



The development of RBL-STEM learning materials to improve the student's forecasting thinking skills to solve resolving efficient dominating set problem

Ahmad Muklisin^{1*}, Arika Indah Kristiana², I Made Tirta³, Dafik⁴

¹ Department of Mathematics Education Postgraduate, University of Jember, Indonesia

² Department of Mathematics Education Postgraduate, University of Jember, Indonesia

³ Jurusan Matematika FMIPA Universitas Jember, Indonesia

⁴ CGANT-Research Group, University of Jember, Indonesia

* Corresponding Author: Ahmad Muklisin

Article Info

ISSN (online): 2582-7138

Volume: 04

Issue: 02

March-April 2023

Received: 14-02-2023;

Accepted: 09-03-2023

Page No: 194-199

Abstract

Forecasting thinking skills are the ability to apply the scientific method in understanding, predicting, discovering knowledge effectively problem. The Indicators of forecasting thinking skills include and identifying the solving characteristics of problems, using patterns recognition for prediction, expressing any possibility in situations that have not been observed. The thinking skills are not possessed optimally by students. The aims of the research is to develop of RBL-STEM learning materials to improve the student's forecasting thinking skills to solve resolving efficient dominating set. The research shows that learning materials that have been developed must obtain valid, practical, and effective criteria. The average score for each aspect obtained on validity, criteria in this study is 3.5 for format validity, 3.6 for content validity and 3.5 for writing format validity. The score on the practicality aspect in this study is 3.8 for media format and 3.9 for language and writing on media. While the effectiveness scores in this study is 85% for student learning achievement test results, 95.5% for student activity results and 81.8% for student response results.

DOI: <https://doi.org/10.54660/IJMRGE.2023.4.2.194-199>

Keywords: RBL-STEM, forecasting, dominating, development

Introduction

Education is a factor that plays a very important role in the process of progress of the country, both formal education at every level of education, to informal education that develops in each individual life in society. Education in the world undergoes various kinds of reforms from time to time in order to correct things that are not right with new things that are better or can correct previous shortcomings. The well-known education reform in recent years is education with STEM approach.

STEM is an approach that consists of four disciplines and their epistemological practices. The STEM approach is a very appropriate combination of problems in the real world with mathematics learning that can provoke students to find solutions in drawing lines from abstract concepts of each aspect, namely science, technology, engineering, and mathematics in building and developing various mathematical thinking skills.

The majority of mathematical thinking skills prioritize the development of problem-solving skills. Research-based learning (RBL) is a learning that emphasizes the activity of searching and browsing repeatedly and continuously which is done by students individually or in groups of Singh et al. This learning model is also considered capable of bringing out various mathematical thinking skills in students that are needed in the 21st century, such as forecasting skills.

Forecasting thinking skills are one of the skills that are integral to the Science Process Skills (KPS), while KPS itself is the ability to apply the scientific method in understanding, developing and discovering science. KPS is very important for every student as a provision to use the scientific method in developing science and is expected to acquire new knowledge or develop

knowledge that is already known. Graph theory is a branch of mathematics that studies the properties of graphs that are widely applied in various fields of science, such as physics, chemistry, biology, architecture, transportation, computer technology, social economics, and others (Yoga, 2020). One of the discussions contained in this graph theory is Resolving efficient dominating set. In graph theory, of course, it is inseparable from the problem of proof. In solving problems about resolving efficient dominating sets, students will be trained to find ideas, develop strategies from what is known to be able to formulate and develop mathematical evidence of the given problem. Therefore, the ability to prove students is needed in developing graphs and solving problems resolving efficient dominating sets.

Based on the problems that have been explained, material

development will be carried out using STEM-based research-based learning model that aims to improve student forecasting skills. Therefore, this study is titled "Development of RBL-STEM Learning Materials to Improve Students' Forecasting Thinking Skills Analyzing resolving efficient dominating sets."

Research Method

The stages used in this study refer to the development of Thiagarajan, namely the 4D-Model which consists of the defining stage, the design stage, the development stage, and the disseminate stage (Hobri, 2021).

Here are the stages of research that refer to the development of Thiagarajan.

