

ARTICLE

Darkness color index analysis using android-based RGB colorimeter for educational science purposes

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Abstract

The UNESCO outlined eight essential competencies that crucial for students to attain the 21st demands. Engaging science learning activities through the experimental practicum can empowers students to employ critical, active, and collaborative thinking when addressing scientific challenges, particularly those related to environmental pollution. The objective of this study how does the effect of TAR amount towards darkness color index using RGB colorimeter application. The research methodology in this study is science practicum development. In this study, science practicum activities are combined with STEM and Project-Based Learning model in conducting the activities. After conducting the experiment, the result shows that the quality of color residue is depend on the amount of TAR and Nicotine inside tobaccos. More amount of TAR in Tobaccos is Darker the color of residue. Furthermore, there are lots of variables that we should consider in this experiment. For example, duration of tobacco smoking (time), the volume of water inside the plastic bottle (volume), and the length of tobaccos (length). Because the variables can affect the tobacco residue and affect the RGB color index.

Keywords: Darkness color index analysis, environmental science, RGB colorimeter, science practicum, tobaccos darkness color index analysis

1. Introduction

The rate growth of the world's population has finally begun to slow to slightly more than 1 percent, after reaching an all-time high of more than 2 percent in the early 1960s. In 2007 there were more than 6.6 billion people on the planet. The United Nations predicts that by the year 2050, there would be almost 9.2 billion people living on Earth—almost four times the number of people living on Earth in 1950. Environmental pollution especially air pollution has existed since people began to congregate in towns and cities. Human activities are now increasingly out of control, industrial and technological progress technology brings a negative side to the environment. The example of human activity that causes air pollution is smoking the tobaccos.

Smoking is the act of inhaling and exhaling the fumes of burning plant or chemical materials (Patel et al. 2020). A variety of plant materials are smoked, including marijuana and hashish, but the act is most commonly associated with tobacco as smoked in a cigarette, cigar, or pipe (Wang and

Finlayson–Pitts 2003). Tobacco contains nicotine, an alkaloid that is addictive and can have both stimulating and tranquilizing psychoactive effects. Tobaccos itself have 3 major ingredients which are TAR, Nicotine, and Carbon Monoxide. Figure 1. shows the victims of smoking tobaccos in Indonesia. Moreover, it takes a year to remove that amount of tar from your lungs. There is no procedure or medication that instantly removes tar from human lungs (Wang and Finlayson–Pitts 2003).

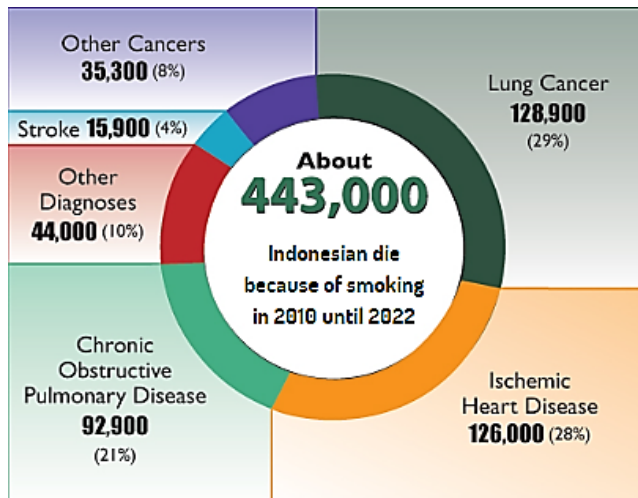


Figure 1. Initial Tobacco's Practicum results Source: (Suwarta, 2022). at www.femina.com

A study stated that the integration of smoke detection in photogrammetric techniques was derived from the intention of generating an algorithm for residue color detection (Çelik, Özkaramanlı, and Demirel 2007). The implementation of specific methods of residue color detection by applying different functions such as image subtraction, morphological filter, thresholding, contouring, and masking enables to create a program designed for optical RGB cameras in visualizing cigarette smoke dispersion. The researchers were able to utilize an optical RGB camera and digital image processing techniques in determining cigarette residue (Çelik, Özkaramanlı, and Demirel 2007).

