtain an overview of quality in general and can be prepared, especially if there are cases in the field that can be discussed in more detail in the training process.

Statistical Quality Control

Quality is the overall characteristics of products and services that include engineering, manufacturing, and maintenance, in which the products and services in use will be following customer needs and expectations (Qiu et al., 2019). Statistics is a method related to the collection and presentation of a data to provide useful information. By using statistics, the data collection obtained will be presented in a concise, neat, and informative manner.

Qiu & Xie (2022) stated quality control is useful for measuring product quality characteristics, comparing them with specifications or requirements, and taking appropriate corrective actions if there are differences between actual and standard observations. Statistical Quality Control has the same definition as Statistical Process Control. Statistical Process Control is a term used to describe the use of techniques to monitor and improve the performance of a process to produce quality products to meet customer needs and expectations. The main objective of statistical quality control is to systematically reduce variability or error from unsuitable product characteristics, improve product quality, and maintain process stability (Stephen, 2017). Potentially failure and errors are reduced through planned control and maintenance thus prolonging the life of the system and reducing costs (Lukitosari et al., 2019).

Quality Control Tools and Data Implementation Practices

Statistical quality control is a management tool to ensure quality. Statistical testing is applied to inspect and test data to define standards and check product conformity to achieve maximum manufacturing operations, and usually results in lower quality costs and an increased level of competitive position. The strategic value of quality management can be increased through deliberate design (Gremyr et al., 2021). In statistical quality control, several tools are used as a tool in solving various quality control problems. These tools are check sheets, histograms, Pareto diagrams, fishbone diagrams, and control diagrams.

Check Sheet

The check sheet is a simply designed sheet containing a list of things needed for data recording purposes so that users can collect data easily, systematically, and regularly when the data appears at the scene. The data in the check sheet, both in the form of quantitative and qualitative data, can be analyzed quickly (directly) or become data input for other quality equipment, for example for inputting Pareto chart data. The following is an example of a check sheet shown in Figure 2.

Daily Complaint

Reject Item	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Turbidity	III				I	II	
Leakage		I	IIII	卌			
Metre	II				卌		II
Dripping			IIII			I	
Etc.	I					II	

Figure 2. Check sheet

Pareto Diagram

Pareto is a bar graph that shows problems in order of the number of occurrences. The order starts from the number of problems that occur the most to the problems with the least frequency of occurrence. Pareto charts guide improvement, showing frequencies in a bar graph and highlighting problems (Subehat, 2022). In the graph, it is indicated by the highest bar graph (far left) to the lowest graph (far right). Here is an example of a Pareto diagram shown in Figure 3.

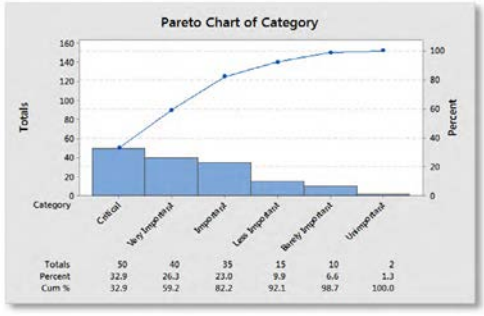

Figure 3. Pareto chart

Fishbone Diagram

A cause-and-effect diagram is a statistical tool used to identify and show the relationship between cause and effect to find the root cause of a problem. Cause and Effect Diagrams are used to show the causal factors and quality effects caused by these causal factors. Because it looks like a fishbone, Cause and Effect Diagrams are often referred to as Fishbone Diagrams. Here is an example of a fishbone diagram shown in Figure 4.

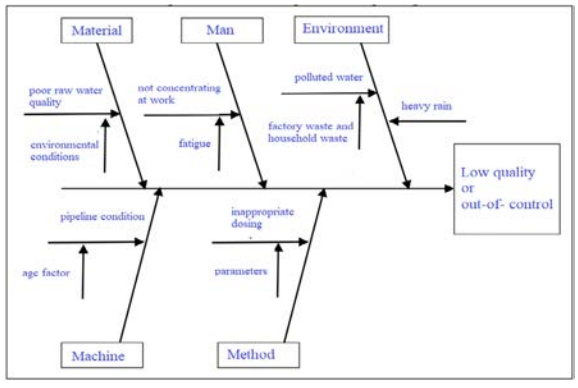

Figure 4. Fishbone Diagram

Histogram

The histogram is a graphical display to show the distribution of data visually or how often a different value occurs in a data set. The benefit of using histograms is to provide information about variations in the process and assist management in making decisions for continuous process improvement. Here is an example histogram is shown in Figure 5.

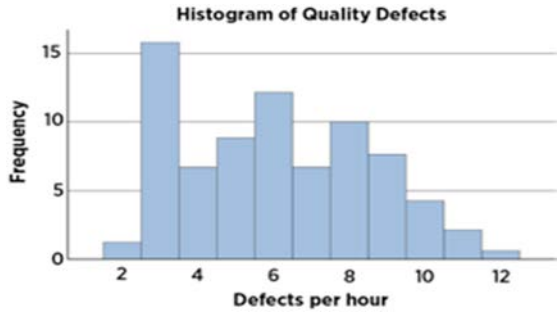

Figure 5. Histogram

Control Chart

A control chart is a statistical tool in the form of a graph and is used to monitor/monitor the stability of a process and study process changes from time to time. This control chart has an upper line (top line) for the upper control limit (highest control limit), a lower line (bottom line) for the lower control limit (lowest control limit) and a central line (middle line) for the average (average). The following is an example of a control chart shown in Figure 6.

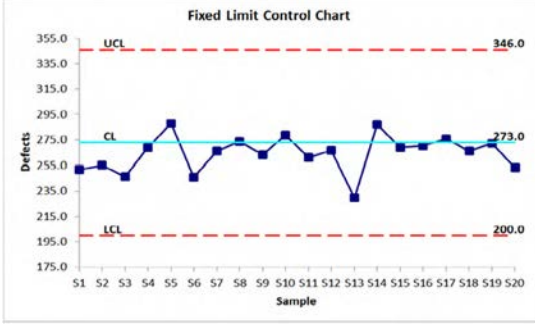

Figure 6. Control chart

3. RESULTS AND DISCUSSION

Quality control training is a problem-solving outreach activity to achieve a stable process and be able to reduce variability in the process. In addition, quality control is also used to describe controllable and uncontrollable variability. As a follow-up to the delivery of statistically quality material, the practice of processing data with a computer program is carried out and interpreting the results. Documentation of some material training activities along with the preparation of worksheets on the implementation of water quality measurement data, data processing and analysis, and continued mentoring of partner teams is shown in Figure 7 and Figure 8.