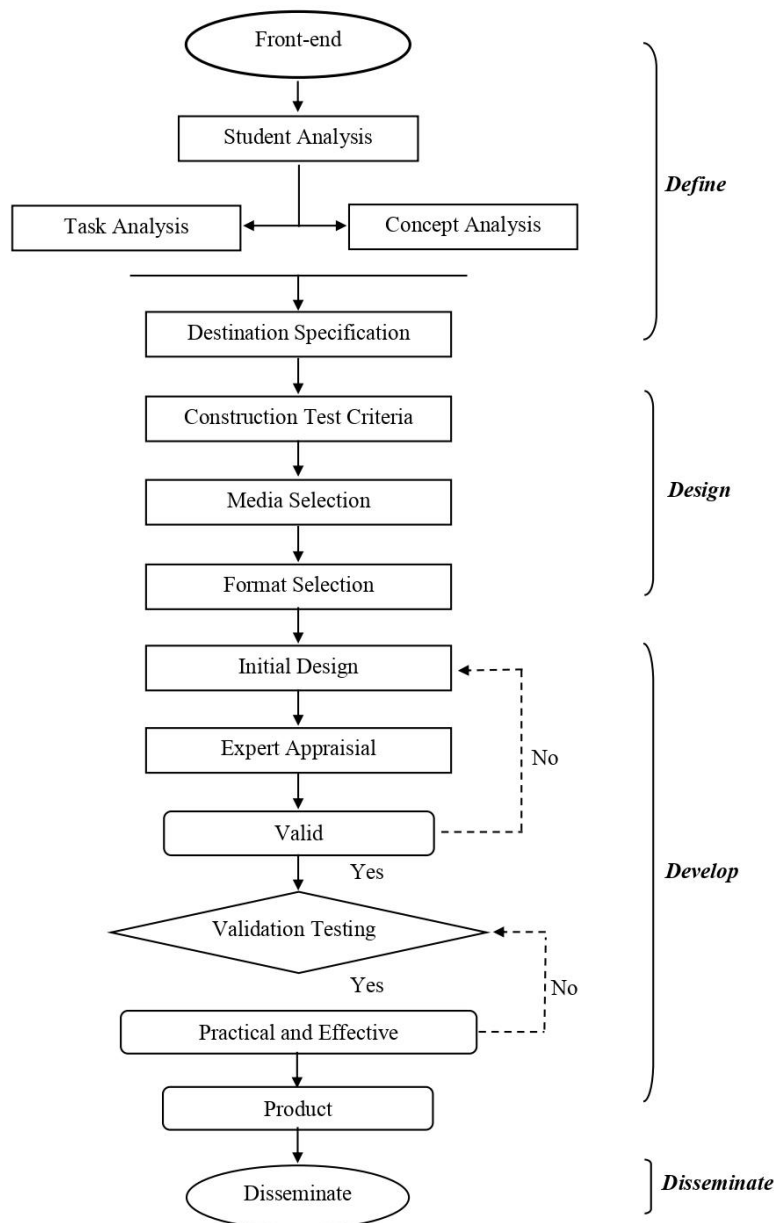


Fig 1: Prosedure of Research

**Results and Discussion
Stem Components**

This research uses a research-based learning model with

STEM approach to help students develop knowledge and skills in the fields of Science, Technology, Engineering, and Mathematics. The description of STEM components is as

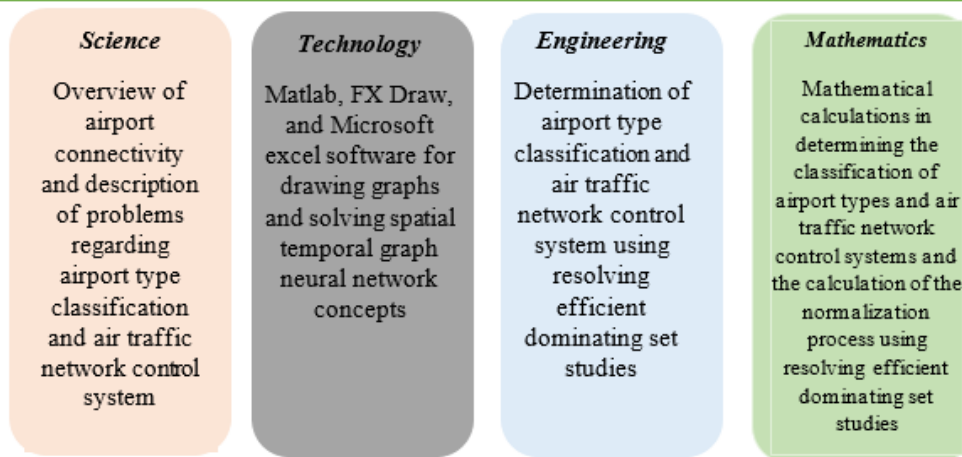
follows:

In the field of science (science) students are expected to be able to understand the problems presented regarding the classification of airport types and air traffic network control systems and determine airports that have the potential for density anomalies and no potential for anomaly density. (Technology) Students are expected to be able to use the internet in finding notion and solutions to the problems provided. In addition, students can search and learn the latest studies on the topic of Resolving efficient dominating sets.

