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Development of Coffee Sensory Technology to Support Coffee Cupper Skills Training for Deaf People

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ABSTRACT: Learning skills models for children with special needs (ABK) in recent years have been widely developed. The model is oriented towards the development of self-help skills and vocational abilities (economic skills) so that ABK can achieve independence of adaptability. In addition to being able to serve coffee, a barista must have the skills to recognize, differentiate and compare types of coffee products. The purpose of this study is to develop supporting technologies in the formation of coffee sensory skills for deaf people. This type of research is developing supporting facilities in the form of array technology of sensory sensors as work electrodes, reference electrodes, data acquisition systems, and artificial intelligence (AI) systems that connect to computers or Android smartphones wirelessly. Technology trials were conducted on 20 deaf people under the auspices of the AORA special education and skills institute. The technology developed is tailored to the needs of various types of identical flavors in coffee such as bitter, salty, sour, sweet, and savory. The target of achieving RIIM's target product from this research activity is to create coffee sensory technology to support barista training for deaf people in AORA's special education and skills institutions. Research outputs other than appropriate technology, activity reports, product patents, tool use modules and reputable international journals.

KEYWORDS: Children with special needs, Coffee sensory skills, Deafness, Technology

1. INTRODUCTION

The unemployment rate in Indonesia is still relatively high. This correlates with job opportunities that are still narrow. Job opportunities are not able to accommodate school and university graduates to the maximum. As a result, the open and hidden unemployment rate is still high. The unemployment rate in Indonesia fluctuates, along with government programs that also experience changes in reducing unemployment [1], [2]. One of the vulnerable groups who do not find work and become unemployed is the disabled, including the deaf. Most of them become unemployed and depend only on their parents and families for their livelihood [3], [4].

Rehabilitation centers for people with disabilities are already available in several cities in Indonesia but programs implemented by the central or local governments have not been successful, not representing the voices of deaf children. The lack of success can be seen from the understanding and change in behavior of deaf children after participating in empowerment programs or activities organized [5]. In some cases, programs for the deaf are often still considered untargeted or failing. The failure referred to in this case is that community empowerment is not carried out according to expectations and the goals of empowerment carried out are not achieved [6].

The use of supporting technology in skill formation for deaf people is an important aspect that currently cannot be considered trivial [7]. A person with unarungu impairment experiences a deficiency or loss of the ability to hear either partially or wholly due to partial or complete damage to his or her hearing apparatus [8]. Even though as someone who has physical and sensory deficiencies, they definitely need special facilities and infrastructure to help the adaptation process.

One potential skill that can be taught is training to be a barista. A barista must have coffee cupper skills that are useful for sensitivity to recognizing, differentiating and comparing coffee products [9]. The distinctive taste and aroma of coffee is an important parameter used to classify and differentiate the types and qualities of various coffees [10], [11], [12], [13]. Several technologies were developed to be able to classify sensory on the scent of materials [14], [15] and rasa [16], [17].

Coffee is a popular beverage all over the world and has become a huge industry. Improving coffee quality is very important to achieve customer satisfaction and increase market competitiveness [18]. One important factor in improving coffee quality is the ability to detect and distinguish the flavor, aroma, and flavor of coffee. This ability is known as Coffee Sensory Skills. However, not everyone has this ability naturally. In fact, individuals with hearing loss or deafness may struggle in exercising coffee's sensory

abilities [19]. Therefore, it is necessary to develop assistive technology that can assist deaf individuals in practicing coffee sensory skills. In Indonesia, there is an AORA Special and Training Institute that provides training and certification in the field of coffee. Therefore, this study aims to develop coffee sensory technology as a support for coffee cupper skills training for deaf people in special institutions and AORA training. Thus, this research is expected to provide benefits for deaf people in improving their coffee sensory abilities and assist them in obtaining cupper coffee certification. By utilizing taste detection technology based on electrical sensors, it will certainly greatly help deaf people to master the sensory abilities of coffee. Based on the description above, the formulation of the problem in this study is

