



Project-Based Learning in Analytic Geometry Courses to Support Student's Mathematic Communication Skill

Yunita Oktavia Wulandari*

Mathematic Education, Wisnuwardhana University, East Java, Indonesia

Eko Yuniarto

Mathematic Education, Wisnuwardhana University, East Java, Indonesia

Cynthia Tri Octavianti

Mathematic Education, Wisnuwardhana University, East Java, Indonesia

*Correspondence author: yunita@wisnuwardhana.ac.id

DOI: <http://dx.doi.org/10.18592/tarbiyah.v12i2.9784>

Key Words:

analytic geometry
communication
mathematical
project based learning

Received : 17 - 06 - 2023

Revised : 14 - 07 - 2023

Accepted : 23 - 11 - 2023

Published : 27 - 12 - 2023

Abstract

This research aims to design project-based learning in analytical geometry learning to develop students' mathematical communication skills. This research is motivated by the reluctance of the majority of students to express their opinions during class learning. Project-based learning was chosen because it has process-centered, problem-focused characteristics, integrating the concepts of several components of knowledge, disciplines, and field experience. Some exciting learning video designs on parabolas, ellipses, and hyperbolas were found in the findings of this project. Definitions, methods for analytically characterizing parabolas, ellipses, and hyperbolas, as well as example problems and exercises, are all included in the learning videos. The video showed that students could audio-visually express mathematical ideas about conic slices, presenting in algebraic form or using mathematical symbols. Through this project assignment, students can also develop their digital literacy skills.

To cite this article: Wulandari, Y.O., Yuniarto, E., Octavianti, C.T. (2023). Project-Based Learning in Analytic Geometry Courses to Support Student's Mathematic Communication Skill. *Tarbiyah: Jurnal Ilmiah Kependidikan*. 12(2), 89-97.

This is an open access article under the CC-BY License
(<https://creativecommons.org/licenses/by/4.0/>)



Introduction

One of the most critical aspects of learning is mathematical communication. One of the fundamental qualities students must possess is the capacity to convey ideas. Mathematical communication allows students to explain mathematical ideas orally, in writing, through drawings, diagrams, and objects, by presenting them in algebraic form or by utilizing mathematical symbols ([Chasanah et al., 2020](#); [Graham & Fennell, 2001](#); [Sumaji et al., 2019](#); [Tinungki, 2015](#)). So far, the reality is that prospective teacher students' mathematics abilities still need to improve ([Tambunan, 2019](#); [Yuniarti, 2016](#); [Hanisah & Noordiyana, 2022](#)).

In the initial observation in the analytical geometry class, it was found that some students still had difficulty describing the known points of the rectangle in the Cartesian diagram, as shown in the picture below.

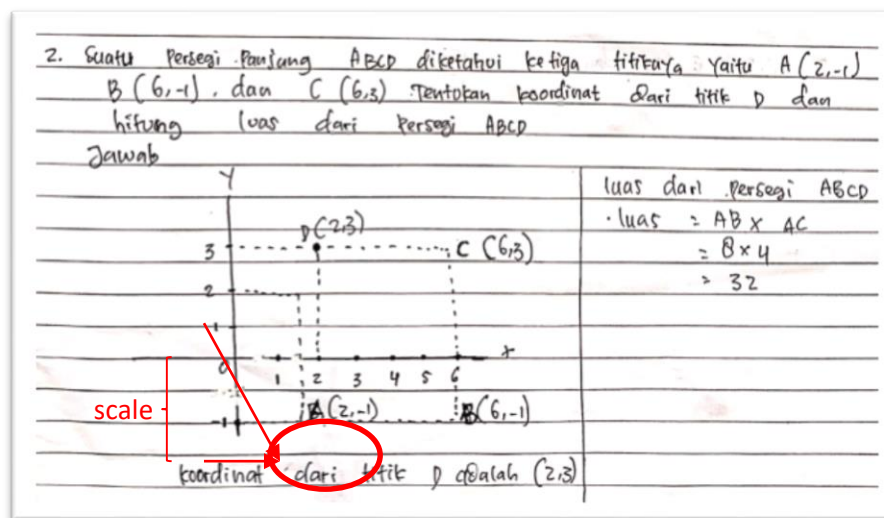


Figure 1. Student Difficulties

One of the indicators of mathematical communication, according to NCTM (2000), is the ability to express mathematical concepts orally, in writing, and visually. This picture shows that students' mathematical communication skills still need to improve. Project-based learning in Analytical Geometry will be devised in this study to improve students' mathematical communication. According to Widjayanti and Wahyudin, problem-based collaborative lecture tactics outperform traditional lecture strategies in building mathematical communication abilities ([Deswita & Kusumah, 2018](#); [Hariati et al., 2022](#); [Widjayanti, 2010](#)).