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) outlined Several crucial competencies (Rieckmann 2017). These competences encompass system thinking, anticipatory skills, normative competency, strategic proficiency, critical thinking, collaborative ability, self-awareness, and integrated problem-solving (UNESCO, 2017). Effective educational methods are vital for cultivating high-caliber human resources, with science education playing a pivotal role in shaping individuals capable of addressing the challenges of the twenty-first century, particularly in science and technology. Integrating the SDGs into the teaching and learning process facilitates meaningful and lifelong learning in science education, enhancing students' capabilities as they engage in scientific studies. The adoption of experiment-based practical learning methods has the potential to enhance students' awareness of environmental issues, particularly in comprehending materials related to environmental contamination. Through hands-on activities, students are prompted to apply critical thinking and teamwork skills in addressing real-world challenges. This ongoing engagement contributes to an increased awareness among students, making it easier for them to recognize and comprehend established concepts (Doloksaribu and Suaka 2021). Science laboratory activities have provided an increase in students' awareness direct practice on teaching material obtained in theory (Doloksaribu and Suaka 2021).

When it comes to discussing SSIs, by observing the material of environmental pollution directly reveals its presence in the immediate surroundings. This is evident through various natural disasters

such as floods, landslides, air pollution, contaminated water, and more, occurring in different regions. Human involvement plays a significant role in these disasters due to a lack of appreciation for the values of environmental wisdom, knowledge that should ideally be imparted through biology education in senior high schools (Laelandi, Sriyati, and Prima 2023; Yuliyanti et al. 2019; Larasati et al. 2021; Melisa 2020). Recognizing the importance of this, it becomes crucial for students to delve into the study and comprehension of the factors and repercussions of environmental pollution prevalent in their surroundings (Yuliyanti et al. 2019; Larasati et al. 2021; Melisa 2020). Nevertheless, imparting understanding to students regarding the causes, impacts, and prevention of environmental pollution is no simple task. Effective methods or approaches are required to convey explanations on this matter to students. The experimental practicum method emerges as a viable approach in this context (Yuliyanti et al. 2019; Larasati et al. 2021; Melisa 2020). Utilizing the socio-scientific approach in science biology learning, especially in the context of environmental pollution, provides students with a hands-on experience. This involvement allows them to directly observe, analyze, and evaluate the outcomes of the practicum activities, facilitating a more comprehensive understanding of the concepts related to water and air pollution (Yuliyanti et al. 2019; Larasati et al. 2021; Melisa 2020).

There are several research related to perception. First is one research of student's perception towards online learning. This research concludes that students perceive that face-to-face learning is preferable than online learning, of which is mainly influenced by support and facilities that they have access to during the pandemic (Knezek et al. 2013). There is one other research of which implement environment power monitoring and its impact towards student's STEM perception (Knezek et al. 2013). This research finds that by implementing said method, student gain better understanding of STEM knowledge, perceive science as more exciting, and increase student's aspirations towards STEM-related professions (Knezek et al. 2013). Finally, many research discussing the use of SSIs on the topic of climate change concluded that in the topic of science-biology content (Afriani 2018; Amah, Sudaryantiningsih, and Lolo 2023; El Takach and Al Tobi 2021), socio-critical Saija et al. 2022, problem-oriented approach (Sari and Wiyarsi 2021), to teaching allows for innovation in science classrooms and leads to higher levels of motivation (Knezek et al. 2013), and a greater perception of the relevance of science for everyday life. However, the research on students' perceptions in science learning at the senior high school level especially in biology has not been conducted directly and has not yet focused on students' perceptions of a particular subject. Students are aware of uncertainties regarding the types of jobs they will obtain after studying science at school (Barry et al. 2023).

Therefore, there is a need for us to better understand how student's perceive SSIs related to the environment (Trinderup et al. 2015; Yuliyanti et al. 2019; Larasati et al. 2021; Melisa 2020). By doing so, we can better devise a strategy to help student gain better perception towards SSIs of environment. Of course, ideally this research should be conducted on students with a focus in biology education. Thus, this research will investigate student' perceptions towards socio-scientific issues in junior high school about science education. The studies about Science Practicum Activities already discovered by other researchers. Previous studies in Science Practicum Activities commonly incorporate the Science Practicum Activities into a method of teaching or various learning models. The example integration of Science Practicum Activities as learning models are Project Based Learning, Problem-Based Learning and STEM through the Engineering Design Process. One of the previous highlighted the engineering competencies as a vital component in Science Practicum Activities. Furthermore, integrating science learning with engineering competencies allows students to simultaneously the scientific reason and engineering concepts. Teachers are encouraged to prioritize scientific knowledge and sustainable development goals through the Science Practicum Activities in a logic sequence of instruction. However, most teachers in Indonesia still have no ideas on how to implementing science practicum activities in science teaching and learning. This statement is supported by previous study, which stated that Science Practicum Activities is only a learning method that has just been conducted

in learning science.