(Engineering) students are expected to be able to develop the topic of resolving efficient dominating sets in several graphs, and can solve problems regarding the classification of airport types and air traffic network control systems. (Mathematics) Students can apply the concept of resolving efficient dominating sets in several graphs and the formation of graphs from the connection between airports, starting from labeling points, determining the dominator and then calculating the connectedness of the set of each point to the dominator.

Briefly it can be described as follows

The classification of airport types and air traffic network control systems is a system that exists on flights in Indonesia. The classification of airport types in Indonesia are divided into three, which is primary, secondary and tertiary (<https://hubud.dephub.go.id/>) airports while the air traffic network control system is a flight navigation operation management system in Indonesia which is currently divided into two parts, namely the Jakarta Air Traffic Service Center (JATSC) and the Makassar Air Traffic Service Center (MATSC).



The stages of device development consist of defining, designing, developing, and deploying. This defining stage has the objective of establishing and defining learning needs by analyzing the objectives and limitations of the material to be delivered. The first step at this stage is that early-late analysis is carried out to determine the problems contained in learning activities and the development of learning materials.

Next stage is student analysis used to obtain data on the characteristics of S1 Mathematics Education students, FKIP, Jember University. Then analysis of the concept of this process is carried out to identify, detail and compile systematically regarding the concepts that will be studied by students on the topic of Resolving efficient dominating set.

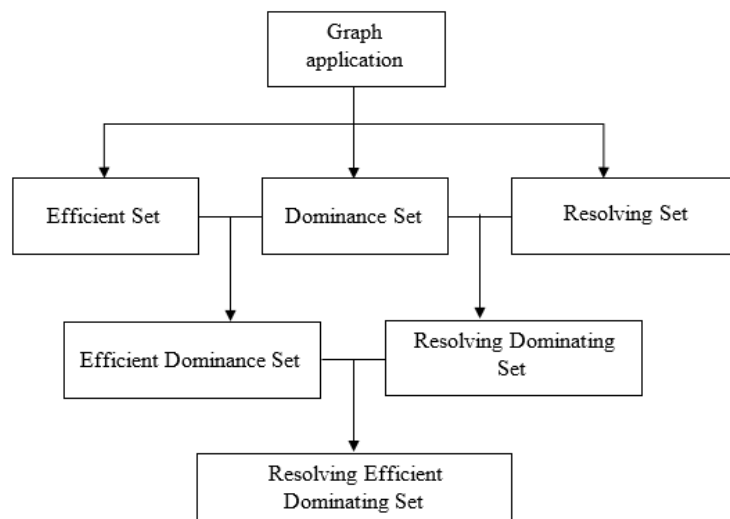


Fig 2: Concept Map of Resolving efficient dominating sets

The next step in this stage is to prepare tests and instruments, media selection, format selection, and initial design. The first learning material is RTM; This RTM is prepared with the topic of Resolving efficient dominating set, with research-based learning model using STEM approach. Second learning material produced is the Student Worksheet (LKM). This LKM contains STEM questions, which is the problem

of airport density, by determining airports that are potentially congested and those that are not potentially density anomalies using a graph artificial neural network. In addition, it also determines the classification of airport types and air traffic network control systems using the concept of Resolving efficient dominating set.



Fig 3: LKM Design

The third learning material is the Learning Outcomes Test (THB), where the results of this test are used to measure

students' forecasting ability. Pre-tests and post-tests are carried out individually.



Fig 4: THB Design

The third stage is the Device development stage. At the development stage, all developed devices are validated by validators. The device was validated by two validators, which is lecturers of the Mathematics Education study program FKIP Jember University, which are Ridho Alfari, S.Pd.,

M.Si., and Rafiantika Megahnia Prihandini, S.Pd., M.Si. In general, based on the assessment of the two validators, all learning materials in the form of RTM, Student Worksheets (LKM), and Learning Outcomes Tests (THB) can be used with minor revisions.

