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Analysis of Geogebra Applications and Manipulative Media in Proving the Level of Spatial Rotating Symmetry

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ABSTRACT

Geometry is a sub-matter that exists in mathematics related to everyday life. The existence of an understanding related to geometry material has a positive impact on increasing spatial abilities from various points of view. The ability to see geometric shapes from various perspectives is related to rotation and rotational symmetry. Studying rotational symmetry and how rotation affects its appearance and geometric properties will help deepen your understanding of the overall geometric shape. The purpose of this study is to provide a description of the views to prove the level of rotational symmetry in geometric 3D shapes by considering the description of the advantages and disadvantages of using geogebra and manipulative application media which are adapted to their respective characteristics. This research is A qualitative research. Data collection techniques used are observation and interviews. The instruments used were observation sheets and interview sheets. The data analysis technique used is data triangulation. The research results obtained are proving the degree of rotational symmetry in geometric shapes which have 1) the advantages of using geogebra: it does not take long to prove, it is flexible regarding geometric dimensions and the determination of the symmetry axis, does not take up space/practical, is available in the form of applications and online websites 2) Weaknesses of using GeoGebra: having to use a PC/laptop, the ability of GeoGebra users to use it is the main variable, limitations on PC/laptop, or internet performance, 3) advantages of using manipulative media: easier and more real in observing the degree of rotational symmetry, display at each level the degree of rotational symmetry can be marked to facilitate calculations, 4) the weakness of using manipulative media: it takes time to make manipulative media, the media requires an appropriate size for practice, inflexibility regarding the size and placement of the axis of symmetry.

Keywords: *Geogebra, Manipulative, Rotating Symmetry Level Proving, 3D-shape*

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INTRODUCTION

Education is a systematic process to help individuals acquire knowledge, skills, values and understanding to develop themselves personally and participate actively in society (Auliani dkk., 2023; Mustafiyanti dkk., 2023; Wanti dkk., 2023). Education can be obtained through formal or informal education. Formal education is education starting from Kindergarten, Elementary, Middle School, High School, and College. Mathematics is a subject that exists at every level. The sub-materials in mathematics are arithmetic, algebra, geometry, statistics and probability, calculus, discrete mathematics, matrices and linear algebra, analytical geometry, probability theory, applied mathematics. Geometry is a sub-matter that studies the nature, size, and relationships of spatial shapes. The existence of an understanding related to geometry material has a positive impact on increasing spatial abilities from various points of view (Mulyasari dkk., 2023; Noer dkk., 2023). The ability to see geometric shapes from various perspectives is related to rotation and rotational symmetry. Studying rotational symmetry and how rotation affects its appearance and geometric properties will help deepen your understanding of the overall geometric shape. Rotational symmetry is the process of rotating a shape by less than one full rotation, so that the shape returns to its original shape. The number of rotations that occur shows how many rotational symmetries occur in the shape (Unaenah dkk., 2020).

The purpose of this study is to provide a description of the views to prove the degree of rotational symmetry in geometric shapes by considering the description of the advantages and disadvantages of using geogebra and manipulative application media which are adapted to their respective characteristics (Al Maarif dkk., 2023; Ranal dkk., 2023; Utami dkk., 2023). Rotational symmetry material is a basic understanding of geometric shapes. An understanding of this rotational symmetry will also affect the understanding of subsequent geometric material. This study will provide recommendations for selecting media for both geogebra and manipulative applications to be used in proving the degree of rotational symmetry in geometric 3D shapes by taking into account their strengths and weaknesses.

Research that raises the topic of rotational symmetry has been carried out by previous studies. Improving mathematics learning outcomes in rotational symmetry material can be obtained using the Media-Assisted Based Learning (PBL) model (PASIPUT) (Lindha & Awaliyah, 2021). Barriers to learning in rotational symmetry material are the lack of readiness of the teacher in the learning process, limited delivery of material, and the teacher does not provide practice questions (Nurvita dkk., 2022). Proof of rotational symmetry in flat shapes can use origami media (Lubis & Tampubolon, 2014). Geogebra helps visualize and discover the concept of rotation in geometry (Hanafi dkk., 2017). There are similarities and differences between previous

research (Fadiyah dkk., 2023; Fiqih dkk., 2023; Hermansyah dkk., 2023). The similarities between this research and previous studies are that they have the same theme, namely rotational symmetry, using geogebra, and manipulative media. The difference between this research and previous research is that this study analyzes the comparison of the use of geogebra and manipulative media as well as the weaknesses and strengths of the rotational symmetry material.