This research is had two objectives, (1) how does the effect of TAR amount towards darkness color index? (2) how does the effect of students' perception towards science activities after conducting tobacco's practicum?

2. Research methodology

2.1 Method

This project is specifically designed for junior high school students, aiming to offer a practical learning approach to environmental pollution materials through experimental methods. The objective is to enhance comprehension and demonstration of events in the practicum object by establishing connections to occurrences in the surrounding environment. Essentially, students are prompted to analyze every event critically and creatively, fostering the development of practical solutions. As per Haniyah et al. (2014), the experimental technique involves students conducting experiments to gain firsthand experience and validation of learned concepts. Through this teaching and learning method, students engage in practical experiences, follow procedural steps, observe objects, analyze data, confirm hypotheses, and draw their own conclusions. The practicum material focuses on a subtopic within environmental air pollution. The practicum spans two to three class hours, approximately eighty to one hundred and twenty minutes, involving six groups of students, each comprising five to six members. Initially, three groups conduct a practicum on air pollution caused by tobacco use. Subsequently, after the lessons, each group completes a practicum on air pollution by calculating the darkness color index within the context of the tobacco experiment. Table 1. describe the materials that students need for conducting Tobacco's air pollution experiment.

Table 1. Apparatuses and Materials for conducting Tobacco's air pollution experiment

Apparatuses Name	Amount	Materials Name	Amount	Tools
Plastic Bottle	100 mL	Tobacco 1 (20 cm)	16 mg	Android-Based RGB Colorimeter Application
Watman Filter Paper	Particle Retention (25µm)	Tobacco 2 (20 cm)	20 mg	Stopwatch
Plastic Straw		Tobacco 3 (20 cm)	24 mg	Micrometer Screw
Printer System Infuse	20 mL	Tobacco 4 (20 cm)	28 mg	Ferner Caliper
		Tobacco 5 (20 cm)	32 mg	
		Tobacco 6 (20 cm)	36 mg	
		Tobacco 7 (20 cm)	40 mg	
		Tobacco 8 (20 cm)	44 mg	
		Tobacco 9 (20 cm)	48 mg	
		Water	100 mL	

2.2 Implementation procedures

This research is divided into tree activities. First, the researcher develops the teaching practicum strategies and testing the initial tobacco's air pollution experiment. Second, the researcher testing the practicum development. Figure 2 shows the procedure of research.

2.3 Participants

The subjects of this study consist of junior high school students who have previously explored the topic of environmental air pollution. The research was carried out in public junior high schools located in Majalengka, involving a total of 60 participants aged 13-16 years, comprising 25 males

