# RBL-STEM Model Learning Activity Framework: VCO (Virgin Coconut Oil) Development Analysis Using Artificial Neural Network to Improve Student Metacognition

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**Abstract.** The ability to metacognition students is needed in welcoming the era of the industrial revolution 4.0 and technological disruption as it is today. Metacognition is a person's ability to regulate and control cognitive processes in learning and thinking so that they become more effective and efficient. Metacognition is generally related to the dimension of one's thinking which can be divided into two parts, namely, the awareness that a person has about his thinking (selfawareness of cognition) and the ability of a person to use his consciousness to regulate his thought processes (self-regulation of cognition). This metacognition can be achieved by cultivating High Order Thinking Skills. Therefore, a research-based learning or RBL (Research Based Learning) approach with a STEM (Science, Technology, Engineering and Mathematics) approach is needed. This study aims to develop a framework of learning activities with the RBL model with a STEM approach through the analysis of making VCO (Virgin Coconut Oil) in improving student metacognition using artificial neural networks. The method used in this study is a narrative qualitative method, which is to develop a syntax of the RBL learning model with a STEM approach. The main results of the study are in the form of a learning activity framework in the form of a description of the four STEM elements and a description table of the six stages of RBL learning activities that will be carried out in the classroom.

**Keywords:** Artificial Neural Network · Metakognition · RBL · STEM · VCO

## 1 Introduction

The ability to metacognition students is needed in welcoming the era of the industrial revolution 4.0 and technological disruption as it is today. Metacognition is a person's ability to regulate and control cognitive processes in learning and thinking so that they become more effective and efficient. Students can solve problems, have awareness of their thought processes, and control their way of thinking through their metacognition skills.


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Metacognition can be used by students in monitoring their cognition ability, namely the extent of understanding a problem. The existence of metacognition in the context of learning, students can know how they learn, know their learning abilities and modalities, and know the most optimal learning strategies in order to learn more effectively and efficiently. However, in fact, the biology learning carried out so far only emphasizes the mastery of the material obtained by the written test, while the space for metacognition is less optimized, so that learning activities like this make students tend to learn by remembering or memorizing, without understanding what the teacher is actually teaching. As a result, when students are faced with problems, students have difficulty solving them, thus causing student learning outcomes to be low [1].

In relation to the independent curriculum that has been launched by the government today, learning in the classroom must be able to motivate students to work, so that not only the acquisition of material is the main goal, but much more important is the ability of students to metacognition in solving problems in real life. One of the learning models that is able to develop students' metacognition ability is the RBL (Research Based Learning) learning model which is integrated with the STEM (Science, Technology, Engineering and Mathematics) approach. Research on RBL is widely carried out regarding the effectiveness in improving higher-order thinking skills [2], critical thinkin [3], problem solving [4], and metaconitive [5].

In the STEM approach, these four elements are always involved in learning, especially the use of science and technology which are important elements in improving students' metacognition abilities. Therefore, in this study, an analysis of the manufacture of VCO (Virgin Coconut Oil) will be carried out in increasing student metacognition using artificial neural networks. Furthermore, how the results of this analysis are applied in the classroom, the syntax of the RBL-STEM learning model will be developed as has been done in research that has been published by [6].

Metacognition skills are one type of higher-order thinking skills (HOTS) that students need in the 21st century [7]. This metacognition skill can be taught. Based on the results of the study, students who have been taught metacognition skills tend to have better learning outcomes [8]. According to [9] metacognition skills can be divided into metacognition knowledge and metacognition regulation. Metacognition knowledge includes declarative, procedural, and conditional knowledge while metacognition settings consist of three main components, namely planning, monitoring, and evaluating. Then students' metacognition skills are expected to grow by involving the Internet of Things (IoT), namely by utilizing programming software with reference to the use of machine learning software, namely MATLAB with artificial neural network algorithms.

## 2 Research Methodology

This research uses narrative qualitative research methods. This research was developed to be applied in high schools, namely junior high schools or high schools. This research started from collecting some literature to review related to RBL and STEM. In this study, exploration was also carried out related to STEM problems. Then a syntactic framework for integration between the RBL learning model and the STEM approach in solving the STEM problematics was developed. Furthermore, learning outcomes,

learning objectives, indicator development, and sub-indicators related to metacognition will also be presented. The research continued by outlining the role of four STEM elements consisting of Science, Technology, Engineering and Mathematics in solving the problems above. The next step is to describe each RBL phase complete with learning activities, complementing the indicators and sub-indicators of metacognition.