1. How can coffee sensory technology be developed to support coffee dinner skills training for deaf people in AORA specialty and training institutions?
2. How effective is coffee sensory technology as a support for coffee cupper skills training for deaf people in specialized institutions and AORA training?
3. What are the supporting and inhibiting factors in the application of coffee sensory technology for deaf people in AORA specialized and training institutions?The purpose of the research with the topic "Development of Coffee Sensory Technology as Support for Coffee Cupper Skills Training for the Deaf Community at the AORA Special and Training Institute" is to develop coffee sensory technology as a support for coffee cupper skills training for deaf people at AORA Special and Training Institutes. This study aims to improve the ability of deaf people in classifying and recognizing the quality of coffee through the sense of smell by utilizing coffee sensory technology. With this technology, it is expected to increase the chances of deaf people in getting jobs in the coffee sector and improve their quality of life [20].

Coffee is one of the agricultural products that has high economic value. Good coffee quality is an important factor in determining the selling price of coffee. Therefore, in the coffee industry, the ability to evaluate the quality of coffee becomes very important. Coffee sensory skills are the ability to evaluate the quality of coffee using the senses of smell, taste, and sight. According to the Specialty Coffee Association (SCA), coffee sensory skills are the ability to evaluate coffee quality by using the senses of smell, taste, and sight to identify coffee characteristics related to aroma, taste, sourness, body, and aftertaste [21]. This ability is crucial in assessing coffee quality and ensuring consistency of quality over time.

CSS is usually trained through coffee feeding skills training, which involves introducing coffee from different regions, processing methods, and maturity level [22]. The training also involved sensory trials on coffee samples and recognition of different coffee characteristics. However, individuals with hearing loss or hearing loss often face difficulties in developing the sensory abilities of coffee [23]. Therefore, assistive technology is needed that can help improve the sensory ability of coffee in individuals with hearing loss or hearing loss, so that they can attend CSS training and get certified [24] Coffee sensory technology is a possible solution, and is currently being developed to help improve the sensory abilities of coffee in individuals with hearing loss or hearing loss [25].

Coffee sensory technology is a technology developed to help improve the sensory abilities of coffee in individuals with hearing loss or hearing loss. The technology uses sensors and software to assist individuals with hearing loss in evaluating coffee quality. Some types of coffee sensory technology that have been developed include:

1. Visual technology: This technology uses images and graphics to help individuals understand the sensory characteristics of coffee such as aroma, taste, and aftertaste. Examples of visual technology used in coffee grading are assessment papers or sensory cards.
2. Vibration technology: This technology utilizes vibrations generated from coffee cups to help individuals feel the sensory characteristics of coffee. The device used is usually a coffee cup equipped with a vibration sensor and software that can produce vibrations according to the desired coffee characteristics.
3. Electrochemical technology: This technology uses electrochemistry to evaluate the sensory characteristics of coffee such as acidity and sugar content. The device used is usually an electrochemical sensor mounted on a coffee acidity measuring device.

Coffee sensory technology can help individuals with hearing loss or hearing loss to understand the sensory characteristics of coffee, so that they can engage in CSS training and get certified. However, this technology can also be a solution to improve the efficiency and accuracy of sensory assessment of coffee in individuals without hearing loss or hearing loss. Deaf people are individuals who experience total or partial hearing loss [26]. This condition can affect an individual's ability to communicate and interact with the surrounding environment, including in terms of recognizing the aroma and taste of coffee. However, this does not prevent them from learning and developing their sensory abilities.

Coffee sensory skills training is training that aims to improve individual sensory abilities in recognizing the aroma, taste, and aftertaste of coffee [27]. This training is very important for professionals in the coffee industry, such as coffee cuppers, to produce quality coffee and according to consumer tastes. However, this training is also beneficial for ordinary individuals who want to improve their knowledge of coffee. Deaf people often face difficulties in developing coffee's sensory abilities, especially in terms of aroma and taste identification. This can be an obstacle in undergoing coffee sensory skills training that requires good sensory skills.