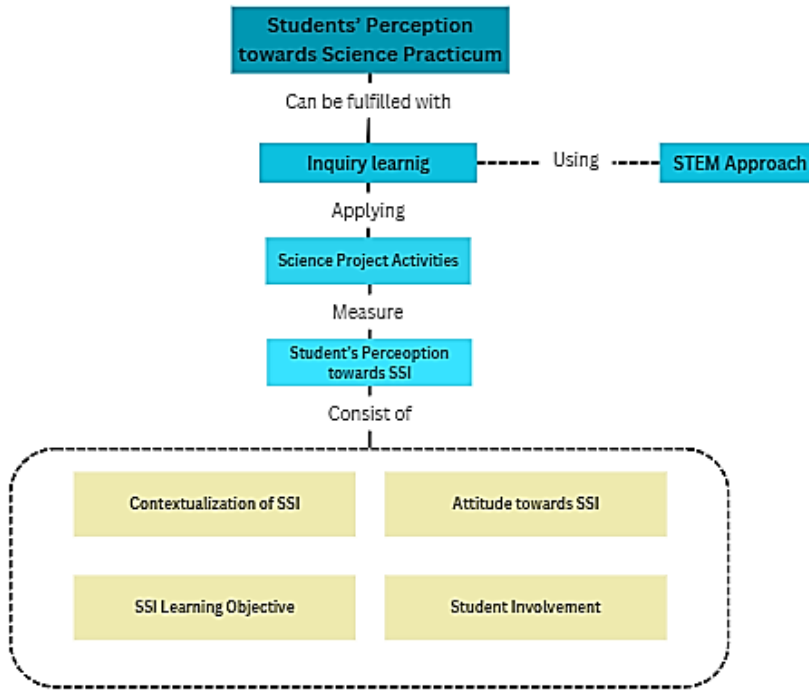


Figure 2. Research Procedure

and 35 females. Among them, 30 participants were in the 7th-grade class, while the remaining 30 were in the 8th-grade class. The participants were selected using purposive sampling, a method that involves the researcher using informed judgment to choose a sample based on specific considerations. In this case, considerations for participant selection included factors such as budget, resources, and time constraints (Creswell and Creswell 2017). The participant proportion of the gender was 41.66% of male students and 58.33% of female students. All these proportions were included to all seventh grade (30) and eight grade (30) in junior high school.

2.4 Instruments

The primary objective of the 5-Likert questionnaire survey is to examine and characterize students' perspectives on socio-scientific issues, specifically focusing on the topic of environmental pollution in this research. A 5-Likert scale is employed for data collection through a subsequent survey. The exploration of students' perceptions regarding socio-scientific issues related to environmental pollution, as outlined in this study, utilizes a student's perception rubric that includes four key indicators: Contextualization of SSI, Student Involvement, Attitude towards SSI-Learning, and SSI-Learning Objectives, aiming to formulate actionable steps. The survey items are designed based on a rubric originally adapted from (Subiantoro and Treagust 2021). The initial structure of the survey items, before undergoing analysis, is presented in Table 2.

2.5 Data analysis

1. Scoring of surveys: The survey score is determined by collecting data from 24 5-Likert scale questionnaire items. Each item in the questionnaire is rated on a scale of 1 to 5, where a correct response is assigned a value of 5 marks, and an incorrect answer is given 0 marks. The assessment

Table 2. The 5-likert questionnaire survey of Students' Perception on tobacco's experiment

Indicators	Question number	Total	Percentage
Contextual of SSI	1,2,3,4,5,6	6	25%
Student Involvement	7,8,9,10,11,12,13	7	29%
Attitude towards SSI-Learning	14,15,16,17,18	5	20%
SSI-Learning Objectives	19,20,21,22,23,24	6	25%

score is then calculated based on the participants' perceptions of socio-scientific issues (SSI), as defined by Subiantoro and Treagust (2021).

2. Pre-requisite survey: Utilizing SPSS version 24 software, an analysis of both pre-survey and post-survey results from both the 7th-grade and 8th-grade classes will be undertaken. The data analysis process includes several evaluations designed to examine the impact of environmental pollution practicum activities on shaping students' perceptions of environmental pollution. Initial surveys, including normality and homogeneity tests, will be performed to identify data suitable for subsequent analyses. In evaluating the data, the following statistical tests were conducted.

The purpose of the normality survey is to assess whether the data for a particular group or variable follows a normal distribution. In this research, the Kolmogorov-Smirnov survey was employed to examine the normality of the pre-survey and Female outcomes for both the control and experimental classes. Should the data exhibit a normal distribution, subsequent analysis will involve parametric surveys. Conversely, if the data doesn't adhere to a normal distribution, the analysis will progress to non parametric surveys.

A homogeneity survey was conducted to determine whether the samples taken from both the 7th grade class and 8th grade class originated from similar populations. The Levene survey was chosen for this study since the data is in a continuous scale format. The criteria for performing the Homogeneity survey using the SPSS program are outlined as follow:

- If the significance value is < 0.05 , then it can interpret that the data are declared as not homogeneous.
- If the significance value is > 0.05 , then it can interpret that the data are declared as homogeneous.

Following the completion of the prerequisite surveys, which confirmed the normal distribution and homogeneity of the data, the subsequent step involved the implementation of the T-survey. The purpose of this T-survey was to ascertain the presence of significant differences between the results of the Male and Female data. The T-survey criteria adopted for this study are outlined as follows:

- If the significance value is < 0.05 , then there is declare a significant difference.
- If the significance value is > 0.05 , then there is declare no significant difference.