This training produces an understanding of statistical quality in addition to the processes of Chemistry, Physics and Biology. In addition, monitoring the production process running under controlled conditions or not is an early warning to be traced immediately to find the cause. Continuous process monitoring is very useful to anticipate non-standard water production and obtain fundamental improvement results.

Evaluation of training activities is also carried out through questionnaires. Questionnaires were given to participants who are staff of the Process Control and Planning section. Figures 9 to 13 are the results and responses from the training results. All participants were asked questions aimed at providing input on the training process. Questions are given alternative answers consisting of the numbers 1 to 5 in the *x*-coordinate (horizontal) which means: (1) Strongly Disagree; (2) Disagree; (3) Neutral; (4) Agree; (5) Strongly Agree.

Questionnaires

The first evaluation was carried out on the presentation process by the resource person to the Process Control and Planning staff in Figure 8. The speakers came from fields that were already involved in Quality Control in theory and its application in several industrial fields, so they were able to explain the presentation material well. Challenging topics in the field of quality and application to water production. Starting with a concise theory. The information in the presentation is accurate, relevant, objective and adapted to the audience and the purpose of the presentation.

The resource persons can attract the audience's attention very well, introduce refresher topics clearly, and adjust field problems in their presentations around 92%. This is supported by the experience of the resource persons in research so that the stages of the problem to completion can be handled smoothly.

Figure 7. Opening by Head of Process Control and Planning Department, 13 July 2022
Figure 8. Quality control training at PDAM Surya Sembada Surabaya: (a) Second day: SQC material presentation; (b) Third day: Presentation about variable-attribute control chart

The second evaluation was carried out on the enthusiasm of the participants in participating in the training in Figure 10. The participants who took part were staff who were well-adapted for presentation purposes. Around 76% are always enthusiastic about participating in the training because there has never been training on a specific topic that relates to Statistic Quality. The quality of water that is guaranteed so far has met quality standards in Chemistry, Physics and Biology. Statistical monitoring needs can be implemented to reduce non-standard water production and at the same time trace the causes.

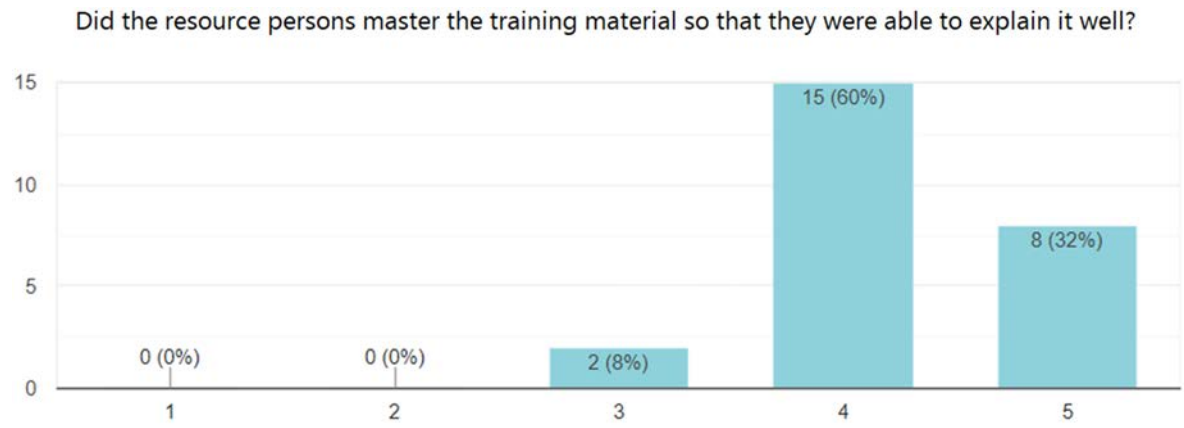

Figure 9. Evaluation of resource persons as presenters

The third evaluation was carried out on the suitability of the material provided as shown in Figure 11. The topics presented met the audience who worked in the field of quality and got about 72% points. This shows the need for identification and new ideas that must be improved according to the production process at the Water Treatment Plant. The material must meet the relevant theme, the objectivity of the training and sufficient time. The timing of the training will be further adjusted according to the density of the material which supports the participants' work.

In the fourth evaluation regarding the ease of material, it was shown that the training materials were still new to the participants because the quality control carried out in the field was in the form of chemical, biological and physical quality. Statistical quality measurements have not been carried out and do not require a special laboratory, only regular and correct sampling is required. Then the existing data is analyzed periodically to anticipate unwanted quality. Figure 12 shows that the material provided is said to be quite difficult, there are 28% of participants find it difficult because this is a new thing, and statistical quality has not been carried out in the field.

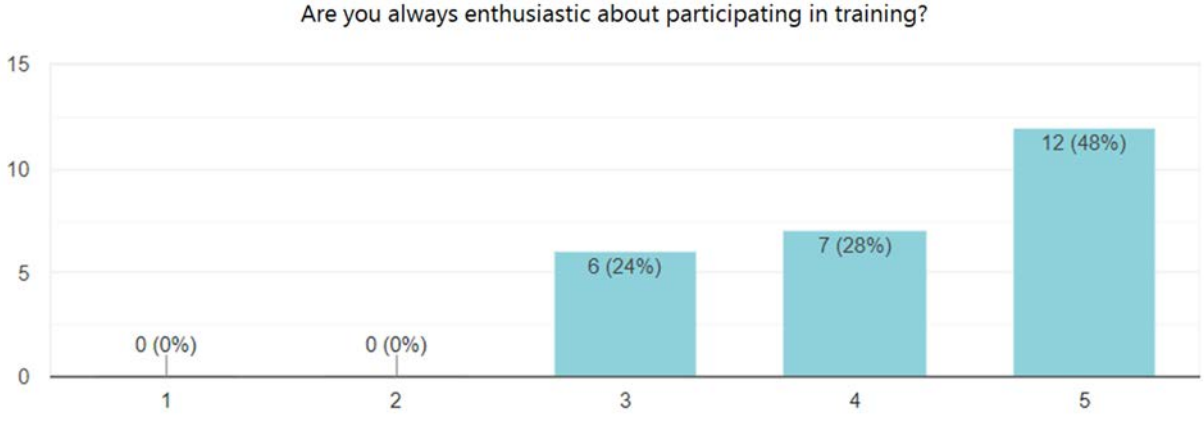

Figure 10. Evaluation of the enthusiasm of participants in participating in the training