## 3 Result

*A. Syntax of RBL Learning Model with STEM Approach*

Syntax or framework to integrate the RBL (research-based learning) learning model with a STEM (Science, Technology, Engineering, and Mathematics) approach in improving students' metacognition skills in analyzing VCO (Virgin Coconut Oil) oil manufacturing problems using artificial neural networks will be presented below. In the initial phase of the RBL learning model syntax, students are asked to understand the problem posed, then students are encouraged to develop problem-solving strategies, collect information from various literature using search engines, then collect the data and at the same time analyze it, and finally report it.

The problem that exists today is that Indonesia has the largest coconut plantation in the world, unfortunately Indonesia related to coconut products is that Indonesia still exports in the form of ordinary coconut oil, while other countries for example the Philippines have exported the world with superior oil, namely in the form of Virgin Coconut Oil (VCO) [10]. Due to the lack of diversification that coconut farmers can do, VCO production in Indonesia is developing slowly. Even though the price of VCO is relatively high, which is three times that of ordinary coconut oil, so this VCO has enormous potential to be developed in Indonesia and can prosper coconut farmers. In addition, according to [11] VCO is also very useful in the world of health, for example as an antimicrobial and antiviral.

Furthermore, students are asked to develop breakthroughs related to the processing of coconut into VCO through google, youtube, google scholar and other online media to find a new breakthrough. The main breakthrough that we already understand is the use of coconut fruit to become VCO. However, an analysis of effectiveness and efficiency needs to be carried out to find out the benefits of utilizing this alternative source used. Schematically the following is presented stem problems and a description of their four elements in the manufacture of VCO (Fig. 1).

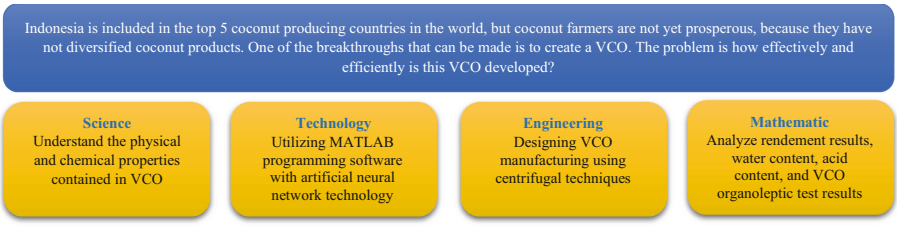


**Fig. 1.** STEM problems in processing coconut into VCO

After understanding the STEM problems above, the next step is to conduct narrative qualitative research by following the syntax of RBL-STEM integration as follows: (1) The first step is to determine the fundamental problems related to the lack of diversification of coconut products by coconut farmers, thus causing their lack of income. In addition, making this VCO opens up opportunities for researchers to better know the potential of VCO as an antimicrobial and antiviral, because there is currently a Covid-19 virus pandemic in the world; (2) The second step is to develop a solution to a real-world problem related to making VCO; (3) The third step is the collection of data and the search for references needed with the help of internet technology related to the creation of VCO; (4) The fourth step is to develop the aspects needed by students in the research process (the potential of coconut fruit; the content of coconut fruit; the design of making VCO, the content of VCO, the benefits of VCO); (5) The fifth step is to analyze the effectiveness and efficiency of making VCO; and (6) The sixth step is to write in the form of a research report on the results of the creation of VCO and present it. More systematically, the RBL-STEM learning model framework is as follows (Fig. 2).

*B. Student learning outcomes and objectives*

The expected learning outcomes in this study through the RBL learning model with a STEM approach are that students can increase their metacognition in solving problems making VCO from coconut. Students know the technique of making VCO through centrifugation technique. Students can also test whether the VCO obtained using centrifugation techniques is effective and efficient. Effective means that it can be used as needed while efficient is the cost needed to make it affordable, so that it can help solve problems that exist in society. Students are also expected to be able to know the content or composition of VCO so that it can be beneficial for health.