The Project Based Learning paradigm is superior to traditional learning ([Anggraini & Wulandari, 2020](#); [Santoso, 2017](#)). This strategy can also help kids enhance their creativity, motivation, and internal curiosity. It is also consistent with [Shin's \(2018\)](#) belief that project-based learners generate concepts that have been taught and apply them in the real world. [Wulandari et al. \(2022\)](#) found that project-based learning considerably impacted learning. Project-based learning also increases student motivation and participation in the classroom ([Mughrabi, 2021](#)).

In this study, project-based Learning will be designed as one of the methods to make learning meaningful in analytical geometry. Project Based Learning was chosen through process-centered, problem-focused characteristics, which integrate the concepts of various knowledge components, disciplines, and field experience. The

study is intended to foster meaningful Learning for prospective mathematics teacher students in Analytical Geometry courses, allowing them to refine their creativity in mathematical communication later on. Project-based Learning was created to help students learn more effectively in analytical geometry classes. High social engagement can also boost pupils' learning attentiveness ([Masruroh et al., 2022](#)). Based on the above description, a study titled Project-Based Learning in Analytical Geometry Subjects in Supporting Student Mathematical Communication will be done.

In mathematics, communication plays a significant role ([Niss & Højgaard, 2019](#); [Rusdi, 2019](#)). Communication is an essential part of mathematics and mathematics education. Communication is a way of sharing ideas and clarifying understanding. Ideas become objects of reflection, refinement, discussion, and revision through communication. Communication also helps establish meaning and permanence for ideas and makes them public ([Allen et al., 2020](#)). a prospective mathematics teacher should be able to communicate his/her mathematical thoughts orally and in writing to his/her peers, lecturers, and others, with indicators of being able to (1) Communicate their mathematical thoughts coherently and clearly to their peers, lecturers, and others; (2) Use mathematical language to express their ideas appropriately; (3) Manage their mathematical thoughts through communication; and (4). Analyse and evaluate the mathematical thoughts and strategies of others.

Project-based learning is a problem-solving learning model that integrates concepts from various components, including knowledge, disciplines, and field experience. According to [Lestari and Yudhanegara \(2015\)](#), project-based learning has three stages: 1. Phase of Project Planning: identifying real problems, researching alternatives, devising problem-solving techniques, and planning are all part of the planning process; 2. The phase of Project Implementation: During the implementation phase, students are guided through assignments, product testing (evaluation), and group presentations; 3. The phase of Project Evaluation: Process and product assessment is included in the evaluation phase: project learning progress, actual problem-solving process, team and individual performance progress, notebooks and research notes, learning contracts, computer use, and reflection. At the same time, they are assessing products such as work and presentations, non-written tasks, and project reports.

This Analytical Geometry course includes the following projects are project assignment: Create a learning film of a parabola, ellipse, or hyperbola. Goal: Students are anticipated to be able to come up with new ideas and strengthen their mathematics communication skills with this project assignment.

Research Method

This study uses qualitative research methods. This qualitative research utilized a case study approach to investigate detailed information ([Bassegy, 2000](#); [Chhetri, 2011](#)) and describe the subject and phenomena seen in depth using the data collected for interpretation ([Creswell, 2012](#)). The study was conducted once a week on first-year college students at Wisnuwardhana University in Malang in an analytical geometry subject. The subjects were 11 college students enrolled in the Analytic Geometry class. The selection of 11 subjects is due to heterogeneous abilities. Through this project, it is hoped that students can discuss with each other to indirectly facilitate mathematical

communication and the process of working on it. Data sources are the outcomes of classroom observations, such as student project results, field notes, and interviews. Compliance involves detecting real problems, identifying alternatives, developing problem-solving solutions, and planning. Data were examined based on Project-Based Learning phases and their impact on student creativity in problem-solving. Figure 2 depicts the stages of this research.