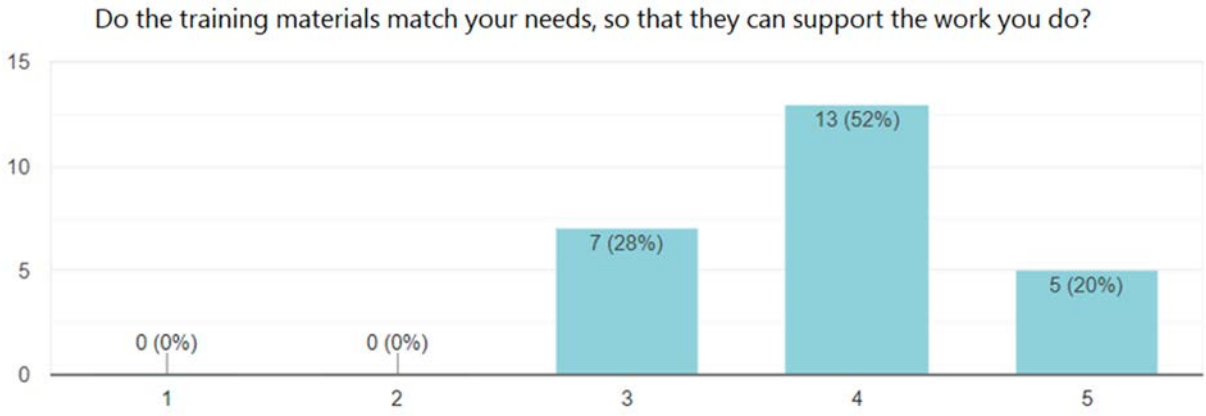

Figure 11. Evaluation of the suitability of the material to support the participants' work

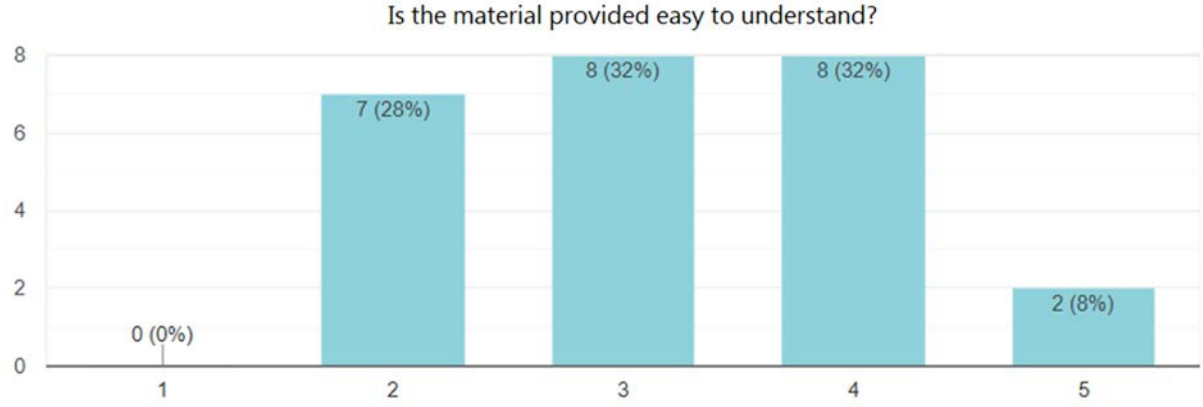

Figure 12. Evaluate the ease of understanding of the training materials

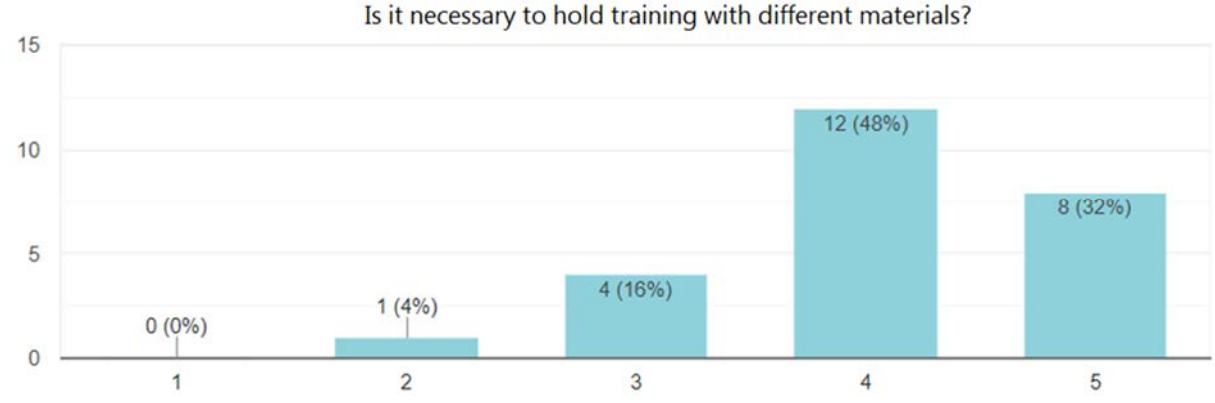

Figure 13. Evaluation of continuing and deepening of training materials

Evaluation of the training process concerning training needs for different materials, or their continuation. Quality control material is indeed a very broad and continuous material. From the results of the discussion of the material carried out, in Figure 13, as many as 70% of participants stated that they still need to continue and deepen some of the materials presented to complete the qualification process, including forecasting of supporting materials for water treatment, forms of quality follow-up after the water arrives at the customer or sampling reception. Big companies like PDAM always need a lot of knowledge to support the running of their production processes, including things that are developing according to lifestyle and today (Lukitosari & Subriadi, 2020). The level of organizational maturity has a positive influence on company performance (Negron, 2020).

Implementation and Exercises of Control Chart

In the experimental exercises, daily data is given for 1 year, then it is practiced to process the data. For example, from the Drinking Water Treatment Plant (IPAM) 1, 2 and 3 there is daily data for which a control chart will be made with: (1) Sample size with each variable in each IPAM considered as an observation; (2) Calculates dan from each iteration. Next, find the average of dan from each iteration; (3) Calculate UCL, CL, dan LCL.

The Figure 14 is an illustration of the control chart in practice used in the training consisting of 4 quality characteristics, namely turbidity, pH, organic matter, and residual chlorine.

Statistical control chart to describe any variation or deviation from the desired quality of water production. From the results of the control chart, boundaries can be made where the production results deviate from the provisions. Monitoring easily whether the process is in a stable condition or not. If there are many variations or deviations in a product, it can immediately determine what decisions must be taken.

