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# Use of Science Process Skills Indicators in "Avicom" Science Creativity Competition To Improve Student Critical Thinking

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**Abstract.** This research was conducted to determine the effectiveness of science process skills indicators (SPS) in scientific creativity competition activities as a learning approach in improving students' critical thinking skills. Avicom is a student scientific creativity competition organized by SMA Avicenna Cinere which is attended by junior high school students from various provinces in Indonesia. This study uses a qualitative descriptive method with a theoretical triangulation approach, namely observation, review, and analysis. The data comes from article documents, videos of participant activities, and competition activities. The results of the analysis of data sources show an increase in the ability of SPS participants in three basic skills which are shown in the form of scientific work products, scientific work articles, and scientific paper presentations. The results of the literature study, this SPS competency indicator has an impact on increasing the participants' critical thinking skills.
**Keywords:** Avicom, science process skills, critical thinking skills

## Introduction

The concept of 21st century learning requires students to have higher order thinking skills. Identification of students' higher-order thinking skills according to various literatures is critical and creative thinking, problem solving and decision making (Rhasvinder et al., 2018) as well as science process skills (Akinbola & Afolabi, 2010; Akcay & Yager, 2016). The structure of research activity is one of the best tools for enhancing the development of research skills in science (Vázquez-Villegas et al., 2023). In addition, just mentioning the scientific method can enhance the development of students' life skills. In this case, it shows that the stages in the scientific method are basic skills that students must have in order to be able to understand science through their scientific work skills and critical thinking. Science Process Skills (SPS) means thinking skills used by scientists to construct knowledge to solve problems and the ability to formulate results. SPS can be obtained through training and developed through learning activities carried out by linking students with daily life activities, including through youth scientific work competitions. According to Rustaman (2003), practicum activities are one of the SPS indicators that can be trained, including skills in observation, classification, identification, communication, interpretation, prediction, using tools and materials and conducting experiments. In addition, according to Shaw et al. (2019); Sumardiana et al. (2019) SPS can improve students' abilities in interpretation, inference, self-regulation, analysis to explain and provide evaluation, open

thinking, and communication skills. The results of research by Inayah et al. (2020), SPS is proven to be one of the important skills students have to be able to complete the learning process, if students have good science process skills then students can more easily understand learning concepts.

Science learning is done not only to provide an assessment or to see a student from the learning outcomes he has achieved. Science learning should pay more attention to the ability to develop various abilities and skills, especially skills that are used as scientific processes and principles and scientific approaches, as a form of implementing the scientific method. The scientific method consists of strategies for obtaining information about a problem at the theoretical (methodological and scientific literature analysis), experimental (experiment and observation) and statistical (result processing) levels. Morozova et el. (2022). In addition to understanding science concepts, students must also be equipped with SPS, this cannot be ignored, because SPS is an approach that focuses on the ability to investigate and is closely related to scientific discoveries (Chiappeta, 2010; Akcay & Yager, 2016). Learning with a scientific approach can give different meanings to students, they not only learn but begin to feel the role of scientists in discovering and understanding concepts. Based on Gamaliel & Suciati (2011) that SPS includes various aspects of intellectual activities carried out by scientists to solve various problems related to science. SPS results are scientific products which can be in the form of theories, concepts, postulates, and laws about science.

Basically learning science with SPS is an activity that provides experience to students so that they feel the process of scientific work that through systematic stages in the scientific method. This is in line with Tawil et al. (2014); Inayah et al. (2020) that SPS is an insight into the development of various types of skills, namely intellectual, social, physical skills which originate from the basic abilities of students to understand natural phenomena that occur around them through methods that structured and systematic. The results of Rustaman (2003); Susetyarini & Fauzi (2020); Akcay & Yager (2016); Shaw et al. (2019) showed that scientific skills in learning science include: observing, classifying, communicating data, interpreting, asking questions, applying concepts and conducting experiments through scientific activities. Scientific activities such as practicum and research have not been widely implemented in schools.