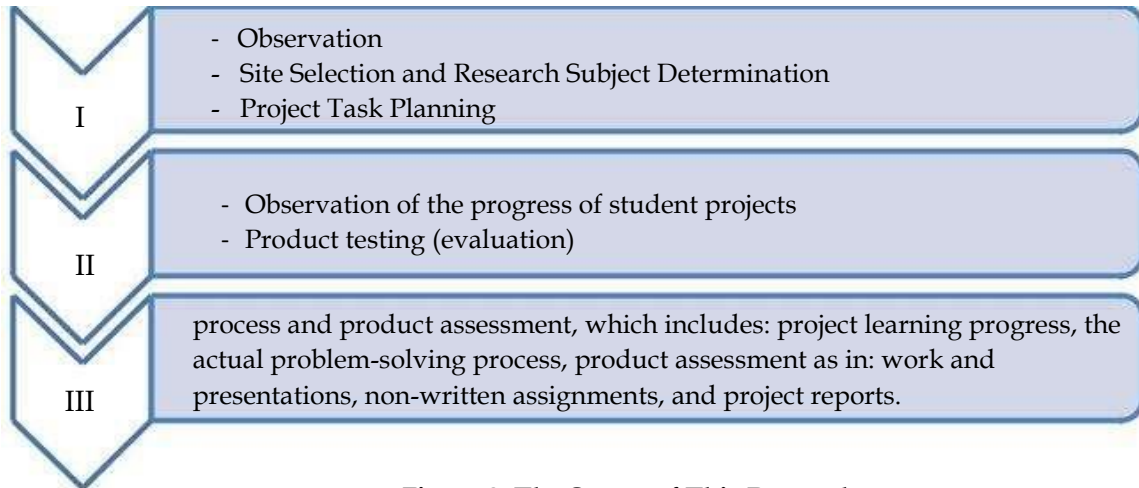


Figure 2. The Stages of This Research

The type of data and how to collect data are presented in Table 1.

Table 1. Data Types and Data Collection Methods

Data Types	Data Collection Methods	Description
Analytic Geometry project assignment document	Subjects were assigned to Project Task.	The participant was assigned the task of creating a learning video regarding cone slices.
Picture	Recording images with video	Images are used to record process information.
Field Notes	During the lesson, we recorded data relating to the project assignment.	The researcher takes field notes for analysis and reports findings.

Finding and Discussion

This research is divided into three stages: Phase I Activities at this stage involve observing the problems encountered by students in Analytical Geometry courses, choosing research venues, and planning project assignments; Phase II activities include progress monitoring and student project help; Phase III Activities include process and product evaluation, which covers project learning progress and the actual problem-solving process; product evaluation, which includes work and presentations, non-written assignments, and reports.

The following are the findings from each step of the research:

Phase I

At this point, researchers conducted observations to identify barriers encountered by students while learning in Analytical Geometry classes. Interviews with lecturers teaching Analytical Geometry courses were also undertaken during the

initial observation to validate the student challenges discovered. The following information was obtained based on the observation findings.

- 1) 60% of pupils still need to share their thoughts when learning in class.
- 2) 75% of students still require assistance in articulating mathematical ideas.

To tackle these challenges, a project assignment was created so students in Analytical Geometry courses might learn to explore and innovate to improve their communication abilities. Students can also improve their digital literacy abilities with this activity. The project prepared in the Analytical Geometry course is described in Table 2 below.

Table 2. Project Assignment

Project Assignmet	Goal
Create a learning video of conic wedges using a parabola, ellipse, or hyperbola. As an example, the circle has been discussed in class.	With this project assignment, students are expected to develop their mathematical communication skills (drawing, writing and explaining mathematical expressions) and improve their digital literacy skills.

Based on field observations, through the project process of making a learning video of cone slices, it is hoped that students can discuss among friends so that their communication is increasingly honed. This project shows how students express mathematical ideas through writing and images and can interpret and evaluate mathematical terms, notations, and graphs audio-visually. These are indicators of mathematical communication skills, according to NCTM ([Nashihah, 2020](#)).

Phase II

The researcher observed the students' progress and project assistance at this stage. The results obtained at this stage are the steps taken by students, namely:

- 1) Studying the tasks and project instructions in the video provided.
- 2) Collecting materials that will be presented in the project.
- 3) Arranging and assembling materials into learning videos.