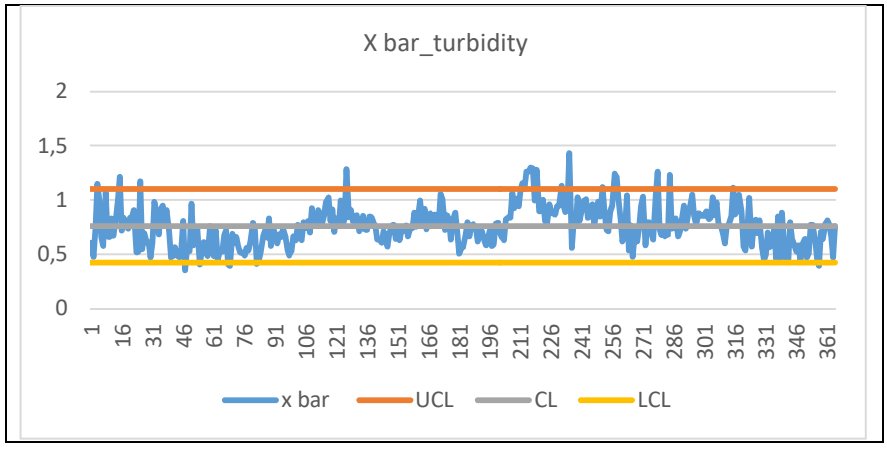

Figure 14. Control chart for characteristics of turbidity, pH, organic substance, and residual chlorine

Variations in water production can occur due to water production during the rainy and dry seasons or due to seasonal differences. Water sampling, among others: at the time of silting of the river, pollution of raw water waste, the top position and too bottom in the control basin also cause quality differences. Control charts can also help identify root causes both at a general level and at a more detailed level. Specific causes of variation can occur due to faulty equipment, the need for recalibration, the condition of old water pipes or new employees. Each IPAM PDAM Surya Sembada Surabaya has several parameters

or quality characteristics that are used to determine the quality of production water, namely turbidity, residual chlorine, pH, and organic (KM_nO_4). The four quality characteristics have been monitored every day because they are wary of water pollution.

4. CONCLUSION AND RECOMMENDATIONS

This community service activity can evaluate the production process of production water, especially in the process of monitoring the variables that cause the most out of control and anticipation of the distribution process of water that is not of good quality. The cause of out of control can be identified from the cause-and-effect diagram. Causes that exceed the specification limit are sorted one by one so that the origin is known. The training process is evaluated based on input from participants regarding the material, resource persons and field conditions. The evaluation results show that the resource persons can provide appropriate material and introduce the concept of statistical quality. However, time is still needed to discuss more methods and other theories needed in PDAM. PDAM always opens cooperation on training in deepening of new materials and theories that develop on campus in the field of statistical quality in the future. In addition to chemical, physical and biological water quality, statistical water quality will increase the trust and value of the community in PDAM.

The development of theory on campus and processes in the field need to be synergized so that there is no gap between theory and practice. Sustainable community service can bridge the development of theory on campus so that it can be utilized as much as possible in the community. Socialization and building two-way communication between campus and companies and the community will have a positive impact in the short and long term.

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Enrichment learning method in STEP-food technology at SMAK Santo Hendrikus Surabaya

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ABSTRACT

The Student and Teacher Empowerment Program of Food Technology (STEP TP) is one of the flagship intracurricular programs at SMAK Santo Hendrikus Surabaya. However, the teachers who assist the STEP TP do not have any background in food technology, thus limiting their ability to provide comprehensive food technology learning materials to the students. This community service aims to assist the teachers in creating STEP TP learning materials in the form of teaching modules and videos, conduct a guest lecture, and hold a food processing workshop guided by food technology lecturers. The methodologies including conducted a focus group discussion with the school's principle and teacher, surveying student's interest and school facilities, providing guest lectures and workshops, designing learning instruments, and evaluating the activities. The survey showed that most students were enthusiastic to learn about bread and cake processing, followed by beverages processing. In addition, the guest lecturer on the subject of food packaging was delivered to supplement the teachers' and students' knowledge other than food processing technology. Furthermore, students and teachers were taught to make pumpkin flour, which is applicable to bread and cake. Overall, the community service was fully supported by the partner's contribution. Modules and video had accepted by the school's partner.

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1. INTRODUCTION

Self-development for students and teachers is one curriculum component that has to be implemented continuously by every formal education system, including senior high school. Students need self-development to cultivate self-confidence and express interests and talents. At the same time, teachers become the facilitators of designing a learning process that is flexible, measurable, and able to motivate students to contribute actively (Hoesny & Darmayanti, 2021; Takwil, 2020). Instead

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of only transferring knowledge, teachers are responsible for teaching life values that guide students' self-development (Harianto & Anshori, 2021). Self-development for students and teachers can be endeavored through establishing collaboration with higher education institutions, including universities.

Collaboration between senior high schools and universities provides positive impacts to all parties. First, collaboration can initiate the realization of community service as one of the three pillars of higher education. Second, senior high school and universities can facilitate students' interests and talent to own insights into major choices at a higher education level. Third, university facilitators can equip students with new knowledge in addition to those shared by teachers in the classroom. Therefore, the established collaboration indirectly facilitates teachers' experiences on various learning sources that help in knowledge and life values transfer, also centered on interactions between students and their surroundings (Setiawan & Karsinah, 2016; Wibawa et al., 2017).

Student-centered learning (SCL) encourages students to start observing fields of interest to be mastered in the future, one of which is food technology. Food technology learning has been introduced to students in senior high schools and designed in an exciting way, such as cooking classes. Nevertheless, many still do not realize that food technology differs from cooking activities. The interest in food technology needs to be based on literacy about food. According to Cullen et al. (2015), food literacy includes knowledge of the food impacts on people's health and wellness, the connection between the production process up to waste management, and food system knowledge that provides for the social, cultural, economic, political, and environmental aspects. Teachers can adopt one of the food literacy aspects as a refreshment material for students interested in food technology because, according to Suminar et al. (2021), teachers with limited knowledge of matters related to student interests will experience obstacles in developing students' potency. Nanayakkara et al. (2018) stated that it is essential to contribute professionals who understand food technology as knowledge and practice to fulfill students' needs for food literacy and develop the curriculum and program held by the schools.