Format, content and language validation

The device can be said to be suitable for use if it meets the valid criteria, if it appropriate with score of $3.25 \leq Va < 4$. Validation of the results of the Student Assignment Design (SAD), obtained a score of $Va = 3.5$ so that the student assignment design can be said to be valid. Aspects that assessed at this stage are format, content, language and writing. The validation of Student Worksheet (LKM) gets a score of $Va = 3.54$. So that the Student Worksheet can be said to be valid. The Validation Results of the Learning Outcomes Test (THB) get a score of $Va = 3.6$. So that the Learning Outcomes Test Sheet can be said to be valid.

Practicality Test

The practicality test of this learning material is carried out by analyzing student learning activities and lecturer activities during learning. Observation of learning activities in the classroom is carried out by five observers taken from Master of Mathematics Education students, the results of their observations can be seen in the Table below Based on this stage the overall average score of the observation results is 3.8 and the percentage is 95%. Meanwhile, based on the criteria for device quality is, a device is said to be practical if the observation results are good ($80\% \leq SR < 90\%$) or very good ($90\% \leq SR \leq 100\%$) in this study the score obtained is 95%. So, it can be concluded that the device developed based on the results of observations meets the criteria very well so that the device being tested meets the practicality criteria.

Effectiveness Test

Test the effectiveness of learning materials. Learning materials can be said to be effective if they meet: 1. Completeness of student learning outcomes tests, 2. Analysis of student activities 3. The results of the student response. The results of the answers collected from the student learning outcomes test were obtained by 30 out of 35 students getting a score above 60, this means that 85% of students are complete and have met one of the criteria for a device called effective. So, it can be concluded that the device developed is effective, then based on student activity analysis data, the percentage of student activity is 95.5% with category of

criteria is very active, student response questionnaire sheets are given in pdf format. The recapitulation of the student response score showed that in the learning atmosphere item showed a positive response, namely 85.8% with the highest positive response details found in the LKM device novelty item, this is because the topics discussed in LKM are indeed relatively new for students of the Mathematics Education Study Program, Faculty of Teacher Training and Education, University of Jember, which is about the coloring of the rainbow side of the antiajaib and the artificial neural network of the graph.

Data Analysis

2-Way Frequency Test

The 2-way Frequency Test here using the Chi-square test in this study was used to determine the effect of the application of project-based learning on students' forecasting thinking ability.

The Chi-square test that used is two-way frequency test using R-Shiny by entering pretest data and categorized posttest data. The hypothesis is formulated in the form of a pair of null hypotheses (H_0) (and alternative hypotheses (H_1)). The test criteria, if the p-value value > 0.05 , then H_0 is accepted, while if the p-value value < 0.05 , then H_0 is rejected. Here are the hypotheses to be tested in this study:

H_0 : No influence of learning materials on students' forecasting thinking ability.

H_1 : There is a significant influence of learning materials on students' forecasting thinking ability.

Pre-test

The results of the *pre-test* were carried out a two-way frequency test to reinforce the results of the distribution in the control class and the experimental class. This statistical test was carried out using r-shiny online software, is <https://statslab-rshiny.fmipa.unej.ac.id/RProg/BasicStat/>.

From the results of the 2-way frequency test, the result that obtained of p-value is 0.1142 because the test results showed more than 0.05, so H_0 was accepted that there was no difference in the distribution of values in the control class and the experimental class.



Fig 5: Pre-test 2-way frequency test results.

Post-test

The results of the 2-way frequency test at the Post-Test stage obtained a p-value of 0.04423, because the test results showed less than 0.05, H_0 was rejected and H_1 was accepted

so that it could be concluded that there was a significant influence of learning materials on forecasting thinking ability.