However, some studies suggest that individuals with hearing loss can develop their sensory abilities through exercise and the use of assistive technology [28]. Coffee sensory technology is a technology developed to help improve the sensory abilities of coffee in

individuals with hearing loss or hearing loss. This technology is designed to help individuals with hearing loss identify the aroma, taste, and aftertaste of coffee more easily and accurately. These technologies can include the use of specialized software, apps, or hardware that helps individuals with hearing loss in recognizing the aroma and taste of coffee more clearly and precisely.

In recent years, coffee sensory technology has evolved and is used in the coffee industry. This technology can help increase efficiency in the process of sensory testing of coffee and ensure consistency in the quality of coffee produced. In addition, this technology can also help individuals with hearing loss to get involved in the coffee industry and develop their sensory abilities. This research aims to develop coffee sensory technology to support coffee dinner training for the deaf at AORA Special and Training Institutes. By using sensory coffee technology, it is hoped that individuals with hearing loss can more easily and accurately identify the aroma and taste of coffee, so that they can attend CSS training and get certified. In addition, this research is also expected to contribute to the development of coffee sensory technology in supporting individuals with hearing loss in the coffee industry.

2. METHODS

Research Design

This study used a quasi-experimental research design. This design was chosen because it was not possible to randomize participants in the study, because the participants in this study were students who had hearing loss and were attending training at the AORA Surabaya Training and Special Center. Therefore, this study used a control group as a substitute for participant randomization.

In the quasi-experimental design, participants were divided into two groups: a control group and an intervention group. The control group received standard treatment or received no treatment at all, while the intervention group received the same treatment. In this study, the control group will receive training in coffee sensory skills with conventional methods, while the intervention group will get training in coffee sensory skills using coffee sensory technology that has been developed. Once the training is complete, both groups will be assessed based on their ability to identify the aroma and taste of coffee.

Data will be collected through post-intervention tests, which will be conducted after training is completed. Post-intervention tests will consist of aroma selection tests and coffee taste identification tests. The aroma selection test will involve 5 different coffee aroma samples, while the coffee flavor identification test will involve 5 different coffee samples with predetermined flavors. Participants will be asked to select a scent or identify a flavor in each sample, and the time taken and accuracy of the answers will be recorded. Data analysis will use a t-test to compare the ability to identify coffee aroma and taste between the control group and the intervention group.

Population and Sample

The population in this study was students who attended coffee sensory skills training at Balai Diklat and had hearing loss. The sample in this study was selected by purposive sampling, namely students who have certain inclusion and exclusion criteria. The inclusion criteria for study participants are students who:

1. He has attended coffee sensory skills training at AORA Surabaya Special Institute and Training
2. Have hearing loss
3. Give consent to participate in the study

While the criteria for exclusion of research participants are students who:

1. Absence from coffee sensory skills training
2. Not giving consent to participate in this study

The number of samples in this study was 20 students. Sampling was carried out by inviting all students who met the inclusion criteria and did not meet the exclusion criteria to participate in this study. Once explained about the objectives and procedures of the study, students willing to participate will be asked to give written consent. If the number of students willing to participate exceeds the required number of samples, a random selection is carried out to select the samples to be included in the study.

Research Instruments

There are two types of instruments used in this study, namely pre-test instruments and post-test instruments. Pre-test instruments were used to collect preliminary data on students' coffee sensory skills prior to the intervention. The pre-test instruments used in this study were taste test and olfactory test. The taste test is carried out by randomly providing coffee samples and students are asked to know the type of coffee and the taste characteristics contained in the coffee sample. While the olfactory test was carried out by giving several coffee aromas and students were asked to identify the aroma of coffee given [29].

Post-test instruments are used to collect data after the intervention. The post-test instruments used in this study are taste tests and olfactory tests which are the same as pre-test instruments. The validity of the instrument is carried out using the content validity method. The validity of the content is carried out by asking experts in the field of coffee sensory skills and special education to evaluate the suitability of the instrument to the research objectives. While the reliability of the instrument is done by testing the instrument to several students before the actual data collection is carried out, then the results of the trial are calculated using the Cronbach alpha formula. The reliability of the instrument is said to be good if the alpha cronbach result reaches 0.7 or more [30].