SMAK Santo Hendrikus Surabaya is one senior high school in Surabaya with a flagship program for students' self-development as an intracurricular activity known as *Student and Teacher Empowerment Program* (STEP). STEP aims to provide a comprehensive and applicative learning process, one of which focuses on food technology (STEP TP). SMAK Santo Hendrikus Surabaya initiated STEP TP in 2019 with participants from class X and XI students from science and social studies classes who are interested in food technology. Lessons designed and carried out in STEP TP activities by the teachers are generally obtained by searching for topics related to food on the internet and added with simple, practical activities. Meetings can also be filled with collaboration between STEPs, such as between food technology and biology, with topics that cover the areas for both STEPs. Another activity from STEP TP is field trips which turned into virtual field trips during the pandemic. Several industries became partners of STEP TP for virtual field trips during the pandemic, including PT. Ajinomoto and PT. Amerta Indah Otsuka. In addition, STEP TP invited competent speakers in the field of food technology to fill in at one of the STEP TP meetings as a guest lecture. The guest lecture that was conducted during the pandemic raised the topic of food additives and their application in meat-based emulsion products. At the end of STEP TP activities for one semester, students work on a final project by making and presenting product innovations from a predetermined food ingredient topic.

The STEP TP activities at SMAK Santo Hendrikus Surabaya have been designed in an exciting way in such a way that students who take part in class X also continue to take STEP TP in class XI. However, based on the communication between SMAK Santo Hendriks Surabaya and the community service team from the Food Technology Study Program, Faculty of Agricultural Technology, Widia Mandala Surabaya Catholic University (FTSP FAT WMSCU) the teachers who are in charge of accompanying

STEP TP experiencing several problems in developing STEP TP. The problems arise due to the different educational backgrounds of the teachers who master chemistry and religion, thus limiting the teachers to understanding and explaining the concept of food technology and the food processing aspects. In addition, the teachers have not been equipped with teaching tools as guidelines for students in deepening the food technology materials. Therefore, the community service team from FTSP FAT WMSCU invited STEP TP at SMAK Santo Hendriks Surabaya to become a partner in enriching STEP TP learning methods through a community service activity. This community service aims to design teaching modules for teachers and assist students in food processing training in supporting STEP TP intracurricular development.

2. METHODS

The community service between Food Technology Study Program, Faculty of Agricultural Technology, Widya Mandala Surabaya Catholic University (FTSP FAT WMSCU) and STEP TP SMAK Santo Hendrikus Surabaya was held from January to June 2022 using a hybrid learning method. The hybrid learning method was chosen due to the government restriction regarding Covid-19, though the cases in Surabaya were starting to decrease. The hybrid learning method is a learning method that combines offline and online learning methods (Irawan et al., 2022). The hybrid learning method requires not only mastery of learning materials but also the ability to use technology (Utomo & Wihartanti, 2019), one of which is video conferencing, such as Zoom. The participants in this community service were students and STEP TP teachers. The community service began with the preparation stage of the activity, which included two activities namely focus group discussions (FGD) and a survey of students' interests and school facilities. Then, the core stage of the activity was the making of learning materials and also learning and practical activities (hybrid method). The final stage of the activity was the evaluation of community service. The flow chart of the community service activities is presented in Figure 1.

Figure 1. Flow chart of the community service activities

Focus Group Discussion (FGD)

The first activity was FGD with the partner using an online meeting application (Zoom). FGDs were conducted three times and attended by the school principal, two teachers, and the community service team. The purpose of the FGDs was to discuss about the school's condition and determine strategic and operational steps that would be taken to assist the school (Suparwoto, 2022). The role of the principal and STEP TP teachers in the FGDs was to provide information about STEP TP based on their knowledge and experience in mentoring and educating high school students. The first FGD was conducted to obtain information about the problems faced by the school and find solutions to the issues faced. The second FGD was held to determine the schedule for the making of learning modules and practical activities. The third FGD was the last meeting to check the enthusiasm of students and school facilities before the practical activities took place.

Survey of Students' Interest and School Facilities

According to the first FGD, the community service team sent a survey (Google Form) to be filled out by STEP TP students. The survey consisted of some questions related to food technology that students wanted to learn during community service. According to Rasam & Sari (2018), interest assessment in the form of surveys can show student tendencies related to awareness, attention, willingness, and enjoyment of certain subjects. The teachers also provided information about school facilities that can be used during community service. One of the school facilities used to support STEP TP activities was the practical kitchen. The condition of the practical kitchen can be seen in Figure 2.

The Making of Learning Materials

Learning media such as books, modules, videos, films, and so on are used to stimulate students' thoughts, feelings, attention, and abilities or skills so that it might improve the learning process (Setiawan & Karsinah, 2016). The making of learning materials (teaching modules and learning videos) was carried out in March-June 2022. The topics in the teaching modules were chosen according to the student interest survey. The teaching module was created in the form of pocketbooks (A6 sized). The community service team also provided some exercise books to help the students understand each topic during practical activities.

Figure 2. The condition of practical kitchen at SMAK Santo Hendrikus Surabaya

The production of learning videos began with orientation activities which were carried out by FTSP FAT WMSCU third-year students. The orientation was carried out to get a clear overview of the making of learning videos. The production of learning videos was carried out in April, while the editing process was carried out in June 2022. Teaching modules, exercise books, and learning videos were given to the school in April 2022. Moreover, teaching modules and learning videos that have been perfected were then given to the school in July 2022.

Learning and Practical Activities (Hybrid Method)

Practical activities were held four times from March to April 2022. The learning method used during the learning and practical activities was the hybrid learning method. The hybrid learning method is a method that combines face-to-face meetings with online meetings (Sari, 2021). The first meeting was held in the form of a guest lecture, the second meeting was held online in the form of talks from

the speaker to STEP TP students, and the third meeting was a practical activity that was carried out in the school's practical kitchen. The third meeting was held with strict health protocols, and students who participated must have permission from their parents. Students who did not have permission from their parents attended the meeting online via Zoom and did the practical activities at home. All the materials used during the practical activity were provided by the community service team, while students who practiced at home provided their own materials. The last meeting was held online via Zoom, which focused on the discussion between students and speakers about previous meetings.

Evaluation of the Community Service

At the end of community service, the team concluded some evaluations regarding the implementation, student understanding, and the outcome of the activity. Fortunately, there is no evaluation for the implementation of community service since the activity was held on time with the schedule agreed upon by the school. The student understanding was measured through a questionnaire that was distributed to STEP TP students at the last meeting. The questionnaire contained several questions on the student's knowledge of food technology before and after attending lectures and practical activities. The outcome of the activities was handing the perfected learning materials (teaching modules and learning modules) to the schools.