Rotational symmetry material, as the basic material of geometry, should be well mastered by students. However, in reality, there are still those who find it difficult to understand the matter of rotational symmetry (Pamuji & Limei, 2023; Putri dkk., 2023). Folding symmetry and rotational symmetry geometry materials are still difficult material for students (Nurvita dkk., 2022). Students find it difficult to determine rotational symmetry in flat shapes (Lubis & Tampubolon, 2014). There is a gap between theory and reality, which makes this research important to do. In this study, recommending two types of media (geographical and manipulative applications) to prove the degree of rotational symmetry along with the advantages and disadvantages of each media.

The focus of this study is the strengths and weaknesses of using Geogebra media and manipulative media in proving the degree of rotational symmetry in geometric shapes. The geometric shape chosen is a cube, and there are 3 selected axes of symmetry, namely 1) the axis of symmetry is the line that connects the center points of the two opposite sides, 2) the axis of symmetry is the line that connects the mid-points of the two opposite edges, 3) the axis of symmetry is a line that connects two opposite corners.

RESEARCH METHODOLOGY

This research is a qualitative research with research subjects being students of the Mathematics Education Study Program at Universitas Ivet. Data collection techniques using interviews and observation (Azizah dkk., 2022; Nicholas dkk., 2023). The instruments used in this study were interview sheets and observation sheets. This interview sheet consists of 1) how to use geogebra and manipulative media to explore the concept of the level of axes of symmetry in geometric shapes, 2) how geogebra and manipulative media help better visualize the concept of rotational symmetry in spatial shapes 3) what are the obstacles encountered in finding the level of the axes of symmetry in geometric shapes using geogebra and manipulative media, 4) how is the learner's response to the use of geogebra and manipulative media in the level of axes of symmetry in spatial shapes. The observation sheet consists of 4 items, namely 1) accuracy in making the axis of symmetry, 2) accuracy in returning the shape to its original position after being rotated, 3) accuracy in finding patterns or elements in a geometric shape that repeats symmetrically when experiencing rotation, 4) accuracy in determining the level protary symmetry in a geometric shape. The validity of the data in this study is using triangulation techniques, namely the use of two kinds of techniques in research, namely interviews and observation. The procedure of this research begins

with giving the problem of determining the degree of rotational symmetry in a geometric shape where the axes lie on the line connecting the center points of the two opposite sides, the line connecting the middle of the two opposite edges, the line connecting the two opposite corners (Holly dkk., 2023; Vicky dkk., 2023). Researchers provide the opportunity to solve these problems using geogebra applications and also manipulative media and also present them. During the exploration and presentation process, the researcher made observations. After making the presentation, the researcher conducted in-depth interviews with the research subjects (Fathia dkk., 2022; Levan's dkk., 2022; Saputra dkk., 2022). The data analysis technique of this study adopts data analysis techniques from Miles and Huberman, namely making notes when checking observation sheets and conducting interviews, filtering the data obtained to answer the problem formulation, identifying patterns from the results of filtered information, describing in detail the collection of information .

RESULT AND DISCUSSION

The research results of this study are the results of observations and in-depth interviews on research subjects. Indicator 1 on observation, namely the accuracy in making the axis of symmetry (Amrina dkk., 2022; Maryati dkk., 2022). Making the axis of symmetry in the GeoGebra application has been done correctly, but the problem encountered is that students are not used to using the GeoGebra feature to determine the midpoint of a line. Difficulties in using geogebra features were also experienced by teachers (Wasiran dkk., 2019). The 3D-graphics feature in Geogebra helps students to visualize geometric shapes (Erlinawati, 2018). The use of the Geogebra application can clarify the learning content of geometry material (Ratna & Wati, 2022). Making the axis of symmetry using manipulative media has been done correctly, the problem encountered is the difficulty of making holes in the space structure to insert a piece of wood as the axis of symmetry. Difficulties in determining the axis of symmetry of a shape are also experienced by students because students are not used to encountering questions related to different axes of symmetry as usual (Lestari dkk., 2018). Indicator 2 on observation, namely the accuracy of returning the shape to its original position after being rotated. The use of geogebra applications and manipulative media gives the same results, namely students are precise in rotating and can return the geometric shapes to their original position after being rotated. This is consistent with previous research that understanding how to get rotational symmetry in a shape can be done by rotating the flat shape so that it occupies its frame (Zuliana, 2017). Indicator 3 is observation, namely the accuracy of finding patterns or elements in a geometric shape that repeats symmetrically when experiencing rotation. Finding patterns in geometric shapes when rotating can be done both using geogebra and manipulative media, it's just that using geogebra students find it a little difficult to find patterns. Whereas in the use of manipulative media, by collaborating with other students students find it easier to find patterns by being able to mark each display according to the pattern with sticky notes