3. DATA ANALYSIS

Data analysis is carried out using several analysis techniques, including:

1. Descriptive Statistics
   Descriptive analysis techniques are used to describe data numerically through statistical calculations such as mean, median, and mode. This technique is used to provide an overview of data characteristics, including data distribution and the level of variability [31].
2. Normality Test
   The normality test is used to test whether the data obtained has a normal distribution or not. The normality test used is the Shapiro-Wilk test [32].
3. Uji T-Test
   The t-test was used to test for significant differences between the two groups. In this study, the t-test was used to test significant differences between students' coffee sensory skills before and after the intervention [33].
4. Regression Analysis
   Regression analysis is used to test the relationship between two or more variables [34]. In this study, regression analysis was used to examine the relationship between the use of coffee sensory technology with the improvement of students' coffee sensory skills.

4. RESULT

Table 1. Paired Sample T-Test

Measure 1		Measure 2	t	Df	p
CSS- Pre	-	CSS-Post	-20.193	19	<.001

Note. Student's t-test.

Paired Samples T-Test is a statistical method used to compare the average of two paired samples or paired data from the same population. In the table above, Measure 1 shows the value of coffee sensory skills before the intervention, while Measure 2 shows the value of coffee sensory skills after intervention using coffee sensory technology [35]. The results of the t test showed that there was a significant difference between the value of coffee sensory skills before and after the intervention, with a t value of -20,193 and df of 19. The p-value obtained was less than 0.001, which means that the difference between the value of coffee sensory skills before and after the intervention was statistically significant [36]. Therefore, it can be concluded that coffee sensory technology used in coffee sensory skills training has a positive influence on improving coffee sensory skills in students with hearing impairment.

Table 2. Test of Normality (Shapiro-Wilk)

	W	p
CSS- Pre - CSS-Post	0.915	0.079

Note. Significant results suggest a deviation from normality.

Test of Normality (Shapiro-Wilk) is a statistical method used to determine whether the data obtained from a sample has a normal distribution or not [37]. In the table above, the W value shows the normality test results from the coffee sensory skills ability value data before (CSS-Pre) and after (CSS-Post) intervention using coffee sensory technology. The p values obtained are 0.915 and 0.079 for CSS-Pre and CSS-Post respectively. Since the p-value obtained is greater than 0.05 (alpha level used), there is not enough evidence to reject the null hypothesis that the data are normally distributed. Therefore, it can be concluded that the data on coffee sensory skills before and after the intervention have a normal distribution. However, it should be noted that if the p value obtained is smaller than 0.05, then it can be said that the data is not normally distributed or has a deviation from normality.

Table 3. Test Results Descriptives

	N	Mean	SD	ONE	Coefficient of variation
CSS-Pre	20	2.955	0.303	0.068	0.103
CSS-Post	20	3.995	0.327	0.073	0.082

Descriptives is a statistical method used to provide descriptive information about data obtained from samples [38]. In the table above, there is descriptive information about coffee sensory skills ability data before (CSS-Pre) and after (CSS-Post) intervention using coffee sensory technology. N indicates the number of samples taken, Mean is the average of the data, SD is the standard deviation from the data, SE is the standard error used to measure the uncertainty of the sample, and the Coefficient of variation is a statistical measure that shows how much variability the data has in percentage.

From the results of the table above, it can be seen that the average value of coffee sensory skills before the intervention (CSS-Pre) was 2,955 with a standard deviation of 0.303, while after the intervention (CSS-Post) the average value of coffee sensory skills increased to 3,995 with a standard deviation of 0.327. In addition, it can be known that the SE for CSS-Pre and CSS-Post is 0.068 and 0.073 respectively. The coefficient of variation for CSS-Pre is 0.103, while for CSS-Post it is 0.082, which indicates that CSS-Post data has lower variability compared to CSS-Pre data.