3. Result and discussion

3.1 Development of tobaccos pollution practicum

This research was started from October 2023, and ended in December 2023. Before testing the darkness color index, the science practicum activity has been developed for one month. Starting with making the worksheet, create the prototype and testing the prototype. The practicum material focuses on a subtopic within environmental air pollution. With tobaccos pollution practicum, the darkness color index of tobaccos residue can be analyze using RGB colorimeter application. Figure 3. Shows the design of tobaccos prototype for the practicum, and Figure 4. shows how the prototype of tobaccos pollution practicum was developed.

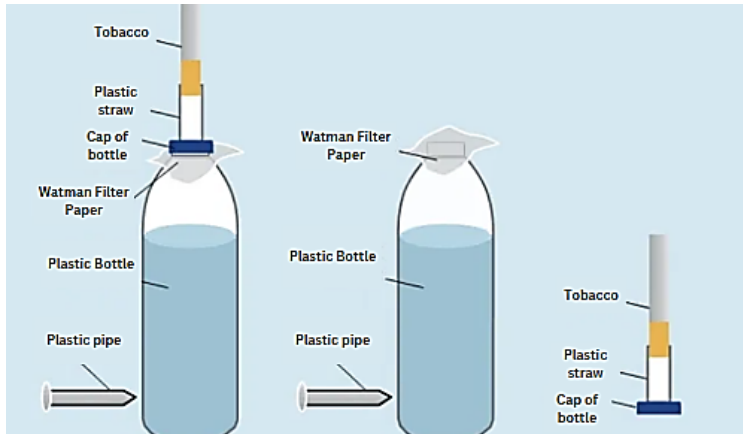


Figure 3. Tobacco practicum prototype

This experimental procedure was carried out to explain the principle of filtration. The experiment was carried out in the laboratory. There are two experiments for analyzing darkness color index of tobaccos air pollution residue.



Figure 4. Tobacco practicum prototype

First experiment, (1) prepare the equipment, gathering the necessary equipment for the experiment, which may include bottles, pens or plastic pipes, a cigarette, water, cotton or tissue, Watman filter paper, and a colorimeter app. (2) make a hole near to the bottom of the bottle and a hole in the cap of the bottle, creating two holes in the bottle, one near the bottom and another in the cap. This suggests a controlled setup for introducing and releasing substances, (3) tuck the pen or plastic pipe on the hole near the bottom of the bottle, Inserting a pen or plastic pipe into the bottom hole of the bottle. This acts as a conduit for the smoke to travel through (4) filled the bottle with the water, pouring 100 mL of water into the bottle. The purpose of this step might be to simulate the filtering action of the respiratory system (5) tuck the cigarette to the bottle cap, and fire it, attaching

a cigarette to the bottle cap and igniting it. This step mimics the combustion process of smoking, (6) attaching the cap of the pen and let the water out, after the bottle filled with the smoke, tuck a cotton or tissue on top of the bottle, (7) blow the pen and let the smoke go out, (8) observe the color on the cotton / tissue, (9) replay the procedures to the number of the examples.

Second experiment, (1) place the Watman filter paper filled with the color of the TAR in a line with the tobaccos, placing Watman filter paper, pre-filled with the tar color, in a line corresponding to different tobacco brands. This step suggests a comparison of tar content among in tobaccos. (2) pen the colorimeter app, (3) serve each cotton color, (4) put the cotton from the lightest color to the darkest After conducting the experiment, the result shows the quality of color residue is depend on the amount of TAR and Nicotine inside tobaccos. More amount of TAR in Tobaccos is darker the color of residue. if the RGB color index decrease that is mean the color index or darker. However, if the RGB color index are increase, it is mean the color is lighter. Figure 5 shows the qualitative result of tobacco residue in Watman filter paper.

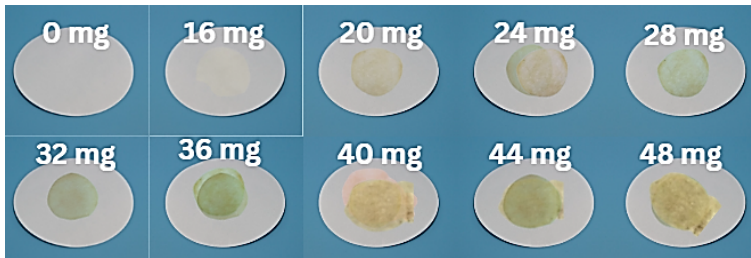


Figure 5. Tobacco practicum prototype

In this experiment, the quality of color residue is depended on the amount of TAR and Nicotine inside tobaccos. More amount of TAR in Tobaccos is darker the color of residue. More amount of TAR is darker the color index on RGB color. Table 3. describes the result of the darkness color index of tobaccos experiments. The formula for calculating darkness color index in tobaccos experiment is:

Table 3. Tobacco's residue after practicum results

Amount of TAR / Tobaccos stick	Red	Green	Blue	RGB Color Index	Darkness Color Index
0 mg	235	234	218	103	0,0097
16 mg	210	215	201	86,83	0,0115
20 mg	200	208	198	82	0,0122
24 mg	117	142	106	31	0,0322
28 mg	105	125	82	22,45	0,0445
32 mg	102	130	98	26	0,0385
36 mg	97	110	96	21,41	0,0467
40 mg	82	107	91	19,81	0,0505
44 mg	75	99	87	17,44	0,0573
48 mg	68	86	83	14,35	0,0697

First result with 0 mg of TAR the color index quality is lighter color, and for the each RGB index indicator, R = 235 G = 234 B = 218. With the RGB color index is 103. Furthermore, the result of darkness color index is 0,0097. The qualitative analysis of the color data suggests that the sample is a lighter color, as indicated by the high RGB values and the low darkness color index. The specific RGB values correspond to a light color, and the combined RGB color index of 103 further supports

this. The darkness color index of 0.0097 also reinforces the qualitative result of the sample as a lighter color. Which mean there is no residue of tobacco's TAR.

Second result with 16 mg of TAR the color index quality is lighter color, and for the each RGB index indicator, $R = 210$ $G = 215$ $B = 201$. Furthermore, the result of darkness color index is 0,0115. The qualitative analysis of the color data suggests that the sample is a lighter color, as indicated by the high RGB values and the low darkness color index. The specific RGB values correspond to a light color, and the combined RGB color index of 86.83 further supports this. The darkness color index of 0.0115 also reinforces the qualitative result of the sample as a lighter color. Which mean there is the residue of tobacco's TAR are hard to be seen with naked eye.

Third result with 20 mg of TAR the color index quality is dark color, and for the each RGB index indicator, $R = 200$ $G = 208$ $B = 198$. Furthermore, the result of darkness color index is 0,0122. The qualitative analysis of the color data suggests that the sample is a lighter color, as indicated by the high RGB values and the low darkness color index. The specific RGB values correspond to a light color, and the combined RGB color index of 82 further supports this. The darkness color index of 0.0122 also reinforces the qualitative result of the sample as a lighter color. Which mean there is the residue of tobacco's TAR are hard to be seen with naked eye.

Fourth result with 24 mg of TAR the color index quality is darker color, and for the each RGB index indicator, $R = 117$ $G = 142$ $B = 106$. Furthermore, the result of darkness color index is 0,0322. The qualitative analysis of the color data suggests that the sample is darker color, as indicated by the high RGB values and the low until medium darkness color index. The specific RGB values correspond to a light color, and the combined RGB color index of 31 further supports this. The darkness color index of 0.0322 also reinforces the qualitative result of the sample as darker color. Which mean there is the residue of tobacco's TAR are visible to be seen with naked eye.

Fifth result with 28 mg of TAR the color index quality is darkest color, and for the each RGB index indicator, $R = 105$ $G = 125$ $B = 82$. Furthermore, the result of darkness color index is 0,0445. The qualitative analysis of the color data suggests that the sample is a lighter color, as indicated by the high RGB values and the low darkness color index. The specific RGB values correspond to a light color, and the combined RGB color index of 22.45 further supports this. The darkness color index of 0.0445 also reinforces the qualitative result of the sample as a lighter color. Which mean there is the residue of tobacco's TAR are visible to be seen with naked eye.

Sixth result with 32 mg of TAR the color index quality is darker color, and for the each RGB index indicator, $R = 102$ $G = 130$ $B = 98$. Furthermore, the result of darkness color index is 0,0385. The qualitative analysis of the color data suggests that the sample is a darker color, as indicated by the high RGB values and the medium darkness color index. The specific RGB values correspond to a light color, and the combined RGB color index of 26 further supports this. The darkness color index of 0.0385 also reinforces the qualitative result of the sample as a darker color. Which mean there is the residue of tobacco's TAR are visible to be seen with naked eye.