Learning activities that provide students with experience in improving SPS must continue to be carried out, because it will require them to think and act scientifically. In addition, these skills are the basis for building students' scientific attitudes so that they obtain sufficient provisions when conducting practicum and research. One example of real activities in everyday life that can be felt by students is the youth scientific work competition. This activity can be used as a learning approach that is able to improve skills and abilities of student in high-level thinking processes, including critical thinking.

There are several options to improve students' critical thinking skills, one of which is the Project Base Learning (PBL) method. The PBL method in education increases student team engagement and learning capacity, provides opportunities to practice skills, educates professionals with a holistic vision, enhances critical thinking, and increases capacity to deal with different market conditions (Razak et al., 2022). Thus the involvement of students in problems, project activities, and other challenges in everyday life can make them skilled in thinking. Strengthened by the opinion of Wilson & Narasuman (2020), that critical thinking is an important aspect of modern education that must be developed and empowered, especially in the current era of the fourth industrial revolution (4IR), where information is in abundance and changes are fast and radical. Critical thinking is also related to cognitive skills because it involves problem solving activities; understand the interplay of factors influencing outcomes; and calculating various possibilities and scenarios to make the right decision. Erikson & Erikson (2019). To think critically requires a rational mind with good reasoning, as well as the ability to follow the rules of logic and scientific

reasoning as the best basis for making decisions. There is a correlation between critical thinking skills and the knowledge that students gain as a result of understanding and justification. In addition, critical thinking is also part of cognitive abilities that involve acquiring knowledge in analyzing, interpreting and concluding information to make decisions (Hidayati et al., 2020). This adds to the belief that the involvement of students in solving problems in scientific projects greatly influences the improvement of their critical thinking skills.

Most researchers acknowledge that critical thinking contains two dimensions of personal disposition (eg, truth-seeking, analytic, and curiosity) and cognitive skills (eg, inference, evaluation, and reasoning). Study results, Liu et al. (2021) show that integrated critical and creative thinking courses have a significant impact on increasing the level of critical thinking disposition and creative self-efficacy. In line with this opinion, this study examines a scientific creativity competition (Avicom) held by the Avicenna Cinere school, namely a scientific competition for junior high school students. This competition was held with the aim of increasing the participants' abilities and insights in analyzing problems and finding the right solutions through the creation of scientific creative works. Musliman & Damayanti (2022). In accordance with the objectives of the competition, this study aims to determine whether scientific creativity competitions with SPS indicators can be a method to improve students' critical thinking skills.

## Methods

This study used a qualitative descriptive method with a theoretical triangulation approach there were observation, review, and analysis. The data came from article documents, videos of participant activities, as well as competition activities as direct observation of competition activities. Comparison of the theory which states that there is a link between SPS and improving students' critical thinking skills, is the reason for the researcher's hypothesis, that Avicom can be a choice of learning approach that is able to improve students' critical thinking skills. In more detail, this research paradigm is shown in Figure 1.

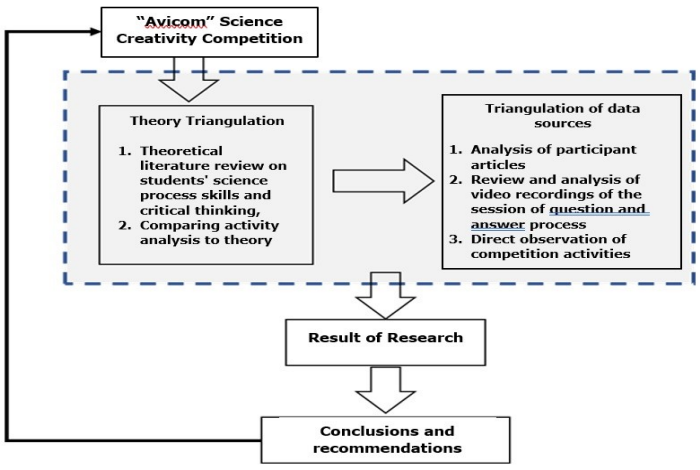


**Figure 1.** Research paradigm

The complete research process is carried out through reviewing articles submitted by competition participants, direct observation of competition activities because researchers

act as judges in competition activities, as well as analysis of videos of the question and answer process in the presentation of the participants' creative works. Avicom is a scientific creativity competition, also called a scientific work competition for junior high school level, organized by senior high school Avicenna Cinere.