The learning objectives in this study are that RBL model learning with a STEM approach allows students to develop knowledge and skills in the fields of Science, Technology, Engineering, and Mathematics. Each element in the STEM model has its own

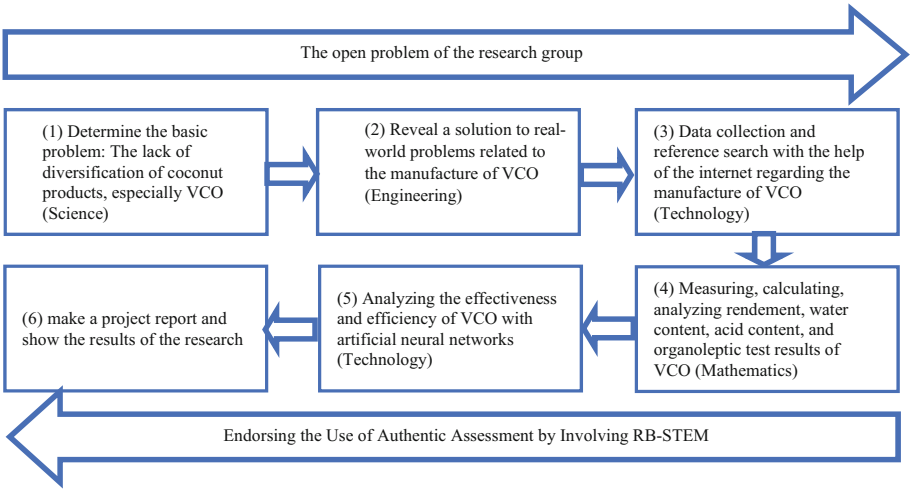


**Fig. 2.** RBL-STEM learning model framework in VCO creation

learning objectives. The learning objectives on the four STEM elements can be described as follows.

*Science* - after carrying out the research process, students are expected to be able to:

- Choosing a good coconut fruit for the material for making VCO.
- Understand the nutritional and chemical content of coconut fruit.
- Understand how to make VCO from coconut fruit.
- Knowing the benefits of VCO for health.

*Technology* - after carrying out the research process, students are expected to be able to:

- Utilize internet, google scholar, or youtube tutorials to know how to create a VCO.
- Utilizing MATLAB programming software to analyze the effectiveness and efficiency of VCO creation using artificial neural network analysis techniques.

*Engineering* - after carrying out the research process, students are expected to be able to:

- Designing the manufacture of VCO from coconut fruit by centrifugation.
- Carry out the process of making VCO based on the design that has been made.

*Mathematic* - after carrying out the research process, students are expected to be able to:

- Make calculations of rendement, moisture content, acid content, and VCO organoleptic test results.
- Perform calculations for the production of VCO from coconuts on a larger scale by using an Artificial Neural Network assisted by MATLAB software programming.

*C. Elements of Coconut Fruit Utilization in Efforts to Make VCO*

- Science Element

Coconut fruit is known to be rich in essential nutrients that are beneficial for the health of the body, such as B vitamins, vitamin C, vitamin E, as well as various types of minerals such as iron, selenium, phosphorus, potassium, zinc, and magnesium. In addition, coconut fruit also contains a lot of antioxidants that are good for body health and skin beauty. Coconut fruit can be processed into virgin coconut oil or VCO (virgin coconut oil). According to [11], VCO is an oil obtained from copra (dried coconut juice) or from coconut milk juice. The oil content in the flesh of old coconuts is estimated at 30%–35%, or the oil content in copra reaches 63–72%.

The need for VCO Oil over time is increasing along with the increasing cost of other types of oil. Various ways have been done to obtain the processed products of VCO oil, ranging from traditional to modern methods. The most valuable coconut product is VCO. VCO is widely used in the pharmaceutical, cosmetic, infant formula, and as a high-quality cooking oil. VCO oil can be used to overcome various diseases in humans. VCO is also used to treat cancer, hepatitis, osteoporosis, diabetes, heart disease, obesity, and various diseases caused by microbes [12]. The content of unripe, half-ripe, and ripe coconuts is presented in Table 1.

**Table 1.** COMPARISON OF COMPOSITIONS IN UNRIPE, HALF-RIPE AND RIPE FRUITS

| Analysis (for 100 gr) | Unripe Fruit | Half Ripe Fruit | Ripe Fruit |
|---|---|---|---|
| Calorie | 65 kal | 178 kal | 356 kal |
| Protein | 1 gr | 3.8 gr | 3.3 gr |
| Fat | 0.7 gr | 12.3 gr | 32.8 |
| Carbohydrates | 13.4 gr | 9.7 gr | 13.6 gr |
| Calcium | 16.3 mg | 9.4 mg | 20 mg |
| Phosphorus | 28 mg | 7.6 mg | 20.3 mg |
| Ferrum | 0.8 mg | 1.2 mg | 1.8 mg |
| Activity of vit. A | 0.01 IU | 9.01 IU | 0.01 IU |
| Thiamin | 0.0 mg | 0.4 mg | 0.2 mg |
| Ascorbic Acid | 3.7 mg | 4.0 mg | 1.6 mg |
| Water | 82.3 gr | 67 gr | 44.5 gr |
| Edible | 54.5 gr | 54.8 gr | 54.6 gr |