(Fathia dkk., 2022; Liam dkk., 2023; Saskia dkk., 2023). Collaborative activities as shown in Figure 1.

Figure 1. Collaborative search for rotational symmetry level

The distribution of tasks was carried out in collaboration, namely students held the axis of symmetry, rotated the geometric shape, and marked sticky notes on each pattern display found. Indicator 4 observation is the accuracy of determining the degree of rotational symmetry in geometric shapes (Raman dkk., 2021; Theodosiou dkk., 2022). The accuracy in determining the level of rotational geometrical symmetry based on the symmetry axis was carried out by students using both the geogebra application and manipulative media, but in the process the use of manipulative media was more real and made it easier for students to visualize.

The results of the interviews show that the use of geogebra media to explore the concept of the level of the axis of symmetry in a geometric shape is started by making a geometric shape on the geogebra and the axis of symmetry and then rotated using the "rotate view" feature. After the feature is run, students can observe the display pattern obtained. While the manipulative media used is in the form of 3 cubic shapes made of transparent mica with a side size of 30 cm with a different symmetry axis placement for each cube. Some collaborating students hold the axis of symmetry, rotate the cube, and mark the display pattern with sticky notes. Application media, both geogebra and manipulative, help visualize the concept of rotational symmetry in geometric shapes better according to the resulting display. The use of manipulative media helps visualize mathematical concepts (Mahmudah dkk., 2018). The Geogebra application also serves to visualize abstract concepts (Zuchri, 2017). Obstacles encountered in finding the level of the axis of symmetry in geometric shapes using GeoGebra media are students having to use a PC/laptop, the ability and skills of GeoGebra users in using it are the main variables, limited PC/laptop performance, or the internet and manipulative. The obstacles found in the use of manipulative media are that it takes time to make manipulative media, the media requires an appropriate size for practice (size that is easy to observe), inflexibility regarding the size and placement of the symmetry axis because if an error occurs students have to make the media from scratch again. 2 out of 6 students prefer to use geogebra media in understanding the level of the axes of symmetry in a shape because it doesn't take long to prove, it's flexible about the size of the shape and the determination of the axes of symmetry, it doesn't take up

space/practically, it's available in the form of an application and an online website. The advantage of Geogebra is that it can produce geometric paintings quickly and accurately compared to using a pencil, ruler, or compass (Ratna & Wati, 2022). The other 4 students prefer manipulative media because they find it easier and more real to observe the rotational symmetry levels. Displays at each rotational symmetry level can be marked to make calculations easier. The use of manipulative media can help students' understanding (Suprihatin, 2018).

CONCLUSION

The conclusions of this research are:

1. The use of geogebra and manipulative media can help visualize the concept of the level of the axis of symmetry in geometric shapes.
2. The use of Geogebra has several advantages, including: it does not require a long time to prove it, it is flexible in setting the size of the shape and determining the axis of symmetry, it is practical because it is available in the form of an application and an online website. However, there are also some drawbacks in using Geogebra, namely dependency on using a PC or laptop, limited user ability to operate it, and limited PC or laptop performance and internet connection.
3. The use of manipulative media also has advantages and disadvantages. The advantages are that it is easier and more obvious to observe the degrees of rotational symmetry, and can mark each level of rotational symmetry to make calculations easier. However, the drawback is that it takes time to make the manipulative media, the media must have the right size for practice, and is not flexible in terms of size and placement of the axes of symmetry.