Phase III

At this stage, researchers evaluated the results of student project products. The following are some displays of student project product results.

1. Learning Video on Ellipse Material





Figure 3. Ellipse Learning Video Display

In the Ellipse Video Figure above, students can explain the geometric definition of an ellipse, then write, interpret, and use mathematical terms and notations in the ellipse equation and describe the ellipse correctly. Based on NCTM (2000) on the indicators of students' mathematical abilities and the results of student projects, it appears that students' mathematical communication skills are getting smoother.

2. Learning Video on Hyperbola Material

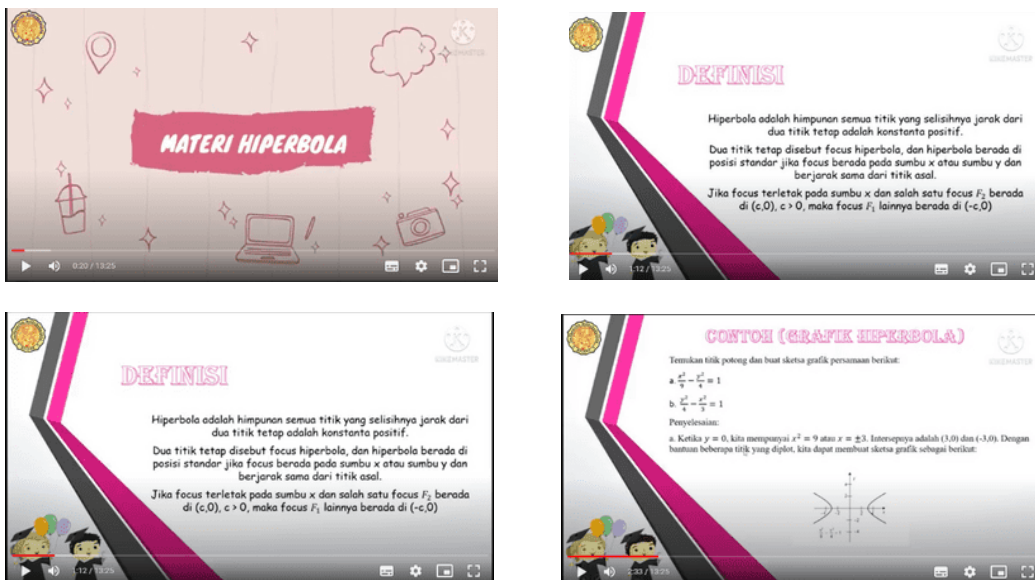


Figure 4. Hyperbola Learning Video Display

Students can write, interpret, and use mathematical terms and notations in hyperbola equations, explain hyperbola analytically, and describe it correctly, as shown in the hyperbola video image above. Students' mathematical communication skills are getting better, according to NCTM (2000) and student project results.

3. Learning Video on Parabola Material



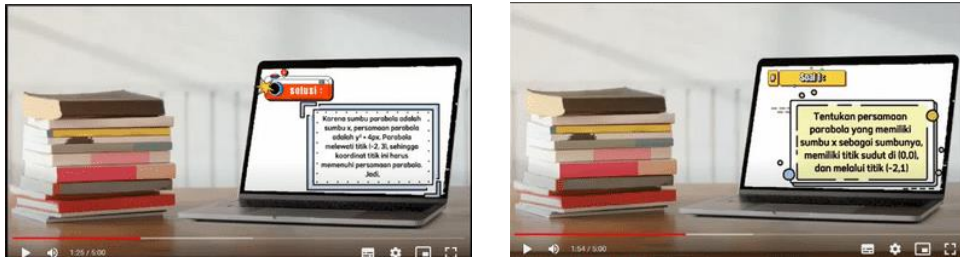


Figure 5. Parabola Learning Video Display

Students can be seen explaining the definition of a parabola, writing, interpreting, and using mathematical terms and notations in the parabola equation, and accurately describing the parabola in the Parabola Video Figure above. According to NCTM (2000) on student project outcomes and mathematical ability markers, students' mathematical communication skills are improving.