- Technology Element

Information and computer technology (ICT) including the internet in it is currently developing very rapidly. Moreover, the existence of a 5G internet network allows everything to be connected to the internet (internet of things). With artificial intelligence technology, Google, and Youtube can be used as the main media for students to learn VCO-related material. Many articles related to the benefits of coconut fruit and VCO can be accessed by Google, and there are many tutorials via Youtube that can be seen related to making VCO from coconut (Fig. 3).

Furthermore, Matlab programming software (Fig. 4) is used, to predict the rendement results, water content, and VCO acid content obtained from the centrifugation results of coconut milk cream. According to Anwar and Salima (2016), rendement are calculated to determine the amount of VCO obtained from the coconut milk centrifugation process.

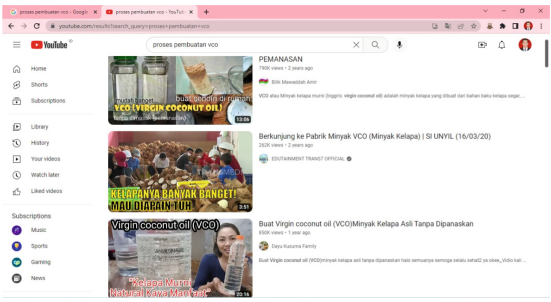


**Fig. 3.** The use of information technology and the internet to identify the characteristics of coconut fruit, the manufacture of VCO and the use of ANN with MATLAB

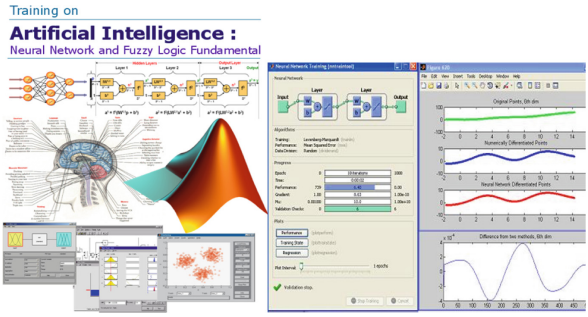


**Fig. 4.** Use of Matlab software for rendement oil, moisture content, and acid content analysis

The rendement is determined by calculating the weight of the oil produced and then compared to the weight of the coconut milk cream used. Determining the moisture content in the oil is very important because the presence of water in the oil will result in a hydrolysis reaction that can cause the oil to smell rancid. The higher the moisture content in the oil is most likely the fatty acid content is also high. Free fatty acids produced by the hydrolysis process can affect the flavor of the oil. So it can be concluded that the lower the free fatty acids, the better the quality of the VCO oil produced.

- Engineering element

The elements in the engineering department are related to designing the manufacture of VCO from coconuts based on previously made designs. There are several kinds of VCO manufacturing techniques, which are heating, oil fishing, fermentation, and centrifugation techniques. In this study, the manufacture of VCO was carried out through centrifugation techniques, the method was as follows: (1) Choosing coconuts that are still good and ripe; (2) Peel the coconut fruit and then take the flesh of the fruit; (3) The flesh of the coconut fruit is grated using a coconut grate machine or manually; (4) Grated coconut then added water in a ratio of 1:1.5 (1 L of water for 1.5 coconuts), then grated coconut kneaded to produce coconut milk; (5) Coconut milk is filtered so that it does not mix with grated coconut; (6) Coconut milk is poured into a transparent container and allowed to stand for 1 h so that coconut milk cream and coconut milk skim are formed. Coconut milk cream is at the top because it contains oil, while coconut milk skim is at the bottom because it contains water and protein; (7) Coconut milk cream is taken and put into a centrifugal tube with rotating of 5,000 rpm, 7,500 rpm, and 10,000 rpm. Lap times are 10, 15, and 20 min; (8) Take the centrifugal tube and inside there are 3 layers, namely VCO oil (top), water, and blondo; (9) Take the VCO using a pipette slowly and then filter it with filter paper so that a clear VCO is obtained.