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REFERENCES

Al Maarif, M. F., Afifah, R. A. N., Choirunnisa, A., Jannah, A. M., Zanuar, M. Y., Saddhono, K., & Yingxiang, S. (2023). Integrating and Strengthening National Vision in the Community as an Effort to Prevent Radicalization and Foster Love for the Motherland. *Pengabdian: Jurnal Abdimas*, *1*(1), 20–29. https://doi.org/10.55849/abdimas.v1i1.151

Amrina, A., Akhiri, I., Lee, C., & Jansee, J. (2022). Using of Visual Application in Arabic Language Learning Class X MAN 1 Kuantan Singingi. *Scientechno: Journal of Science and Technology*, *1*(1), 1–14. https://doi.org/10.55849/scientechno.v1i1.1

Auliani, R., Suprawihadi, R., & Avinash, B. (2023). Application of Appropriate Technology for Clean Water. *Pengabdian: Jurnal Abdimas*, *1*(1), 30–39. https://doi.org/10.55849/abdimas.v1i1.152

Azizah, W., Oktavia, N. A., & Mudinillah, A. (2022). The Use of The Canva Application in The Learning of Maharah Kitabah at The Islamic Boarding School Prof. Hamka Maninjau Class VII. *Scientechno: Journal of Science and Technology*, *1*(1), 15–24. https://doi.org/10.55849/scientechno.v1i1.2

Erlinawati. (2018). Penggunaan Aplikasi Geogebra Untuk Meningkatkan Motivasi Pelajaran Matematika. *Jurnal Prinsip Pendidikan Matematika*, *1*(1), 47–52. https://doi.org/10.33578/prinsip.v1i1.21

Fadiyah, F., Fuadi, A., Nurjannah, N., Irmayanti, I., & Lita, W. (2023). Quizizz Application-Based Interactive Learning Media Development Workshop for Junior High School Teacher. *Pengabdian: Jurnal Abdimas*, *1*(2), 59–65. https://doi.org/10.55849/abdimas.v1i2.157

Fathia, W., March, J., & Sie, P. (2022). Utilization of Design Application for Mufradat Class X MTS Baabusalam Learning. *Scientechno: Journal of Science and Technology*, *1*(1), 58–70. https://doi.org/10.55849/scientechno.v1i1.5

Fiqih, M., Thaha, A., Shidiq, S., Nafis, Moch. A., & Martin, W. (2023). The Concept of Internal Quality Assurance in Madrasah Diniyah PP. Al-Hidayah Tanggulangin Sidoarjo. *Pengabdian: Jurnal Abdimas*, *1*(1), 40–45. https://doi.org/10.55849/abdimas.v1i1.150

Hanafi, M., Wulandari, K. N., & Wulansari, R. (2017). Transformasi Geometri Rotasi Berbantuan Software Geogebra. *FIBONACCI: Jurnal Pendidikan Matematika dan Matematika*, *3*(2), 93. https://doi.org/10.24853/fbc.3.2.93-102

Hermansyah, S., Nasmilah, N., Pammu, A., Saleh, N. J., Huazheng, H., & Congzhao, H. (2023). Socialization Making Media Learning Interactive E-Module based Flippbook in Elementary School 4 Maiwa. *Pengabdian: Jurnal Abdimas*, *1*(1), 1–7. https://doi.org/10.55849/abdimas.v1i1.117

Holly, S., Maulik, B., & Samuel, I. (2023). Use of Whatsapp as A Learning Media to Increase Students' Learning Interest. *Scientechno: Journal of Science and Technology*, *2*(1), 35–48. https://doi.org/10.55849/scientechno.v2i1.57

Lestari, J., Haki Pranata, O., & Muiz, A. (2018). Desain Didaktis Jaring-Jaring Kubus dan Balok untuk Mengembangkan Kemampuan Berpikir Kreatif Siswa. *PEDADIDAKTIKA: JURNAL ILMIAH PENDIDIKAN GURU SEKOLAH DASAR*, *5*(1), 263–273.