Several appealing learning video designs on parabolas, ellipses, and hyperbolas were discovered due to the project findings. Definitions, how to characterize parabolas, ellipses, and hyperbolas analytically, and example problems and exercises are all included in student videos. The video demonstrates how students can explain mathematical ideas about cone slices by audio-visual representation, algebraic representation, or mathematical symbols. This indicates that pupils were proficient in mathematics communication. Mathematical communication skills include the ability to convey mathematical ideas both orally and in writing, as well as the ability to carefully, analytically, critically, and evaluatively understand and accept other people's mathematical ideas (Firman et al., 2022; Lestari & Yudhanegara, 2015; Novinarsyih Dasaprawira et al., 2019; Setiyani et al., 2020). This is also consistent with NCTM's (2000) definition of mathematical communication as a method for students to express mathematical ideas orally, in writing, drawings, diagrams, utilizing objects, presenting in algebraic form, or using mathematical symbols.

Students can improve their digital literacy skills by completing this project work. Students use bandi.com, kinemaster, screencast o'matic, inshot, and other tools to generate learning videos. Educational media is one form of stimulant for pupils to engage in learning activities (Sudarsana et al., 2019).

Conclusion

The project in this research can stimulate creative thinking and mathematics communication skills. The movie demonstrates how students can explain mathematical ideas about cone slices audio-visually, algebraically, or through mathematical symbols. This indicates that pupils were capable of effective mathematical communication. This learning can also help them improve their digital literacy.

References

- Allen, C. E., Froustet, M. E., LeBlanc, J. F., Payne, J. N., Priest, A., Reed, J. F., Worth, J. E., Thomason, G. M., Robinson, B., & Payne, J. N. (2020). National Council of Teachers of Mathematics. *The Arithmetic Teacher*, 29(5), 59. <https://doi.org/10.5951/at.29.5.0059>

- Anggraini, P. D., & Wulandari, S. S. (2020). Analisis Penggunaan Model Pembelajaran Project Based Learning Dalam Peningkatan Keaktifan Siswa. *Jurnal Pendidikan Administrasi Perkantoran (JPAP)*, 9(2), 292–299. <https://doi.org/10.26740/jpap.v9n2.p292-299>
- Bassey, M. (2000). Case Study Research in Education Settings. [Http://Lst-liep.liep-unesco.org/Cgi-Bin/Wwwi32.Exe/\[In=epidoc1.in\]/?T2000=012102/\(100\)](http://Lst-liep.liep-unesco.org/Cgi-Bin/Wwwi32.Exe/[In=epidoc1.in]/?T2000=012102/(100)).
- Chasanah, C., Riyadi, & Usodo, B. (2020). The effectiveness of learning models on written mathematical communication skills viewed from students' cognitive styles. *European Journal of Educational Research*, 9(3), 979–994. <https://doi.org/10.12973/EU-JER.9.3.979>
- Chhetri, A. (2011). *Case Study Research In Educational Settings Related papers*.
- Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Pearson Education, Inc.
- Deswita, R., & Kusumah, Y. S. (2018). Peningkatan Kemampuan Komunikasi Matematis Siswa Melalui Model Pembelajaran CORE dengan Pendekatan Scientific. *Edumatika: Jurnal Riset Pendidikan Matematika*, 1(1), 35. <https://doi.org/10.32939/ejrpm.v1i1.220>
- Firman, M., Saputra, A., Isnarto, I., & Hartono, H. (2022). *Unnes Journal of Mathematics Education Research Students' Mathematical Communication Skills based on AQ in Discovery Learning Model with Realistic Approach*. 2, 220–231.
- Graham, K. J., & Fennell, F. (2001). Principles and standards for school mathematics and teacher education: Preparing and empowering teachers. *School Science and Mathematics*, 101(6), 319–327.
- Hanisah, H., & Noordiyana, M. A. (2022). Kemampuan Komunikasi Matematis Siswa pada Materi Penyajian Data di Desa Bojong. *Plusminus: Jurnal Pendidikan Matematika*, 2(1), 131–140. <https://doi.org/10.31980/plusminus.v2i1.1588>
- Hariati, M. E., Sinaga, B., & Mukhtar, M. (2022). Analisis Kesulitan Komunikasi Matematis Siswa Dalam Penerapan Model Pembelajaran Think Pair Share. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 6(1), 702–709. <https://doi.org/10.31004/cendekia.v6i1.1228>
- Lestari, K. E., & Yudhanegara, M. R. (2015). Penelitian pendidikan matematika. *Bandung: PT Refika Aditama*, 2(3).
- Masruroh, Nawafilah, N. Q., & Anggraini, E. (2022). The Analysis of students' school burnout level and academic achievement on the science management subject. *Tarbiyah: Jurnal Ilmiah Kependidikan*, 11(2), 49–57.
- Mughrabi, N. (2021). *Exploring Project-Based Learning Practices to Foster Students' Motivation*.
- Nashihah, U. H. (2020). Membangun Kemampuan Komunikasi Matematis Siswa dengan Pendekatan Saintifik: Sebuah Perspektif. *Jurnal Pendidikan Matematika (Kudus)*, 3(2), 201. <https://doi.org/10.21043/jmtk.v3i2.7193>
- Niss, M., & Højgaard, T. (2019). Mathematical competencies revisited. *Educational Studies in Mathematics*, 102, 9–28.
- Noviarsyh Dasaprawira, M., Zulkardi, & Susanti, E. (2019). Developing mathematics questions of Pisa type using Bangka context. *Journal on Mathematics Education*, 10(2), 303–314. <https://doi.org/10.22342/jme.10.2.5366.303-314>
- Rusdi. (2019). The importance of speaking skills in English classrooms. *Alford Council*