Competition activities are carried out in three phases of activity, such as: 1) the selection of scientific articles, 2) the elimination round, and 3) the final round, namely the presentation of scientific work by selected participants. Through these phases, nine participants were selected to enter the finals and were invited to make presentations in front of the jury via the zoom platform. Of the nine participants, three participants were selected as research samples to be followed up and analyzed and analyzed. The data analysis technique used is the technique proposed by Sugiyono (2013), which consists of three stages, namely data reduction, data presentation, and drawing conclusions or verification.

## Results and Discussion

**Theoretical review**

The data of this research came from collection of documents, videos and results of interviews with competition participants which were recorded during the activity. The real form of the data generated, among others; 1) scientific work articles, 2) a List of questions the jury asked during the competition, and 3) a video recording of the father of the final competition. All available data sources are then analyzed to determine the impact of the competition activity on students' critical thinking skills. In this study, the completeness of science learning was not sufficiently measured based on students' cognitive abilities on concepts, but basic science skills became a complement and an important part so that students could explore science concepts in more depth. Students' critical thinking and learning outcomes depend on learning design and student activities (Wardani et al., 2017). SPS and students' critical thinking are important aspects that must be possessed in learning science. Both are skills that involve scientific inquiry and problem-solving about scientific concepts that apply to life. The results of the study found that students' SPS influenced critical thinking in science learning (Tanti et al., 2020). This illustrates that the relationship between SPS and students' critical thinking skills is quite significant so in order to improve students' critical thinking skills in the science learning process, it is necessary to develop learning designs that involve students directly in scientific work.

Critical thinking ability is identified as an important life skill, Atabaki, et al. (2015). With this competence, people can carry out important basic activities, including distinguishing whether information received from the environment is true or false. Critical thinking involves analysis and evaluation rather than just accepting ideas or information. Students' critical thinking skills can be seen from the types of basic abilities as indicators including understanding of relationships, similarities, and differences; find patterns; classify; understand cause/effect; observing trends and big ideas; predict outcomes; consider multiple perspectives; provide judgment, and ask questions and reasons. Likewise, if given data or information, he will be able to make the right conclusions while at the same time seeing contradictions, consistency or irregularities in that information (Sumarni & Kadarwati, 2020).

Developing critical thinking skills in class, begins with students having a deep understanding of subject matter Piergiovanni (2014). Meanwhile, et al. (2021 highlighted that the capacity for critical reflection was previously a key component of transformative learning, and argued that non-reflective experiences did not lead to meaningful learning. Bennett (2012). This shows that the development of students' critical thinking cannot be obtained "naturally or just like that", so it needs to be stimulated by encouraging students to reflect on what they observe or think about what they know to build new knowledge,

solve problems or make decisions. will increase when the learning process takes place students actively carry out activities that train their thinking skills.Active learning in experimental activities is a basic scientific work skill which is an indicator of critical thinking skills.This is in line with the results of research by Akcay & Yager (2016), students who participating in science, technology, and social experimental classes showed significant results in using SPS when compared to students who only got ordinary science from teachers and/or through textbooks.

Critical thinking skills are proven to have long-term benefits in education. The application of critical thinking skills can help students to solve problems encountered in the learning process as well as their application in everyday life (Kaddoura, 2011). This shows that in principle the concept of science is very close to students' daily life activities. Thus learning science is learning that is close to natural phenomena that occur in everyday life. Science must be able to provide answers to the problems that exist in human life. Meanwhile, the short-term goal of critical thinking skills in the learning process is to strengthen students' conceptual understanding (Khasanah et al., 2017), especially in science subjects. In other words, students critical thinking skills are needed to solve problems in everyday life.