Levan's, O., Tanucan, J. C. M., & Garzozi-Pincay, R. F. (2022). Used Learning at Al-Irsyad Bulaan Kamba Islamic Boarding School. *Scientechno: Journal of Science and Technology*, *1*(1), 71–85. https://doi.org/10.55849/scientechno.v1i1.6

Liam, L., Hui, H., & Carsten, L. (2023). Utilization of ICT in Learning the History of Islamic Culture. *Scientechno: Journal of Science and Technology*, *2*(1), 64–79. https://doi.org/10.55849/scientechno.v2i1.49

Lindha, F., & Awaliyah, S. (2021). Model Problem Based Learning (PBL) Berbantuan Media (PASIPUT) Untuk Meningkatkan Hasil Belajar Matematika Di Kelas III SDN 6 DAMPIT. *JISIP (Jurnal Ilmu Sosial dan Pendidikan)*, *5*(4), 1086–1091. https://doi.org/10.58258/jisip.v5i4.2545

Lubis, F., & Tampubolon, B. (2014). Pengaruh Media Manipulatif Pada Pembelajaran Matematika Terhadap Hasil Belajar Siswa Kelas V Sekolah Dasar. *Jurnal Pendidikan dan Pembelajaran Khatulistiwa (JPPK)*, *3*(6), 1–10.

Mahmudah, R., As'ari, A. R., & Sisworo. (2018). Penggunaan Bahan Manipulatif Untuk Meningkatkan Pemahaman Siswa. *Jurnal Kajian Pembelajaran Matematika*, *2*(April), 39–45.

Maryati, A., Ameer, A., & Egie, J. (2022). Utilization of Animiz Animation Application in Arabic Class 2 Madrasah Tsanawiyah Lessons at Diniyyah Pasia Modern Islamic Boarding School. *Scientechno: Journal of Science and Technology*, *1*(1), 25–45. https://doi.org/10.55849/scientechno.v1i1.3

Mulyasari, D., Noer, R. M., Sari, N., Ermawaty, E., Triharyadi, F., Tampubolon, D., & Catherine, S. (2023). Improving Health Status in The Elderly Through Health Checks and Education at Nuriah Nursing Homes in Karimun. *Pengabdian: Jurnal Abdimas*, *1*(2), 75–81. https://doi.org/10.55849/abdimas.v1i2.183

Mustafiyanti, M., Putri, M. P., Muyassaroh, M., Noviani, D., & Dylan, M. (2023). A Form of Independent Curriculum, an Overview of Independent Learning at State Elementary School 05 Gelumbang Muaraenim. *Pengabdian: Jurnal Abdimas*, *1*(2), 82–96. https://doi.org/10.55849/abdimas.v1i2.185

Nicholas, T., James, G., & Robert, K. (2023). Moral Aqidah Learning Using Video-Based Technology. *Scientechno: Journal of Science and Technology*, *2*(1), 1–16. https://doi.org/10.55849/scientechno.v2i1.65

Noer, R. M., Silalahi, A. D., Mulyasari, D., Sari, N., Ermawaty, E., Triharyadi, F., Tampubolon, D., & Bevoor, B. (2023). Improving the Degree of Health in the Elderly Through Health Checks and Education. *Pengabdian: Jurnal Abdimas*, *1*(1), 8–13. https://doi.org/10.55849/abdimas.v1i1.139

Nurvita, C. P. K., Sary, R. M., & Artharina, F. P. (2022). Analisis Learning Obstacles Pada Materi Simetri Lipat dan Simetri Putar Untuk Kelas III Sekolah Dasar. *DIKDAS MATAPPA: Jurnal Ilmu Pendidikan Dasar*, *5*(3), 706–716.

Pamuji, S., & Limei, S. (2023). The Managerial Competence Of The Madrasa Head In Improving Teacher Professionalism And Performance At Mi Al-Maarif Bojongsari, Cilacap District. *Pengabdian: Jurnal Abdimas*, *1*(2), 66–74. https://doi.org/10.55849/abdimas.v1i2.158

Putri, N. A., Kamaluddin, K., & Amrina, A. (2023). TikTok Application on Achievement and Learning Motivation at Influence Colleges. *Scientechno: Journal of Science and Technology*, *2*(1), 80–96. https://doi.org/10.55849/scientechno.v2i1.62

Raman, V., Balaji, S., & Rajkumar, R. (2021). An Augmented Reality Greenhouse to Demonstrate Game-Based Learning. *2021 International Conference on Intelligent Technologies (CONIT)*, 1–4. https://doi.org/10.1109/CONIT51480.2021.9498304