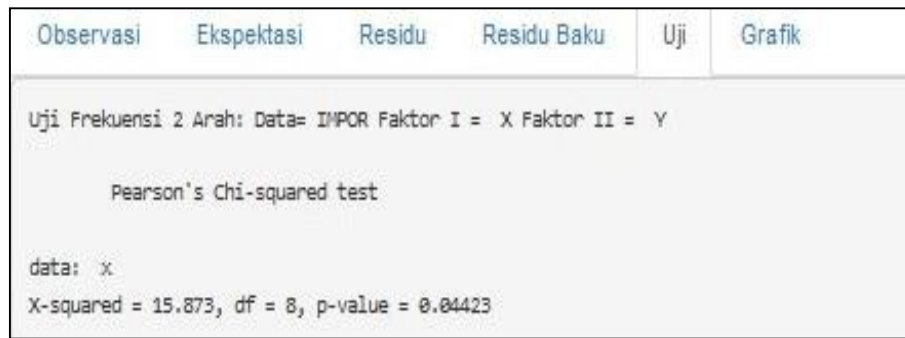


Fig 6: Post-test 2-way frequency test results

Discussion

Research-based learning materials with STEM approach that developed in this research must be valid, practical, and effective. The device that has been developed is carried out a validation process by two validators, which are two lecturers of mathematics education FKIP Jember University. The validation results show that this learning device is included in the valid category, this is in line with Margiandini's explanation which shows that the learning device is said to be valid if it meets $61 < \text{score} < 80$ and is very valid if it meets $81 < \text{score} < 100$ (Margiandini, et al. 2022). In addition, this learning material has also met the criteria of a learning material called practical and effective.

This research-based learning model is recommended in the application of education in order to produce student higher motivation and can improve learning outcomes and be able to apply it in life (Dafik, 2019). This research-based learning, when applied in the classroom, will produce students who are more active, creative, and able to think more critically than students who use conventional learning. This is in accordance with research conducted by Suntusia (2019), Suntusia explained that learning carried out in conventional classes causes students to tend to be passive and lack the drive to learn to develop their potential (Suntusia, 2019).

Conclusion

The device that has been developed has been validated by two validators and tested on Test Trial class. These validation results meet the criteria of validity, practicality, and effectiveness. The validity score obtained on each device is 3.5 for RTM (valid), 3.54 for LKS (valid), and 3.6 learning outcome tests (valid). The observation score of learning implementation resulted in 3.8 with percentage is 95%. In addition to being valid and practical, the device also meets the criteria for effectiveness. On average, 91% of the students in the trial class were relatively complete and the response from students was very positive. Based on the test results, researchers obtained 30 students who scored above 60. This means that 86.7% of the students in this class have completed and met one of the effectiveness criteria. Student responses through questionnaires also provide more positive responses than negative responses.

Acknowledgment

We gratefully acknowledge the support from master of mathematics education, University of Jember of year 2022.

References

1. A'yun Q, Slamini, dan Dafik. The Development of Research-Based Learning Tools with a STEM Approach

- to Improve Metaliteracy Skills to Solve Rainbow Vertex Anti-magic Coloring Problems. *Pancaran.*, 2022, 11(2).
2. Anik M, Dan M Retno. Pengembangan Media Pembelajaran Berbasis Problem Based Learning Pada Mata Pelajaran Ekonomi. *JUPE.* 2021; 17(2):15-19.
 3. As'ari AR. Tantangan Pengembangan Profesionalisme Guru Dalam Rangka Membelajarkan Matematika Di Abad Ke-21 Dan Membangun Karakter Peserta Didik. *Seminar Nasional Pengembangan Profesionalisme Guru.* Malang: Kerjasama Ditjen GTK dengan Pascasarjana UM, 2016, 1-11.
 4. Chartrand G, Gary dan, OR Oellerman. *Applied and Algorithmic Graph Theory.* New York: Mc Graw-Hill, 1993.
 5. Dafik Suciato B, Irvan M, Rohim MA. The Analysis of Student Metacognition Skill in Solving Rainbow Connection Problem under the Implementation of Research-Based Learning Model. *International Journal of Instruction,* 2019, 12(4). E-ISSN: 1308-1470.
 6. Deng YP, YQ Sun, Q Liu, dan HC Wang. Efficient Dominating Sets in Circulant Graphs. *Discrete Mathematics.* 2017; 340:1503-1507.
 7. Fathoni A, A Muslim, E dan L. Nurlaela. *STEM: Inovasi dalam Pembelajaran Vokasi.* Pendidikan Teknologi dan Kejuruan. 2020; 17(1):33-42.
 8. Graumann G. General aims of mathematics education explained with examples in geometry teaching. *Palermo: The Mathematics Education into the 21st Century Project,* 2002.
 9. Hartsfield N, dan G Ringel. *Pearls in Graph Theory A Comprehensive Introduction.* New York, 1990.
 10. Haynes TW, ST Hedetniemi, dan PJ Slater. *Fundamentals of Domination in Graphs.* Marcel Dekker, 2000.
 11. Hobri. *Metodologi Penelitian Pengembangan (Aplikasi pada Penelitian Pendidikan Matematika).* Jember: Pena Salsabila, 2021.