Many studies have been conducted on the relationship between SPS and critical thinking skills. The results of Padilla's research (1983), show that SPS ability is strongly related to logical thinking. Therefore, the ability to think critically is one factor that has a direct influence. The link between SPS and students' critical thinking skills is very clear, students' critical thinking skills can be improved through learning activities that apply a scientific approach. SPS becomes a basic skill so that students can do scientific work in their learning activities. The SPS needed by students is categorized as useful and has analytical thinking skills. So there is a significant relationship between SPS and students' higher-order thinking skills (Kurniawan et al., 2020). It can be illustrated how the SPS relates to students' critical thinking skills in science learning as in Figure 2 there are intersections of skills indicators in science learning. SPS with critical thinking skills are abilities in different domains, cognitive and psychomotor, but there are indicators that have similarities in the two domains.

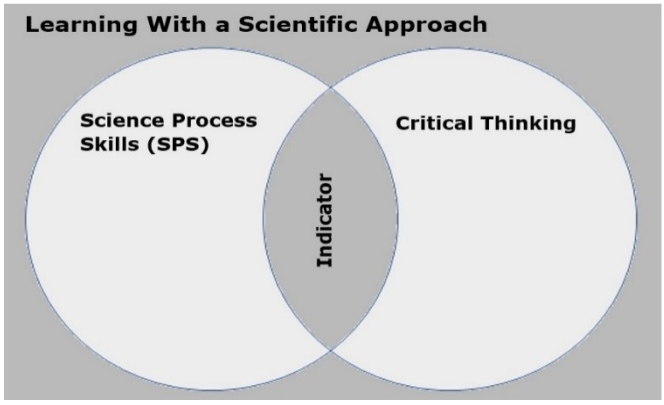


**Figure 2.** SPS indicator scheme

In this study, the SPS indicators that will be examined to determine their impact on critical thinking skills are observing, designing experiments, and communicating. These three indicators are the basic skills used by competition participants in the process of making scientific work. An explanation of each intersection of the SPS indicator with critical thinking skills as the assessment criteria can be seen in full in Table 1.

**Table 1.** The intersection of SPS indicators with critical thinking skills

| No | Types of skills | Indicator | Intersection |
|---|---|---|---|
| 1 | Observe | collecting/using relevant and sufficient facts | The ability to collect/use facts from observations requires a deeper level of thinking, especially the ability to understand the specifications of conditions or elements of facts is one part of critical thinking skills. |
| 2 | Designing Experiments | • Determine the material tools and sources to be used<br>• Determine the variables or determining factors that will be regulated, observed and recorded<br>• Determine what will be done or what scientific work steps | Experimental design requires skills in connecting and applying each part of the experimental step. The ability to choose and determine variables, determining factors and work steps to be carried out as part of critical thinking skills. |
| 3 | Communicate | Describe or explain the empirical data of the experimental results in the form of graphs, tables and diagrams as a report on the results of the experiment | Skills in conducting analysis of experimental results and providing explanations of graphs, tables and diagrams require a high level of thinking skills and depth. |

There is a strong relationship and connection between SPS on indicators of observing, designing experiments, and communicating with critical thinking skills. Observing skills relate to the ability to think critically in identifying and formulating problems, skills to design and conduct experiments relate to the ability to think critically in applying concepts, and communication skills relate to the ability to think critically in the analysis of experimental results.

**Avicom Analysis**

Avicom is the designation for a scientific work competition for junior high school students held by Avicenna Cinere High School. This competition was held as an annual school activity agenda that aims to establish communication between students and increase creativity in the development of science and technology. The form of competition that is contested is student scientific writing as the publication of students' creative works in the form of products or ideas that answer problems that exist in everyday life.