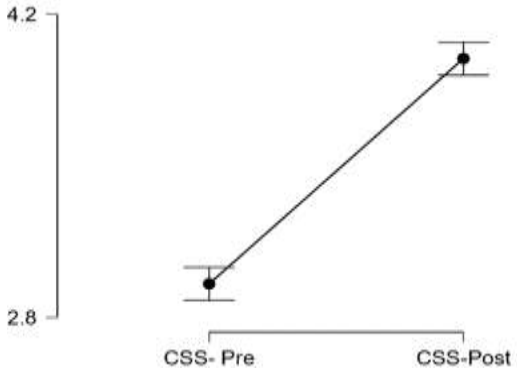

Figure 1. CSS Pre- CSS Post

The figure shows the Descriptive Plots of CSS (Coffee Sensory Skills) value comparison between pre-intervention and post-intervention conditions. The plot shows the distribution of CSS values in both conditions, and also shows the mean, standard deviation (SD), and coefficient of variation in each condition. In this plot, it can be seen that the average value of CSS increases after the intervention, and the distribution of CSS values in the post-intervention conditions looks more homogeneous than in the pre-intervention conditions.

Regression Test Results

Table 4. Model Summary - CSS Skill (Y)

Type	R	R^2	Adjusted R^2	RMSE
H_0	0.000	0.000	0.000	0.739
H_1	0.969	0.939	0.936	0.187

Model Summary shows the results of evaluating the suitability of a simple linear regression model used to analyze the relationship between independent variables (coffee sensory technology) and dependent variables (CSS skills) in existing data samples.

In the H_0 Model, the values of R and R^2 are 0.000, which indicates no correlation or relationship between the two variables. While in the H_1 Model, an R value of 0.969 indicates that there is a very strong correlation between coffee sensory technology and CSS skills, and an R^2 of 0.939 explains that variability in CSS skills can be explained by 93.9% by coffee sensory technology. In addition, an Adjusted R^2 of 0.936 indicates that the regression model has a good match in explaining the relationship between the two variables.

The Root Mean Square Error (RMSE) in the H_0 Model of 0.739 indicates that the mean prediction error in the model is 0.739. While in the H_1 Model, an RMSE of 0.187 indicates that the average prediction error in the model is lower, so the model can be used to predict CSS skills more accurately.

Table 5. Collinearity Diagnostics

Type	Dimension	Eigenvalue	Condition Index	Variance Proportions (Intercept)	Variance Proportions TCS(X)
H_1	1	1.976	1.000	0.012	0.012
	2	0.024	9.110	0.988	0.988

Note. The intercept model is omitted, as no meaningful information can be shown.

Collinearity Diagnostics is a technique used to evaluate how much the relationship between variables in a regression model [39]. In the Variance Proportions table, there is information about the dimensions, eigenvalue, and condition index of the regression model tested.

The dimension indicates the number of independent variables in the model. Eigenvalue indicates the proportion of variation in data that can be explained by each dimension. The condition index indicates how strong the relationship between variables in the model is, where the higher the value, the higher the level of multicollinearity between variables. In the table, it can be seen that there is only one dimension in the H_1 model, with an eigenvalue of 1.976. The condition index is valued at 1,000, which indicates there is no significant multicollinearity in the model. Variance proportions also show that the two variables in the model, namely (Intercept) and TCS (X), have a balanced contribution in explaining variation in the dependent variable.

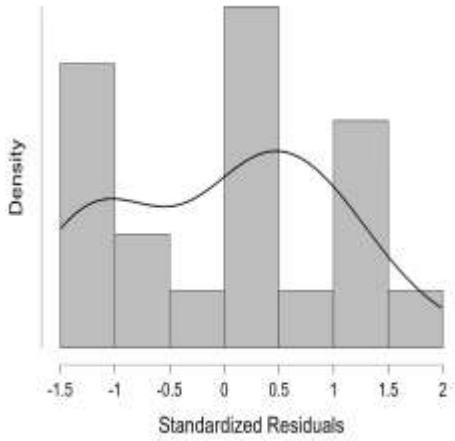

Figure 2. Standardized Residuals Histogram

Standardized Residuals Histogram is a frequency distribution graph of standardized residuals. Residual itself is the difference between the actual value of the dependent variable and the value predicted by the regression model. Stadardized residuals are usually obtained by dividing the residual by the standard deviation of the residual. This histogram is used to evaluate whether the residuals of the regression model have met the normality assumption. If the histogram shows a normally distributed residual distribution with a bell-like shape, then the normality assumption is met and the regression model is reliable. However, if the histogram shows an abnormal residual distribution or tends to skew, then the regression model needs to be reevaluated or adjusted.