- Mathematics Element

In this mathematical section, coconut weight, grater weight, pulp weight, coconut milk yield, and VCO produced (Table 2) will be studied. Based on Table 3, it is known that different coconut weights can provide different variations in results. In addition, it will be studied regarding the yield results, water content, and fatty acid content of

**Table 2.** CALCULATION OF THE WEIGHT, GRATER, PULP, COCONUT MILK, AND VCO PRODUCED

| Sample | Weight (g) | Grater (g) | Pulp (g) | Coconut Milk (g) | VCO (ml) |
|---|---|---|---|---|---|
| Coconut 1 | 855 | 854 | 553 | 1.254 | 163 |
| Coconut 2 | 895 | 863 | 570 | 1.295 | 166 |
| Coconut 3 | 910 | 877 | 584 | 1.310 | 170 |

centrifugation of coconut cream with variations in revolutions of 5,000 rpm, 7,500 rpm, and 10,000 rpm, as well as rotation times of 10, 15, and 20 min (Fig. 5).

Furthermore, the use of artificial neural networks is a technique or approach to information processing inspired by the workings of the biological nervous system, especially in human brain cells in processing information. Artificial neural networks consist of a large number of information processing elements (neurons) that are interconnected and work together to solve a specific problem, which in general is for the purposes of classification, clustering, and prediction.

In this study, ANN was used for predictive purposes. After students understand how to make VCO for one to two coconuts, students are expected to be able to make predictions by using ANN and MATLAB programming to find out the VCO data of coconuts, each of which contains data on the weight of the grater, the weight of the pulp,

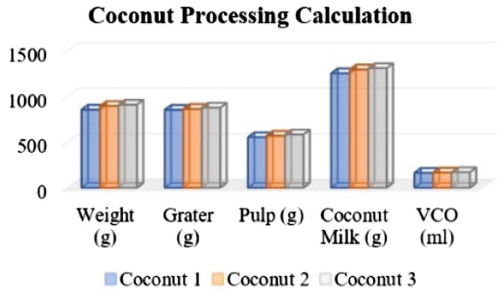


**Fig. 5.** Weight calculation diagram, grater, pulp, coconut milk, and VCO

**Table 3.** CALCULATION OF OIL RENDEMENT, MOISTURE CONTENT, AND ACID CONTENT OF VCO

| VCO | Rotating speed (rpm) | Time (min.) | Rende-ment (%) | Moisture content (%) | Acid Content (ml KOH/gr) |
|---|---|---|---|---|---|
| VCO 1 | 5.000 | 10 | 19.13 | 0.27 | 12.44 |
| VCO 2 | 7.500 | 15 | 22.53 | 0.25 | 12.10 |
| VCO 3 | 10.000 | 20 | 25.89 | 0.21 | 11.72 |

and the yield of coconut milk. The phases carried out is to simulate 400 coconut data then conduct training on 75% of the data and test 30% of the data to produce the best ANN model that can be used to predict new data.

There are three models that will be studied in the mathematical aspects of this STEM, namely **Feedfowardnet, Fitnet and Cascadefowardnet** by basing themselves on three ANN architectures, namely **ANN (8,7,7), ANN (8,5,9) and ANN (7,6,6).** From the simulation results, the model with the best architecture will be selected that produces the largest regression value close to number 1 and produces the smallest MSE training and MSE testing (Fig. 6).

Based on the results of Matlab programming with an artificial neural network model, using the network model (8,7,7) results were obtained related to the comparison of output data and data targets as well as regression values in both simulations for the acquisition of coconut milk and virgin coconut oil (Figs. 8 and 9).

From the data, Fig. 7 shows simulated training data from 300 coconuts and testing 100 coconuts in producing VCO. From these results, it shows that the **ANN Feedforwardnet model (8,7,7)** provides a regression accuracy of 0.99775, with a fairly stable convergence of errors (errors) that is decreasing starting from error = 10^5 in the first epoch to achieving its best training performance at epoch 745 with MSE Training = 230.1257 and MSE Testing = 216.450. The comparison graph between the output and target data generated from this model Fig.s interpolation of data that almost resembles the target data in a training simulation or testing data (Table 4).