The researcher has the opportunity as a jury to evaluate the participants to determine and select the winner of the competition based on predetermined criteria. In the judging process, each participant presented their creative work and explained the scientific work process they had carried out, starting from the discovery of ideas, and the process of making products up to the publication in competition activities. Based on this, researchers are interested in conducting a study of activities, namely knowing the impact of scientific work competitions and the application of SPS indicators on improving students' critical

thinking abilities as contest participants. This thinking is based on the statement of the research results that have been conducted by Sriyati et al. (2021), that learning to make dadiah through practicum can explore and train students' SPS. These results also show that there is a positive relationship between SPS and student learning outcomes with strong interpretations.

The research carried out by researchers towards this activity begins with paying attention to and identifying the contestants, the origins of the participants and the title of the scientific work submitted. The list of contestants and the titles of the scientific papers produced are shown in Table 2 containing the nine participants who entered the final round. Of the nine final participants, three participants were selected as the object of research and were the best participant choices.

**Table 2.** List of Final Round Participants

| No | Participant's school | Title of scientific writing |
|---|---|---|
| 1 | SMP Negeri 1 Kota Bengkulu | Efforts to Reduce Damage to Coral Reefs in the Bengkulu Coastal Area by Processing Plastic Waste into Plastic Brick (Bata Plastik "Batik") |
| 2 | SMP Negeri 3 Denpasar | Accelerate the Spread of the COVID-19 Virus-New Normal Life Protection Door |
| 3 | SMP Negeri 131 Jakarta - Tim A | Making Use of Glodogan Leaf in the Pigment of Paint |
| 4 | SMPS Lazuardi GCS Kota Depok | Comparison of Consumer Behaviour Between Teenagers and Adults in Jabodetabek Area Towards Ecolabels in 2021 |
| 5 | SMPS Avicenna Cinere Kota Depok | Aromatherapy of LIMBAD to Prevent the Spread of Covid-19 Disease |
| 6 | SMP Neger 131 Jakarta – Tim C | The Impact of Being Addicted to social media tik tok for SMP 131 Jakarta Students' Learning Habits |
| 7 | SMP Islam Cendekia Cianjur Tim A | Sleepy Gummy Utilization of fruits And Chamomile Leaves into Candy Jelly for Better Sleep |
| 8 | SMP Islam Cendekia Cianjur Tim B | Harmless Slime |
| 9 | SMP Negeri 131 Jakarta – Tim B | Utilizing the Waste Cans as A Speaker for Students Use as A tool to Focus When Learning Videos |

**Article Analysis and Exposure**

After selecting nine participants entered the final round, and then they were selected based on the region and type of work of the participants as a sample. For the sample that has been selected, further action research is carried out by starting with a review of the article. The article review was carried out with the criteria of knowing the application of SPS indicators to the basic skills of observing, designing and conducting experiments, and communicating or publishing works. The three participants who underwent the review were given a code to maintain objectivity and simplify the process (Table 3).

**Table 3.** Article Review According to Intersection of SPS Indicators and Critical Thinking

| No | Code | Title of scientific writing | Results of review of indicators |
|---|---|---|---|
| 1 | A | Efforts to Reduce Damage to Coral Reefs in the Bengkulu Coastal Area by Processing Plastic Waste into Plastic Brick (Bata Plastik "Batik") | • Participants found the fact that there is a plastic waste on the coast of Bengkulu, it is suspected that this waste can pollute the beach and damage coral reefs. These facts and conjectures serve as the background for scientific work<br>• The critical thinking of the participants was shown by the emergence of the idea to utilize plastic waste in useful products<br>• Designing an experiment for processing plastic waste into plastic bricks |
| 2 | B | Accelerate the Spread of the covid-19 Virus-New Normal Life Protection Door | • The condition of the community environment that must comply with health protocols is the background for scientific work<br>• Critical thinking skills and creative ideas to make tools can be a solution to meet community needs |
| 3 | C | Making Use of Glodogan Leaf in the Pigment of Paint | • Concern for the surrounding environment is the background for scientific work that is produced through observation of the fact that there is glodogan leaf waste which disturbs the cleanliness of the environment<br>• The critical thinking is to relate the colour of the leaves with the need for environmentally friendly paint dyes |