3. RESULT AND DISCUSSION

Focus Group Discussion (FGD) and Survey of Students' Interest

The FGD activity was attended by the UKWMS FTP community service team, the principal of SMAK Santo Hendrikus Surabaya, and two teachers supervising STEP Food Technology (STEP TP) activities. Information from the first FGD was about the development of STEP TP and activities carried out before and during the Covid-19 pandemic. SMAK Santo Hendrikus Surabaya initiated STEP TP in 2019 with participants from class X and XI students from science and social classes. In the academic year of 2021/2022, there were 23 students took STEP TP. Two teachers are assigned to develop STEP TP. One of the teachers have basic science of food chemistry. The role of the accompanying teacher is to design learning activities and as a facilitator of activities at each STEP TP meeting. The design of STEP TP learning activities is prepared by the accompanying teacher creatively and flexibly so that students are interested in participating in the program. Explanation of the STEP TP activity plan to students is carried out at the first meeting at the beginning of each semester. STEP TP activities are conducted every Wednesday (16 times) per semester.

STEP TP activities for each semester consist of six main activities as follows: explanation of material according to the topic presented in the activity plan, practicum about topic based on the material that has been explained, presentation of the results of the practical activity, guest seminar by experts, field trip to campus or factory, and year-end project as a closing for STEP TP activities at the end of the semester. The three main activities, namely material explanation, practical activity, and presentation of the result of practical work are interrelated and raise one main topic. The other three activities are independent or not related to other activities. During the Covid-19 pandemic (2020-2021), the STEP TP activities took place online via Zoom. If there are practical activities, students were instructed to work at home with materials available around the house. The duration of the weekly meeting is 60 minutes, while practical activity is 90 minutes.

In the first FGD, the STEP TP accompanying teacher informed the guest lecture plans and the difficulties experienced in giving topics to students, mainly related to practical activities. The result of the first FGD was an agreement to conduct a guest lecture with speakers from FTSP FAT WMSCU lecturers. Previously, the topics conveyed by the STEP TP accompanying teacher to students came from Youtube videos, blogspot, or information from the internet websites, due to the unavailability of a module used for STEP TP activities. Therefore, one of the outputs resulting from this community service activity was a teaching module that can be used for conducting STEP TP activities in the following years.

The student interest survey was conducted after the first FGD activity. The survey results showed that the topic most interested in by STEP TP participant students was the processing of bread and cake, followed by beverage processing such as jelly drinks. The results of the student interest survey are presented in Figure 3. After obtaining these results, the community service team conducted a second FGD to plan a schedule for implementing activities. In the second FGD, the community service team and the school discussed plans for practical work to be carried out in STEP TP. The school principal proposed the topic of processing bread and cake from pumpkin. This topic was then approved to be carried out. The raw material for bread and cake processing is flour, so it is necessary to know how to make pumpkin flour before pumpkin flour using for bread and cake processing. Therefore, the main topic that was carried out for the STEP TP meeting after the guest lecture was pumpkin flour processing technology.

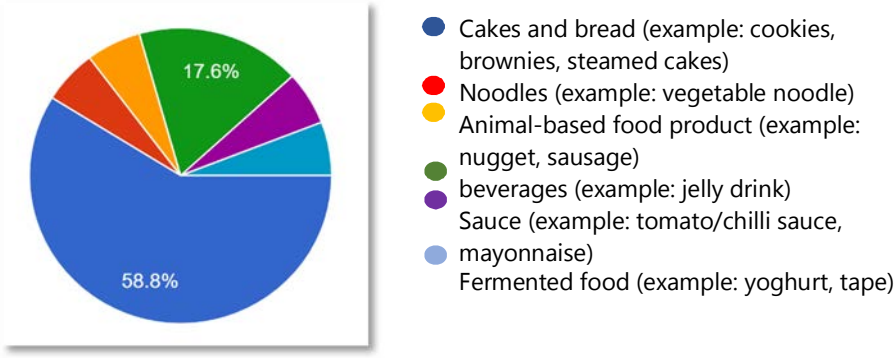

Figure 3. The results of the STEP TP participant student's interest survey

The implementation of community service activities was carried out every Wednesday, from the end of March to April 2022 with four effective weeks due to a national holiday in early May and the limitation of the active learning period for high school students that have finished in mid-May 2022. Therefore, the topic of jelly drink processing drink was not carried out in the STEP TP that semester and will be presented at the STEP TP meeting in the coming academic year. The activities and objectives of each meeting during community service activities are presented in Table 1.

The third FGD discussed the preparation of practical activities using the hybrid method. After that, the STEP TP accompanying teacher informed the parents of the students regarding the things that needed to be prepared if students carried out STEP TP practice activities at home. Students who participated in practical activities at school were required to obtain a statement containing permission from their parents to carry out activities during laboratory activities and comply with health protocols. The accompanying teacher also prepared a room for practice as well as tools and materials for laboratory activities.

Table 1. Activities and objectives of the meeting on the implementation of community service activities with partner schools

Meeting 1	
Activiy	Guest lecture on the topic of Food Packaging Design
Purpose	Explain the importance of food packaging, the types and functions of various food packaging, and the things that need to be included in food packaging.
Meeting 2	
Activiy	Lecture on Pumpkin Flour Technology
Purpose	- Provide knowledge about flour technology, including materials for making flour, the steps for making flour, and the factors that influence the stages of making flour. - Explain technically the practical activities carried out at the next meeting.
Meeting 3	
Activiy	Practical activity on Blanching Yellow Pumpkin
Purpose	Understand the effect of the thickness of the pumpkin pieces, the type of heating, and the heating time on the texture of the pumpkin pieces after the blanching proces
Meeting 4	
Activiy	Discussion about the results of laboratory activities and materials on the Application of Yellow Pumpkin Flour in food processing.
Purpose	- Questions and answers regarding the results of practical activities - A brief description of the application of pumpkin flour for bakery and cake products

The Making of Learning Modules and Videos

The learning modules were prepared by the lecturer from FTSP FAT WMSCU and the community service team. There were two topics learning modules, i. e. pumpkin flour processing technology and butterfly-pea flower jelly drink processing technology. These two modules were used as guidelines for teachers in providing information to students before implementing topics in practical activities. The community service team packed the learning modules in the form of a pocketbook. According to Siwiendrayanti et al. (2019), a pocketbook is simple, can be read repeatedly without taking up much time to read, can be lent to families, and can be read without the need for any electronic aids. The appearance of the pocketbook is presented in Figure 4.

Figure 4. Pocketbooks

The learning module on processing technology for pumpkin flour reviews the meaning of flour, the process of blanching raw materials and drying, general information about pumpkin as a commodity

for making flour, and the stages of processing pumpkin flour. Yellow pumpkin was chosen to be used as flour because the amount is very abundant in Indonesia. Making fruits or vegetable flour provides many benefits, including reducing storage volume, weight, and packaging, being easier to apply in processing, being easy to transport and distribute, and having a longer shelf life than in fresh form (Mittal et al., 2019). The learning module topic of butterfly-pea jelly drink processing technology will be delivered at the STEP TP meeting in the coming semester.