*D. RBL learning with a STEM approach in the problem of making VCO from coconut.*

In this section, one by one the six phases of RBL learning models with a STEM approach. The six phases will Fig. out how students are in the learning process using the

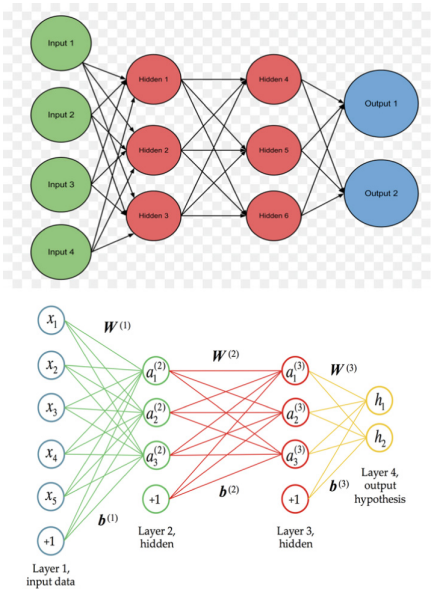


**Fig. 6.** Artificial neural network architecture with ANN (3.3) and ANN (4.4) architectures

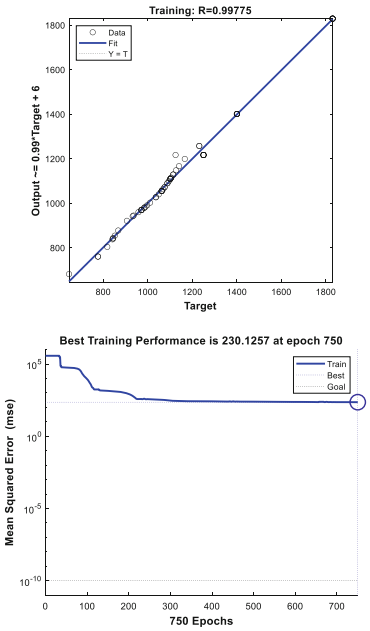


**Fig. 7.** Programming results related to regression and performance values of 70% of available training data

RBL learning model with a STEM approach about the use of coconut fruit as a material for making VCO to improve student metacognition.

1. The first phase of Science, which is to determine the fundamental problems related to the lack of diversification of coconut products by coconut farmers, thus causing their lack of income. In addition, making this VCO opens up opportunities for researchers to better know the potential of VCO as an antimicrobial and antiviral, because there is currently a Covid-19 virus pandemic in the world. RBL-STEM learning activities in phase 1 can be seen in Table 5.
2. The second phase of technology is to develop a solution to real-world problems related to making VCO from coconut. RBL-STEM learning activities in phase 2 can be seen in Table 6.
3. The third phase of Technology is data collection and reference tracing needed with the help of internet technology related to making VCO from coconut. RBL-STEM learning activities in phase 3 as shown in Table 7.
4. The fourth phase (Mathematics-Engineering) is to develop the aspects needed by students in the research process (the potential of coconut fruit; coconut fruit content; including measuring, calculating the total amount of coconut weight, grated weight, and coconut pulp weight, rendement, water content, and fatty acid content). RBL-STEM learning activities in phase 4 can be seen in Table 8.

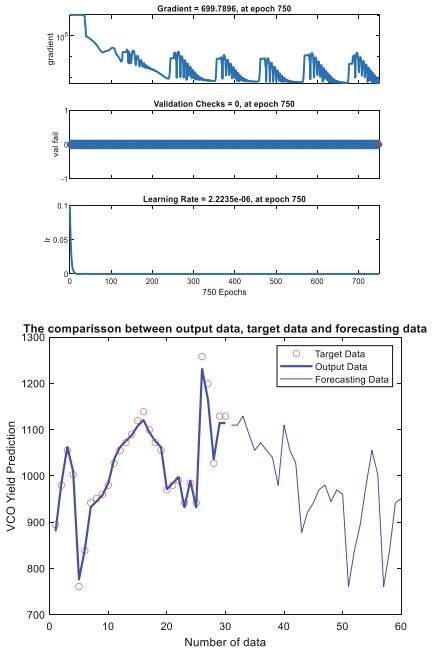


**Fig. 8.** Programming results related to learning rate and testing training data between target and output

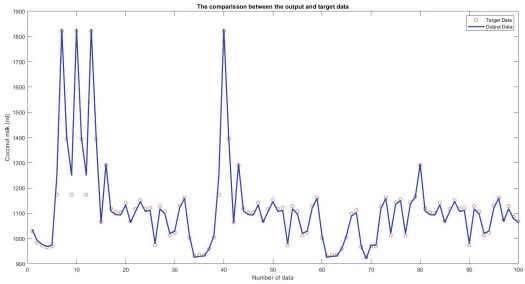


**Fig. 9.** Programming results related to testing data and comparison between target and output

5. The fifth phase (Mathematics) is to develop a way to test the correctness of the hypothesis of making VCO from coconut fruit. RBL-STEM learning activities in phase 5 can be seen in Table 9.
6. The sixth phase (RBL Report) is carried out by students to present research results and make RBL-STEM research reports. In this case, students will take part in a focus group discussion (FGD), so that they can observe students' metacognition skills. For more details, see Table 10.