To facilitate this study, the researcher gave the code to the three best participants. Participants with code A discuss scientific work in the field of environmental innovation, code B discuss the field of local product innovation, and code C discusses the field of industrial innovation. The three participants received the same treatment when presenting their scientific work. To explore the competency of the participants on the indicators that have been set, the participants are given the questions that have been prepared. In particular, the researcher has prepared questions that lead to gathering information according to the SPS competency indicators. The questions submitted to the participants have been selected by the researcher made with an approach at the level of critical thinking with three indicators of basic SPS skills, namely observing, designing and conducting experiments, and communication. As Gagne (1974) argued, such thinking begins with a series of careful systematic observations, continues by devising the necessary measurements, clearly distinguishing between what is observed and what is inferred, and creating interpretations that under ideal circumstances would be brilliant leap, but always testable, and draw reasonable conclusions. The questions submitted as a researcher's observation tool are shown in Table 4.

**Table 4.** Indicator Questions

| SPS' indicator | No | Question |
|---|---|---|
| Observe | 1 | Try to explain how you got the idea for the scientific work you made? |
| | 2 | What is the main problem that forms the background of your scientific work, so that you think this work is the answer to the problem? |
| Designing Experiments | 3 | Explain how the work steps or experimental procedures that you do in making scientific work? |
| | 4 | At what stage did you encounter the most difficult obstacle and how did you overcome it? |
| Communicate | 5 | What are the most important benefits for society or the environment from the scientific work you make? |
| | 6 | How do you convey information to others to prove your scientific work? |

The six questions that were determined were to explore the participants' SPS competencies, namely the ability to observe the object to be made into works, the ability to plan experiments or experiments in the process of making works, and the ability to publish works. Each participant submits the answer to the question directly in the competition forum. For each participant's answer, the researcher made a resume as research data and became a fact that strengthens the reasons for the results of the analysis, shown in Table 5.

**Table 5.** Resumes of Participant Answers

| No | Code | Resumes of participant answers |
|---|---|---|
| 1 | A | The idea was obtained from observations at a beach located on the south coast of Bengkulu where there are piles of plastic waste that pollute and pollute the beach. |
| | B | Based on direct observations in several places, there is a need for hand sanitizer which is used as a condition for entering a place. |
| | C | The existence of a location where there are glodogan trees with fallen leaves is quite troublesome for cleaners to remove the leaves. |
| 2 | A | The abundance of plastic waste on the south coast of Bengkulu is marine pollution. |
| | B | Queuing when entering a place where people must be sterile from the covid-19 virus as a condition of entering the place. |
| | C | A large number of glodogan leaf fall that becomes garden waste interferes with the beauty of the garden and becomes a burden for the cleaners. |
| 3 | A | From the emergence of ideas, it is thought that testing such waste can be used to become a useful object. Arguing that plastic is a difficult material to destroy, it is tried to be compacted and formed into bricks. |
| | B | The working steps of the created tool are based on temperature sensors that are used to detect the condition of the human body and are then processed by a device that converts it into information about the condition of the person's body. |
| | C | Conducting scientific studies on glodogan leaves then conducting experiments, namely making pigments produced from glodogan leaf |