Seventh result with 36 mg of TAR the color index quality is darkest color, and for the each RGB index indicator, $R = 97$ $G = 110$ $B = 96$. Furthermore, the result of darkness color index is 0,0467. The qualitative analysis of the color data suggests that the sample is a darker color, as indicated by the high RGB values and the medium darkness color index. The specific RGB values correspond to a dark color, and the combined RGB color index of 21.41 further supports this. The darkness color index of 0.0467 also reinforces the qualitative result of the sample as a lighter color. Which mean there is the residue of tobacco's TAR are visible to be seen with naked eye.

Eighth result with 40 mg of TAR the color index quality is darkest color, and for the each RGB index indicator, $R = 82$ $G = 107$ $B = 91$. Furthermore, the result of darkness color index is 0,0505. The qualitative analysis of the color data suggests that the sample is a lighter color, as indicated by the high RGB values and the high darkness color index. The specific RGB values correspond to a light color, and the combined RGB color index of 19.81 further supports this. The darkness color

index of 0.0505 also reinforces the qualitative result of the sample as a lighter color. Which mean there is the residue of tobacco's TAR are visible to be seen with naked eye.

Ninth result with 44 mg of TAR the color index quality is darker color, and for the each RGB index indicator, R = 75 G = 99 B = 87. Furthermore, the result of darkness color index is 0,0573. The qualitative analysis of the color data suggests that the sample is a dark color, as indicated by the high RGB values and the low darkness color index. The specific RGB values correspond to a dark color, and the combined RGB color index of 17.44 further supports this. The darkness color index of 0.0573 also reinforces the qualitative result of the sample as a lighter color. Which mean there is the residue of tobacco's TAR are clearly to be seen with naked eye.

Tenth result with 48 mg of TAR the color index quality is darkest color, and for the each RGB index indicator, R = 68 G = 86 B = 83. Furthermore, the result of darkness color index is 0,0679. The qualitative analysis of the color data suggests that the sample is the darkest color, as indicated by the high RGB values and the highest darkness color index. The specific RGB values correspond to a dark color, and the combined RGB color index of 14.35 further supports this. The darkness color index of 0.0697 also reinforces the qualitative result of the sample as the darkest color in this practicum. Which mean there is the residue of tobacco's TAR are clearly visible to be seen with naked eye.

After experimenting, we know that the quality of color residue depends on the amount of TAR and Nicotine inside tobacco. More the amount of TAR in Tobaccos is darker the color of the residue. There are lots of variables that we should consider in this experiment. For example, the duration of tobacco smoking (time), the volume of water inside the plastic bottle (volume), and the length of tobacco (length). Because the variables can affect the tobacco residue and affect the RGB color index and darkness color index. For more clearer visualization Figure 6. shows the graph about relationship between amount of TAR in each tobacco stick towards darkness color index.

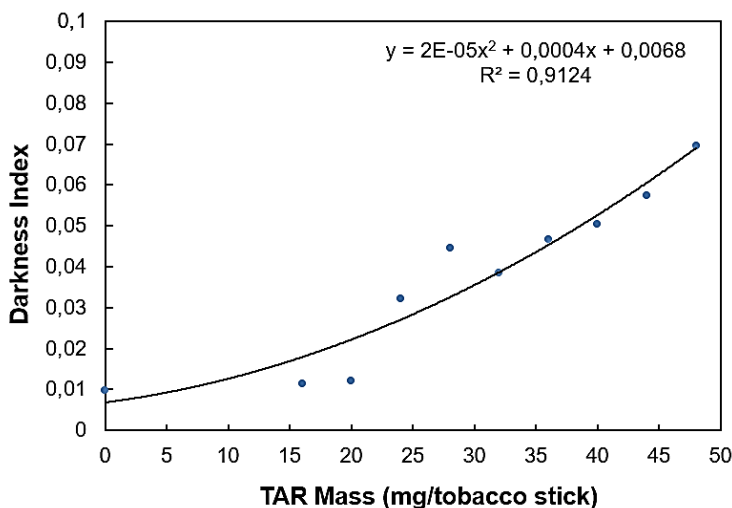


Figure 6. Tobacco practicum prototype

3.2 Student's perception towards Socio-Scientific issue in science education

Student's perception towards SSI in Science Education environmental pollution topic is assessed by giving all participant students in the control and 8th grade class a 5-likert questionnaire survey once. The first time of giving the survey was before implementing the treatment or called as Male and the second time was after implementing the treatment or called as Female. The research was conducted the fore-mentioned Male and Female in a private Middle high school in Majalengka.