*E. Student Metacognition Ability Assessment Instrument Framework*

**Table 4.** COMPARISON OF EFFECTIVENESS BETWEEN MULTIPLE MODELS AND NETWORK ARCHITECTURES

| Model | Architecture | Time | Regression | MSE Training | MSE Testing |
|---|---|---|---|---|---|
| Feedforwardnet | ANN(8,7,7) | 0,2680 | **0, 99775** | **230.1257** | **216.4500** |
| Fitnet | ANN(8,7,7) | 0,3330 | 0,99638 | 304.8764 | 312.9189 |
| Cascadeforwardnet | ANN(8,7,7) | 0,2940 | 0,99659 | 255.6004 | 260.2291 |
| Feedforwardnet | ANN(8,5,9) | 0,7390 | 0,99765 | 315.6004 | 316.4452 |
| Fitnet | ANN(8,5,9) | 0,7260 | 0,99767 | 310.7492 | 343.4459 |
| Cascadeforwardnet | ANN(8,5,9) | 0,7950 | 0,99667 | 303.6046 | 314.6655 |
| Feedforwardnet | ANN(7,6,6) | 0,9910 | 0,99555 | 231.5132 | 241.0834 |
| Fitnet | ANN(7,6,6) | 0,8420 | 0,99568 | 252.3428 | 253.0834 |
| Cascadeforwardnet | ANN(7,6,6) | 0,7780 | 0,99551 | 267.0308 | 275.0510 |

**Table 5.** RBL-STEM LEARNING ACTIVITIES AT PHASE 1

| **Phase 1** | **Learning Activities** |
|---|---|
| Propose/determine fundamental problems related to the lack of diversification of coconut products by coconut farmers (Science). | a. Teachers ask students if they have ever seen or consumed VCO oil from coconut? |
| | b. The teacher shows the students about VCO from coconut and asks if they can develop or think about how to make it. |
| | c. Students are working on developing how to make VCO from coconut and trying to analyze whether it can solve the problem at hand. |
| | d. Students begin group discussions |

The metacognition ability of students in the form of an assessment framework for metacognition ability instruments can be seen in Table 11.

The learning tool development phase will be used by the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model developed by Raiser and Mollenda. The model consists of analysis, designing, developing, implementation and evaluation. The first phase, the analysis phase, is to analyze student characteristics, materials, learning processes, and learning media to be used. The second phase, the design phase, is to design the integration of the RBL model into the STEM approach. In this phase, teaching materials, namely syllabus, RPP, LKS, pre-test, post-test, and other assessment instruments, are prepared by researchers. The third phase, the development phase, is a trial of teaching materials and instruments to check the validity of teaching materials and practicality. The validation results are in the form of content validity, format validity, language validity, and practicality level. The fourth phase, the implementation phase, is to determine the effectiveness of RBL-STEM teaching materials in increasing student

**Table 6.** RBL-STEM LEARNING ACTIVITIES AT PHASE 2

| **Phase 2** | **Learning Activities** |
|---|---|
| Develop a solution to real-world problems related to making VCO from coconut (Technology). | a. The teacher guides the students to discuss breakthroughs on how to solve problems related to making VCO from coconut. |
| | b. The teacher explained to the students that VCO can be made from coconut fruit which we can find easily and can be done by ourselves at home. |
| | c. Students are asked to find a way or technique for making VCO from coconut fruit. |

**Table 7.** RBL-STEM LEARNING ACTIVIES AT PHASE 3

| **Phase 3** | **Learning Activities** |
|---|---|
| Data collection and reference tracing needed with the help of internet technology related to the manufacture of VCO from coconut (Technology). | a. Students under the guidance of the teacher browse references from the internet and download files related to the manufacture of VCO from coconut fruit. |
| | b. Data collection related to the manufacture of VCO from coconut fruit. by browsing journals / articles and videos related to making VCO from coconut fruit. |
| | c. Students can use various reference sources, for example, namely Google Shcolar, Orcid, Mendeley, Scopus, Publons, Slideshare, Youtube, and so on. |
| | d. Students develop techniques for making VCO from coconut fruit based on internet searches. |

metacognition in solving VCO manufacturing problems by utilizing coconut fruit. The fifth phase, the evaluation phase, is a reflection activity to assess whether the application of RBL model learning materials with a STEM approach can increase student metacognition in solving VCO manufacturing problems by utilizing coconut fruit.