- of International English & Literature Journal*, 2(2), 6–18. www.acielj.com
- Santoso, P. (2017). Penggunaan model pembelajaran project based learning (pbl) sebagai upaya peningkatan hasil belajar ekonomi. *Prosiding Seminar Pendidikan Ekonomi Dan Bisnis UNS*, 3(1), 1–7.
- Setiyani, Putri, D. P., Ferdianto, F., & Fauji, S. H. (2020). Designing a digital teaching module based on mathematical communication in relation and function. *Journal on Mathematics Education*, 11(2), 223–236. <https://doi.org/10.22342/jme.11.2.7320.223-236>
- Shin, M.-H. (2018). Effects of project-based learning on students' motivation and self-efficacy. *English Teaching*, 73(1), 95–115. <https://doi.org/10.15858/engtea.73.1.201803.95>
- Sudarsana, I. K., Mulyaningsih, I., Kurniasih, N., Haimah, Wulandari, Y. O., Ramon, H., Satria, E., Saddhono, K., Nasution, F., & Abdullah, D. (2019). Integrating Technology and Media in Learning Process. *Journal of Physics: Conference Series*, 1363(1). <https://doi.org/10.1088/1742-6596/1363/1/012060>
- Sumaji, Sa'Dijah, C., Susiswo, & Sisworo. (2019). Students' problem in communicating mathematical problem solving of Geometry. *IOP Conference Series: Earth and Environmental Science*, 243(1). <https://doi.org/10.1088/1755-1315/243/1/012128>
- Tambunan, H. (2019). The Effectiveness of the Problem Solving Strategy and the Scientific Approach to Students' Mathematical Capabilities in High Order Thinking Skills. *International Electronic Journal of Mathematics Education*, 14(2), 293–302. <https://doi.org/10.29333/iejme/5715>
- Tinungki, G. M. (2015). The Role of Cooperative Learning Type Team Assisted Individualization to Improve the Students' Mathematics Communication Ability in the Subject of Probability Theory. *Proc.of the Fifth Conference for the Psychology of Mathematics Education*, 6(32), 27–31. <https://eric.ed.gov/?id=EJ1083611>
- Widjayanti, D. B. W. (2010). *Mengembangkan Kemampuan Komunikasi Matematis Mahasiswa Calon Guru Matematika Melalui Strategi Perkuliahan Kolaboratif Berbasis Masalah*. 1–13.
- Wulandari, Y. O., Khasanah, F., & Octavianti, C. T. (2022). Project-based learning as an alternative solution for learning computer basics during the Covid-19 pandemic. *International Journal for Educational and Vocational Studies*, 4(2), 125. <https://doi.org/10.29103/ijevs.v0i0.5645>
- Yuniarti, Y. (2016). Pengembangan Kemampuan Komunikasi Matematis dalam Pembelajaran Matematika di Sekolah Dasar. *EduHumaniora | Jurnal Pendidikan Dasar Kampus Cibiru*, 6(2), 109–114. <https://doi.org/10.17509/eh.v6i2.4575>