There are two learning videos produced from community service activities with the same title as the topic of the pocketbook, namely pumpkin flour processing technology (https://youtu.be/bPLekyIOPMs) and butterfly-pea flower jelly drink (https://youtu.be/GvsJxDgt8Ao). These 3-4 minutes videos are effective learning media for STEP TP students because the animation and visuals of the images can motivate students to learn. Nurdewanto et al. (2018) stated that learning videos can clarify the meaning of teaching materials so that students easily understand them. The benefits of video learning are as a tool that can be used to stimulate students' thoughts, feelings, and willingness to learn through displaying ideas, messages, or audio-visual information, and to support the gain of the expected qualified learning.

Guest lecture, course delivery, and Hybrid Practice Activity

This community service was integrated with STEP TP activity during the even semester 2021/2022. The first meeting was delivered as a guest lecture and held with Zoom online platform. The topic was food storage and packaging technology, especially food packaging design. The speaker was a lecturer from the FTSP FAT WMSCU who taught the same courses as the delivered topic. Therefore, the speaker could provide scientific understanding to the student accurately and attractively. Many students asked about the material of lessons until the actual application of food packaging design. This event was conducted on 30 Maret 2022 from 12.00-1.30 PM and attended by the team of community services, the principal, the teacher who supervised STEP TP, and 23 students as participants of STEP TP. Documentation about the guest lecture activity is shown in Figure 5.

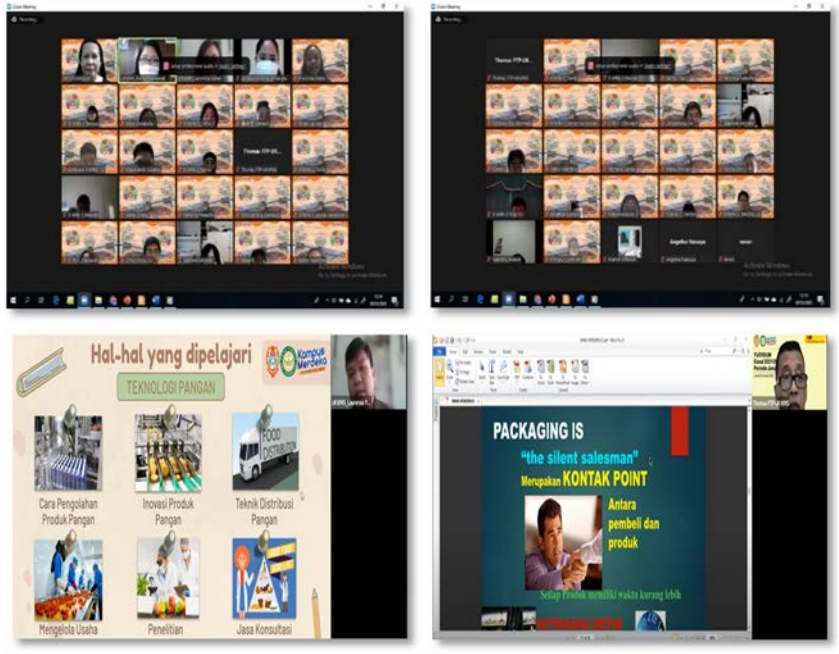

Figure 5. Guest lecturer activity conducted online by Zoom platform

The second meeting was also delivered online, and the topic was the technology processing of yellow pumpkin flour. The learning tool used was slide presentations and files shared with the students. The activity was held on 6 April 2022 for 60 minutes. The speaker was a lecturer of Plant-based Product Processing Technology and Technology Processing of Bread and Cake courses; thus, the delivery of yellow pumpkin flour processing technology can be systematically elaborated from the aspect of science and technology. Discussion time was held after the topic was presented.

The third meeting was a practicum activity about blanching the yellow pumpkin. The students did the practicum according to practicum guidelines arranged by the community service team from the second meeting. The accompanying teachers and the team shared tasks to guide the students, either those who came directly to the school or online via the Zoom platform. This event was performed on 13 April 2022, and the documentation during the activities can be seen in Figure 6 and Figure 7. Two students from FTSP FAT WMSCU assisted the practicum in the school attended by 10 participants of STEP TP, whereas the other 11 participants independently did the practicum at home and were supervised by the teacher through the Zoom platform. Three treatments were executed comprising the different sizes of yellow pumpkin slices (2 and 4 cm), different blanching methods (steam blanching and water blanching), and different heating duration (1 and 3 minutes).

Figure 6. Online practicum supervision by Zoom (left), kitchen room to carry out practicum activity (center), and explanation from the teacher of STEP TP before practicum (right)

The students examined the condition of the yellow pumpkin slice and the water qualitatively after blanching. The criteria for yellow pumpkin slices consist of performance, texture, the intensity of the yellow color, and the intensity of the flour's taste. At the same time, water condition was determined through the intensity of transparency and color of the water. The speaker also explained how to fill out the guidelines book for the practicum activity. Furthermore, the student could complete the experiment table in that book. The enthusiasm from the students described that they were enjoying the activity.

Figure 7. The result of the yellow pumpkin slice and water condition with different blanching methods (left), brief explanation from the speaker to complete the practicum form (center), and documentation after practicum activity (right)

The result of the practicum indicated there were differences between two methods of blanching due to both direct and indirect contact between heat and the yellow pumpkin slice. Nevertheless, both methods used the same principle, heat transfer. Generally, water blanching was a pre-treatment to inactive the enzyme which decreased the freshness of food during storage (Oshima et al., 2021). In addition, water blanching decreased carotenoid from yellow pumpkin bigger than steam blanching, hence, water from the water blanching looks cloudier than steam blanching (Mashiane et al., 2021). Water's color and texture of yellow pumpkin slice also influenced the duration of blanching.

The last meeting was also conducted online via Zoom for 60 minutes. The agenda was a discussion about the result of the practicum in the previous meeting. The speaker was informed that yellow pumpkin flour could be added to the formulation of bread, cake, and other food products. Learning video about how to make yellow pumpkin flour also played. The video, which has a duration of 3.5 minutes, helped the students understand the effect of different blanching methods on the characteristics of yellow pumpkin flour. One of the scenes in the learning video showed the different colors of yellow pumpkin flour with two blanching methods and documentation during the discussion depicted in Figure 8. The color of yellow pumpkin flour from water blanching was brighter than steam blanching due to the degradation of the carotenoid during heating.