**Table 8.** RBL-STEM LEARNING ACTIVITIES IN PHASE 4.

| **Phase 4** | **Learning Activities** |
|---|---|
| Develop aspects needed by students in the research process including the potential of coconut fruit; coconut fruit content; including measuring, calculating the total amount of coconut weight, grated weight, coconut pulp weight, rendement, water content, and fatty acid content (*Mathematics-Engineering*). | a. Students choose coconuts that are of good quality to make VCO. |
| | b. Students choose techniques to be used in making VCO from coconuts such as centrifugal techniques. |
| | c. Students identify the content of coconut fruit. |
| | d. Students take measurements, calculate the total amount of coconut weight, grater weight, coconut pulp weight, rendement, water content, and fatty acid content. |
| | e. Students write down the measurement results and their identification, for example in the form of a Table. |

**Table 9.** RBL-STEM LEARNING ACTIVITIES IN PHASE 5.

| **Phase 5** | **Learning activities** |
|---|---|
| Develop a way of testing the correctness of the hypothesis of making VCO from coconut fruit (Mathematics) | a. Students identify the technique of making VCO whether it is in accordance with the established procedures. |
| | b. Students prove that they have succeeded in making VCO from coconut fruit with centrifugal techniques according to what they choose. |

**Table 10.** RBL-STEM LEARNING ACTIVITIES IN PHASE 6.

| **Phase 6** | **Learning Activities** |
|---|---|
| Presenting research results and making RBL-STEM research reports related to the use of coconut fruit as material for making VCO to improve student metacognition. | a. Students develop research reports on the use of coconut fruit as a material for making VCO to improve student metacognition. |
| | b. Students make presentations in front of the class to conduct focus group discussions (FGD). |

(*continued*)

**Table 10.** (*continued*)

| Phase 6 | Learning Activities |
|---|---|
| | c. The teacher evaluates and clarifies all the results of student research activities. |
| | d. The teacher observes students' metacognition skills using observation sheets. |

**Table 11.** STUDENT METACOGNITION ABILITY ASSESSMENT INSTRUMENT FRAMEWORK

| Indicator | Information | Test Material |
|---|---|---|
| *Planning* | Planning Phase helps students recall previously acquired knowledge so as to facilitate the planning process of understanding the material being studied. | 1. Identify the underlying problems associated with the lack of diversification of coconut products by coconut farmers, thus causing their lack of income. In addition, making this VCO opens up opportunities for researchers to better know the potential of VCO as an antimicrobial and antiviral, because there is currently a Covid-19 virus pandemic in the world.<br>2. Discuss a solution to a real-world problem related to making VCO from coconut oil. |
| *Monitoring* | Monitoring Phase plays a role in monitoring student activities during the learning process. | 1. Search and collect data through searching for needed references with the help of internet technology related to the creation of VCO.<br>2. Identify the aspects needed in the research process (potential of coconut fruit; coconut fruit content; VCO manufacturing design, VCO content, VCO benefits). |
| *Evaluating* | Evaluating Phase evaluate plays a role in improving student learning outcomes because students can evaluate and correct deficiencies during the learning process. | 1. Analysis of the effectiveness and efficiency of making VCO.<br>2. Make a report on the results of the research on the creation of VCO and present it in front of the class. |

## 4 Discussion

The development of a RBL-STEM model learning activity framework in solving the problem of making VCO by utilizing coconut fruit to improve student metacognition is very useful to learn. These results become guidelines in conducting further research.

There are at least two more research activities that can be carried out further, namely: (1) developing RBL-STEM learning materials with the ADDIE development model, (2) Analyzing the implementation of RBL-STEM learning materials in improving student metacognition in solving VCO making problems by utilizing coconut fruit. The RBL-STEM combination learning activity framework is very effective in realizing student metacognition when applied in learning in schools as conducted by several studies on the application of RBL and STEM in the classroom, can be found at [12–15].

## 5 Conclusion

The results of this study have shown how the syntax of the RBL learning model is integrated with the STEM approach. The main result is a framework of learning activities with an RBL model with a STEM approach, namely the use of coconut fruit as a material for making VCO as an effort to increase student metacognition. The results of the study are in the form of a learning activity framework in the form of a description table consisting of six phases and each phase contains a description of the learning activities carried out. Included in the results of this study is to develop a framework of test instruments related to student metacognition. With the results of this study, further research related to device development and RBL-STEM implementation analysis can be carried out easily.

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