| No | Code | Resumes of participant answers |
|---|---|---|
| | | waste and making binders as the main material for paint and finally testing the quality of binders. |
| 4 | A | The difficulty that we experience is when we do the method of compacting plastic waste so that it can stick together, therefore we do it repeatedly until we find the easiest way. |
| | B | Difficulties when making application programs that use mathematical logic. |
| | C | We experienced difficulties in the process of taking pigment from the color of the glodogan leaves. |
| 5 | A | The most significant benefit for the community from making batik (plastic bricks) is the existence of a coastal environment that is clean from plastic waste pollution. |
| | B | Simplify and speed up the process of identifying people as access to places that must be sterile. |
| | C | The most important benefit is that paint products are produced which are environmentally friendly. |
| 6 | A | The scientific work products that we have just made are presented in this competition activity, plans will be conveyed to the community around the coast through the local area administrators. |
| | B | It is still closed, so it cannot be communicated to the public, only this scientific work competition activity is conveyed. |
| | C | In addition to being presented here, it will be followed up so that it can be mass-produced as an industrial product. |

The ability to observe is a basic skill of SPS. Qualitative observations are observations made by involving some or all of the senses. Qualitative observation describes what is seen, what is felt, what is smelled, what is heard, and what is tasted from the object being observed. If the observation only involves one sense, it cannot provide a complete description of an object being observed (Khaeruddin et al., 2005). The answers from the three participants can be explained that the ability to observe both the phenomena of the surrounding natural environment and the theory used as a reference shows that there is sufficient ability as students who are training themselves in scientific work activities.

Observation of plastic waste that pollutes the south coast of Bengkulu conducted by group A shows that apart from being concerned, there is also the ability to think deeper about the environmental impact it causes and the idea to come up with an answer by thinking of a useful step, namely by making plastic bricks. Observations made by group B saw that there was a queue of residents when entering a certain area because they had to get permission to enter that they were safe and free of covid-19, this problem was thought about and an answer was made by making an electronic device in the form of a sensor that is capable of detecting a safe and covid -free body condition 19. On the other hand, the observations made by group C paying attention to the condition of the waste that fell off the gldogan leaves which every morning littered the environmental area became an idea to explore what benefits the leaves had, where from the literature study, gldogan leaves have dominant colour pigments and this was used as the reason for making paint colours. which is eco-friendly. Observations made by the three participants proceeded to think about problems in scientific work and their critical thinking answered these problems with creative ideas to produce useful products. The process of changing from the ability to observe to an idea is shown in the background of the scientific work they make, as shown in Figure 3.