5. DISCUSSION

In this study, the main objective is to find out how coffee sensory technology can be developed to support coffee cupper skill training for deaf people in special institutions and AORA training and how effective this technology is as a support for coffee cupper skill training for deaf people in special institutions and AORA training. In addition, this study also aims to identify supporting and inhibiting factors in the application of coffee sensory technology to deaf people in special institutions and AORA training.

In its discussion, this study takes a regression analysis approach to analyze the effectiveness of using coffee sensory technology as a support for coffee cupper skill training for deaf people in special institutions and AORA training. The results of regression analysis showed that there was a significant relationship between the supporting variables of coffee cupper skill training with the improvement of CSS skills in deaf people in special institutions and AORA training. This indicates that coffee sensory technology can be an effective support in improving coffee cupper skills in deaf people.

In addition, this study also identified supporting and inhibiting factors in the application of coffee sensory technology to deaf people in special institutions and AORA training. Supporting factors include support and motivation from the institution, easy access to sensory coffee technology, and the availability of training and assistance from experts. While inhibiting factors include limited resources and budget, lack of awareness and understanding of the importance of using sensory coffee technology, and lack of technical skills and accessibility for deaf people.

Based on the results of the discussion above, this study concludes that coffee sensory technology can be developed to support coffee cupper skill training for deaf people in special institutions and AORA training with significant effectiveness. However, the development of this technology also requires better support and efforts from the institution, as well as better awareness and understanding from deaf people about the importance of using coffee sensory technology as a tool in improving coffee cupper skills. Therefore, this study recommends that institutions can improve accessibility and training on sensory coffee technology, as well as increase understanding and awareness of the importance of using this technology as a tool in improving coffee cupper skills in deaf people in special institutions and AORA training.

6. CONCLUSION

Based on the regression analysis conducted, it can be concluded that there is a significant positive relationship between the development of coffee sensory technology and the improvement of coffee cupper skills in deaf people at AORA Special and Training Institutes. The regression model used has an R^2 of 0.939 and an Adjusted R^2 of 0.936, showing that the variable of coffee sensory technology development is able to explain 93.6% of the variability of increasing coffee cupper skills. The value of the TCS regression coefficient (X) of 0.044 shows that every increase in one unit of coffee sensory technology development will be followed by an increase of 0.044 units in the increase in coffee cupper skills.

Analysis of collinearity diagnostics showed that there was no multicollinearity problem in the regression model used. From the results of the ANOVA test, a significance value of < 0.001 was obtained, indicating that the regression model used was statistically significant. In addition, the histogram standardized residuals showed that the residual model had a normal distribution with a mean of 0 and a standard deviation of 1, indicating that the regression model used was quite good in modeling the relationship between the variables of coffee sensory technology development and the improvement of coffee cupper skills in deaf people at AORA Special and Training Institutes. Therefore, it can be concluded that the development of coffee sensory technology is an effective support in improving coffee cupper skills in deaf people at AORA Special and Training Institutes.

Suggestion

As a suggestion from the topic "Development of Coffee Sensory Technology as a Support for Coffee Cupper Skill Training for Deaf People in Special Institutions and AORA Training", some things that can be done include:

1. The use of coffee sensory technology can continue to be developed and improved to support coffee cupper skill training for deaf people. This technology can help them hone their skills in tasting coffee quality.
2. Coffee cupper skill training can continue to be carried out regularly and structured, so that deaf people can improve their ability to recognize coffee characteristics better.
3. AORA Special Institutions and Training may consider establishing partnership programs with local coffee producers, so that deaf people can be directly involved in coffee processing and expand their knowledge in this field.

The support from various parties such as government institutions, the private sector, and the general public can help deaf people in getting wider opportunities to be involved in the coffee industry.

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