The indicators of Students' Perception used in this research is adopted (Subiantoro and Treagust 2021). who stated that the critical thinking survey consisted of 5 open-ended 5-likert questionnaire questions. The 5-likert questionnaire survey covered five aspects of Students' Perception Indicators. The Skill indicators are Contextual of SSI, Student Involvement, Attitude towards SSI-Learning, SSI-Learning Objectives. This 5-likert questionnaire survey has been surveyed first on the aspects of validity, normality, and reliability. This survey has also been judged by three experts on the subject and therefore has fulfilled the requirements for a valid 5-likert questionnaire survey for Student's perception towards SSI in Science Education environmental pollution topic. A statistical survey was carried out to determine the students' perception in the class being treated based on the difference in the outcome of their male and female. The summary of Student's perception towards SSI in Science Education environmental pollution topic in the 7th grade class and 8th grade class can be seen on Table 5.

Based on Table 5 the average score in the 7th grade class is 3.28 (SD 1.20) interpreted as neutral for the male and 3.33 (SD 1.29) interpreted as neutral for the female. Meanwhile, the average score in the 8th grade class is 3.29 (SD 1.19) interpreted as a neutral for the Male and 3.35 (SD 1.18) interpreted as a neutral for the female. The average scores before and after implementing treatment in both classes show an increasing trend. This finding is further explained by other results of the lowest and highest scores in both classes which show the similar increasing trend. Figure 1 shows the average score of Student's perception towards SSI in Science Education environmental pollution topic in both classes.

Table 4. Summary of Student's perception towards SSI in science education about environmental pollution topic Score

Measurements	Seventh Grade		Eight Grade	
	Male	Female	Male	Female
Mean	3.28	3.33	3.29	3.35
SD	1.2	1.29	1.19	1.18
Highest score	1	1	1	1
Lowest score	5	5	5	5

The finding in Table 4, which shows the increasing trend in the average score of Students' Perception that students achieved before and after participating in the learning treatment. Then, it can be interpreted that the implementation of treatment in learning activities is effective to increase Student's perception towards SSI in Science Education environmental pollution topic. To support the above finding and interpretation, homogeneity survey is needed, since the more valid conclusion can be drawn from a homogeneous sample or population. Homogeneity can be applied through the use of Normality Survey, in which this research takes from Kolmogorov-Smirnov Survey and Lavene Survey.

The normality survey (Kolmogorov-Smirnov survey) in the 7th grade class is 0.056 for the male and 0.058 for the female result. Meanwhile, the normality survey (Kolmogorov-Smirnov survey) in the 8th grade class is 0.051 for the male and 0.053 for the female. It can be interpreted that the normality survey (Kolmogorov-Smirnov) is more than 0.05 which means the data are normally distributed (i.e. 0.056 (male of seventh grade); 0.058 (female seventh grade); 0.051 (male eight grade); 0.053 (female eight grade)).

The output of the homogeneity test (Levene test) is 0.362 for the 7th grade and 0.382 for the 8th grade result. It can be interpreted that the homogeneity test is more than 0.05 which means the data group comes from a population that has the same variance (homogeneous) homogeneously distributed (i.e. 0.362 (seventh grade) and 0.382 (eight grade)). In addition, the output of the independent t-test is 0.063 for the 7th grade and 0.059 for the 8th grade result. It can be interpreted that the significance level is more than 0.05 the null hypothesis (H0) is accepted, which means there are no significant

differences between the 7th grade class and the 8th grade class. Independent t-test of students' perception towards SSI in Science Education environmental pollution topic showed no significance (i.e. 0.063 (seventh grade) and 0.059 (eighth grade)).

4. Conclusion

After conducting the experiment, we know that the quality of color residue is depend on the amount of TAR and Nicotine inside tobaccos. More amount of TAR in Tobaccos is more darker the color of residue. Furthermore, there are lots of variables that we should consider in this experiment. For example, duration of tobacco smoking (time), the volume of water inside the plastic bottle (volume), and the length of tobaccos (length). Because the variables can affect the tobacco residue and affect the RGB color index.

The students have a neutral perception of SSI (socio-scientific issues) related to environmental pollution, and there is no significant difference in the level of SSI perception based on gender or grade level. Students have a neutral perception of Biology learning, but some students are still confused about the connection between biology learning and their daily lives.

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