Figure 8. One of the scenes in the learning video about the technology processing of yellow pumpkin flour (left) and documentation for the last meeting (right)

Evaluation Activity and School's Contribution

Evaluation activity is a summary of all of the events that were conducted during community services and aimed to evaluate the understanding of student concepts about the topics. There are three goals for this community service: (1) All of the agenda was conducted regarding the schedule agreed upon with the school as a partner; (2) Students can understand all delivered topics (technology processing of yellow pumpkin flour, practicum activity about blanching, and discussion of the practicum result, including playing the learning video). The development of the percentage of students' ability to understand each topic depicts in Figure 9; (3) The output of these community services had learning tools (module and video) and journal articles that informed STEP TP at SMAK Santo Hendrikus Surabaya wider toward society.

The output of this activity could be fulfilled with the contribution of SMAK Santo Hendrikus Surabaya as a partner. Many factors have influenced an event's success story, such as speakers' competencies, good services for providing material and equipment during the event, and enthusiasm from all participants that enjoy the activities (Rahayu & Hayati, 2020). The students of SMAK Santo Hendrikus Surabaya showed their enthusiasm in each meeting, especially on practicum day. Practicum can help students understand the material with fun and real things they can do. Teachers swiftly facilitate

and support the community services team using a hybrid method; thus, students can receive assistance both online and offline. The principal and teacher have supported the implementation of community services activities by providing ideas and suggestions that are informative and open-minded regarding the topics of activities and plan of implementation. The output of this community service was print-out modules and learning videos given to partners to be used in STEP TP activities ahead.

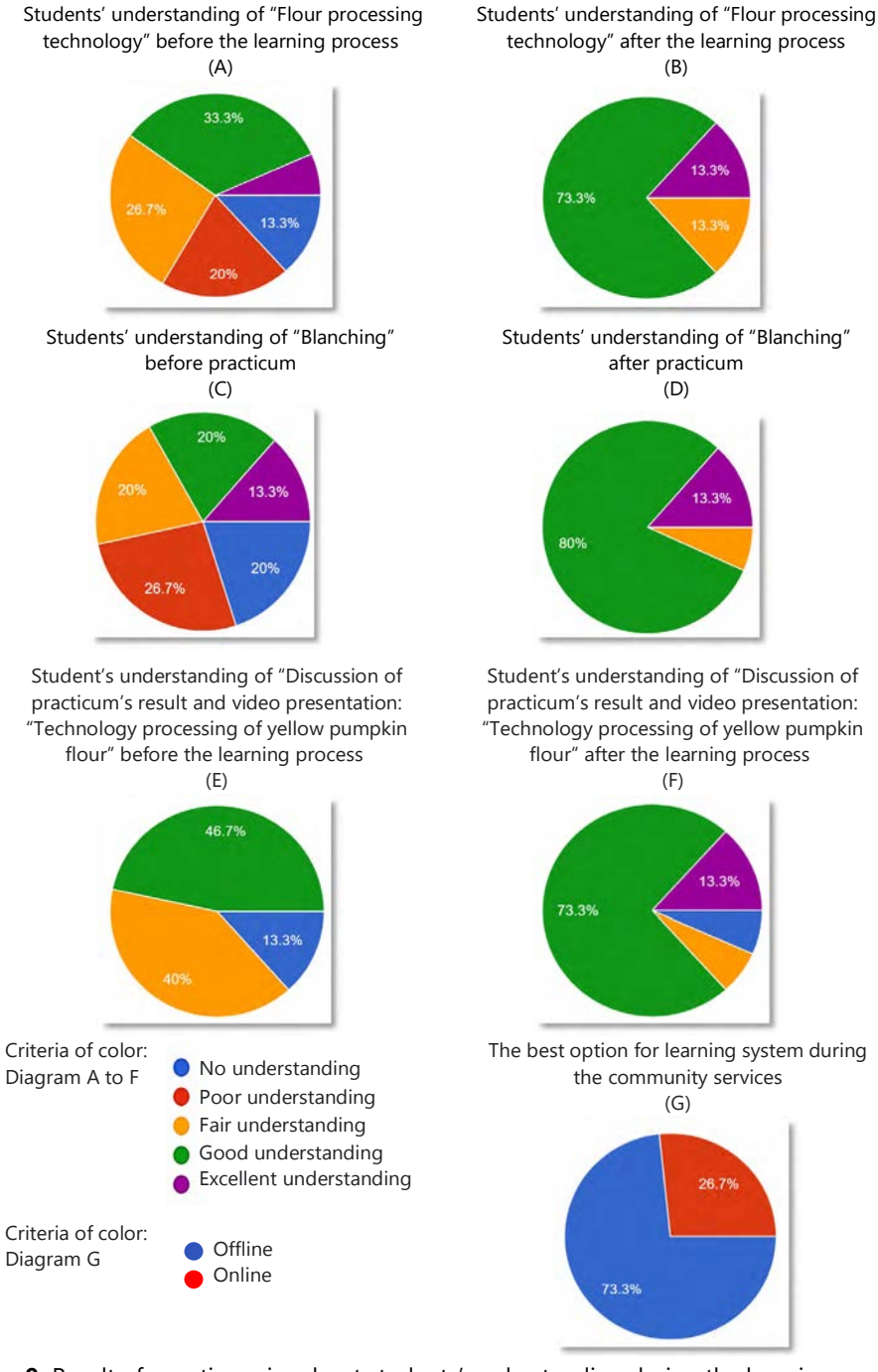

Figure 9. Result of questionnaire about students' understanding during the learning process

4. CONCLUSION AND RECOMMENDATIONS

The student and teacher empowerment program in food technology (STEP TP) at SMAK Santo Hendrikus Surabaya needed to develop collaboration with partners that own science competencies to optimize the learning process and enhance students' interest in food technology. This community service acted as a bridge for long-term cooperation for STEP TP development. Students interested in food technology can follow this program every year, and the teacher can arrange the learning meeting plan more creatively based on adequate food technology literation. During the community service, various activities have been carried out in STEP TP, such as guest lectures, online FGD, hybrid practicum, and learning tools (module and video) production that helped students better understand the topic. The topic of food technology learned by students in this community service activity is the processing technology of yellow pumpkin flour to be further applied to food products. Teaching modules and videos have been produced and arranged based on the two topics selected by students and given to the school as a partner. The practicum of one of the topics, processing technology of jelly drinks, could not be realized and will be delivered in the next semester of STEP TP's meeting. SMAK Santo Hendrikus as a partner, showed enthusiasm, good communication, and promote in providing information to support the smooth running of the community service activities.

These community service can be realized and implemented optimally when partners inform academic calender each other and hold FGD early. Moreover, there should explore to enhance students' enthusiasm when activities are delivered online via the Zoom platform. The frequency of offline practicum can be added to attract the students and answer their curiosities about food technology.

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