Ranal, A., Husniyah, H., Fienti, Y., Putri, S. A., Lenin, F., Musrika, M., Diana, D., & Xin, D. (2023). Physical Activity Training Education for the Elderly at Nursing

Homes. *Pengabdian: Jurnal Abdimas*, *1*(1), 14–19. https://doi.org/10.55849/abdimas.v1i1.143

Ratna, W., & Wati, A. (2022). Analisis Media Pembelajaran Interaktif Berbasis Aplikasi Geogebra Dalam Pembelajaran Bangun Ruang Di Sekolah Dasar. *Prosiding: Konferensi Nasional Matematika dan IPA Universitas PGRI Banyuwangi*, *2*(1), 16–23.

Saputra, A. G., Rahmawati, T., Andrew, B., & Amri, Y. (2022). Using Canva Application for Elementary School Learning Media. *Scientechno: Journal of Science and Technology*, *1*(1), 46–57. https://doi.org/10.55849/scientechno.v1i1.4

Saskia, R., Okuda, M., & Cooney, B. (2023). Utilization of Google From as a Quiz for Learning Fiqh. *Scientechno: Journal of Science and Technology*, *2*(1), 49–63. https://doi.org/10.55849/scientechno.v2i1.45

Suprihatin. (2018). Peningkatan Hasil Belajar dan Pemahaman Konsep Volume Balok Menggunakan Media Manipulatif pada Siswa Kelas V SDN Bandulan 5 Kota Malang. *ProsidingSeminar Nasional "Pengembangan Profesionalisme Dosen dan Guru Indonesia," 2*(2010), 246–249.

Theodosiou, Z., Thoma, M., Partaourides, H., & Lanitis, A. (2022). A Systematic Approach for Developing a Robust Artwork Recognition Framework Using Smartphone Cameras. *Algorithms*, *15*(9), 305. https://doi.org/10.3390/a15090305

Unaenah, E., Hidyah, A., Aditya, A. M., Yolawati, N. N., Maghfiroh, N., Dewanti, R. R., Safitri, T., & Tangerang, U. M. (2020). Teori Brunner Pada Konsep Bangun Datar Sekolah Dasar. *Jurnal Pendidikan dan Ilmu Sosial*, *2*(2), 327–349.

Utami, L. D., Amin, M., Mustafiyanti, M., & Alon, F. (2023). Masjid Friendly: Mosque Based Economic Empowerment. *Pengabdian: Jurnal Abdimas*, *1*(2), 97–106. https://doi.org/10.55849/abdimas.v1i2.186

Vicky, D., Adrianna, H., & Phan, B. (2023). Use of Gadgets by Early Childhood in the Digital Age to Increase Learning Interest. *Scientechno: Journal of Science and Technology*, *2*(1), 17–34. https://doi.org/10.55849/scientechno.v2i1.58

Wanti, L. P., Romadloni, A., Somantri, O., Sari, L., Prasetya, N. W. A., & Johanna, A. (2023). English Learning Assistance Using Interactive Media for Children with Special Needs to Improve Growth and Development. *Pengabdian: Jurnal Abdimas*, *1*(2), 46–58. https://doi.org/10.55849/abdimas.v1i2.155

Wasiran, Y., Maja, I., & Husien, F. (2019). Pkm Bagi Guru Smp Yang Mengalami Kesulitan Menggunakan Software Geogebra Dalam Pembelajaran Matematika. *Aptekmas : Jurnal Pengabdian Kepada Masyarakat*, *2*(2), 13–19. https://doi.org/10.36257/apts.v2i2.1601

Zuchri, S. (2017). Manipulatif Berbantuan Geogebra Untuk Membantu Pemahaman Siswa Dalam Menyelesaikan Word Problem Kelas 7 Smp. *Euclid*, *4*(2), 780–789. https://doi.org/10.33603/e.v4i2.420

Zuliana, E. (2017). Desain Siputmatika Dan Rancangan Lintasan Belajar Siswa Sekolah Dasar Pada Materi Simetri Putar. *Refleksi Edukatika : Jurnal Ilmiah Kependidikan*, *7*(2), 151–158. https://doi.org/10.24176/re.v7i2.1226