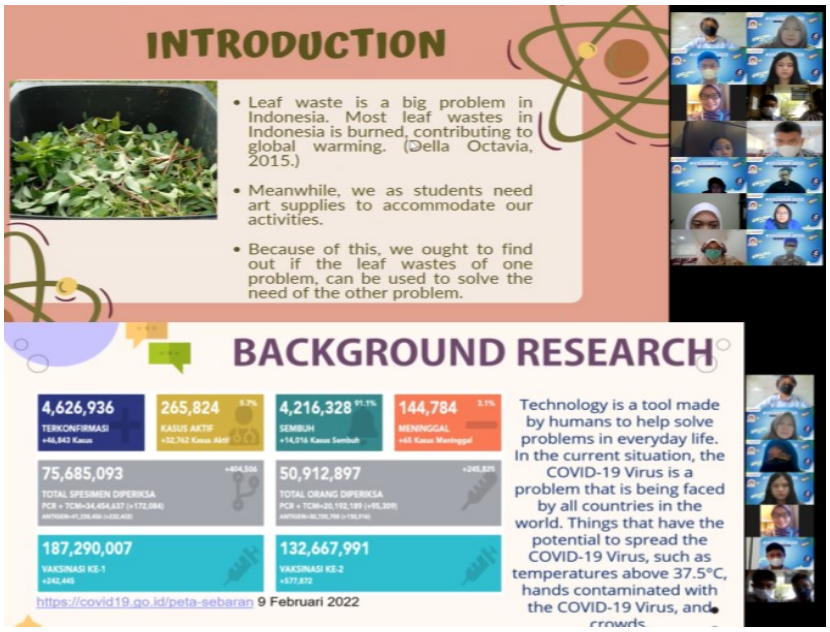


**Figure 3.** Scientific work background

The experiment is a form of action to test an object through practical investigation. Experiment according to Abruscato (2000) was a process of combining all basic and integrated processes. Exercises to improve the experimental process usually begin with observations that lead to thoughts in the form of hypotheses or conjectures to find answers. The experimental steps include identifying control variables, designing and making operational definitions, collecting and interpreting data, and modifying the hypotheses that have been tested. Science activities as a basic ability to work scientifically provide an understanding of knowledge, basic thinking and higher-order thinking, as well as cultivating work skills in relevant activities. Rustaman (2005) stated that experimental or investigation planning activities include several activities using the mind included in the SPS to plan an investigation. Designing an experiment or investigation plan consists of several activities, such as: determining the tools and materials to be used in the investigation, determining control variables and independent variables, determining what would be observed, measured, or written as well as determining work methods and steps.

Trials in the form of practicum activities or conducting experiments can be interpreted as detailed activities planned to generate data in answering a problem or testing hypotheses. The ability to conduct experiments from contestants could be seen in the scientific work they produce. The experimental design skills of the "Avicom" participants were demonstrated by the stages in the process of making the scientific work produced, although it was difficult to prove whether it was a pure thought or external influence from their supervisor, the experience they got became the fact that they had done scientific work. Real evidence from the contestants in designing and conducting experiments is in the work they make. The plastic bricks they produce are the result of a trial process, that not all types of plastic can be made into plastic bricks is one of the facts and part of the proof of their scientific work effort. Processing of gldogan leaf waste into colour pigments used as a paint material, followed by extracting information through a literature study on how the properties of gldogan leaves is a form of scientific work carried out by different groups. Meanwhile, other groups produce electronic test kits to determine how free a person is from the effects of the covid-19 virus. Even though the works they produce are

not yet technological products that can be manufactured as mass industrial products, their innovations are proof of the participants' work skills and critical thinking.

Communication is the process of exchanging stimuli, signals, symbols, and information in both verbal and non-verbal forms from the sender to the sender of the message to change cognitive, affective and psychomotor aspects (Mundakir, 2006). Communication is a form of skill that consists of the ability to know diagrams, graphs and tables of experimental results. Able to explain empirical information in the form of diagrams, graphs and tables. Communication skills in practice are the ability to express an idea or research results in written or oral form. Science communication skills can be trained through students' direct involvement in processes that provide a practical experience (Luisi et al., 2019), not only teaching students how to communicate effectively, but also practising the ability to explain and convey explanations. Based on the explanation of communication skills as SPS, the communication skills of participants in scientific work competitions can be observed during the presentation of their works. Explanation of the results of experiments on making plastic bricks shows that their communication to describe in full starting from the preparation stage, the trial process to produce finished products is a systematic communication ability. The same thing was also done by other groups who explained that regarding the use of gldogan leaf waste as paint colour pigments and electronic product products as an accelerated test for Covid-19, is an effective scientific communication ability. Their ability to convey the results of scientific work is proof that their skills in communication skills as SPS skills are quite good. This effective communication has implications for the concept of deeper thinking, an explanation of the questions submitted by the judges on indicators of communication ability becomes corroborating evidence that communication skills can improve critical thinking skills.

## Conclusion

The scientific work competition for junior high school students organized by SMA Avicenna Cinere entitled "Avicom" is a form of active learning activity that involves SPS skills and develops the contestants' critical thinking skills. Analysis of all data sources shows an increase in SPS capabilities. Competitors have SPS competence in three basic skills which are shown in the form of scientific work products, scientific work articles, and presentation of scientific papers. Observing skills are demonstrated in conveying the background of scientific work, skills in designing and conducting experiments are demonstrated in the process of making scientific work products, and communication skills are demonstrated in presenting and explaining scientific work. SPS competence in these three indicators has an impact on increasing the participants' critical thinking skills. The literature study provides an illustration of a correlation between SPS ability and critical thinking skills improvement, however, a quantitative study of this correlation is a recommendation for further study.

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