Ethnomathematics exploration in the Galasin traditional games in Jakarta on mathematical concepts

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Abstract: This study aims to explore ethnomathematics in the traditional game Galasin in Jakarta on mathematical concepts such as gradients, point to point distance, and vectors. This study uses an ethnographic approach to obtain a description of an in-depth analysis of a culture based on the information that has been obtained and by conducting observations and interviews in data collection. This research focuses on one of the traditional games in Jakarta, namely the Galasin game as a form of understanding ethnomathematics in mathematical concepts such as vectors, gradients, and point to point distances. This shows that the traditional game Galasin in Jakarta has a connection with mathematical concepts and forms of deepening in previous studies which have links with geometric mathematical concepts such as flat shapes. The existence of traditional game media in learning mathematics can provide benefits, namely visualizing mathematics learning in a real form so that students become more understanding and easier to understand learning the mathematical concepts being studied.

Keywords: Ethnomathematics; Galasin, Traditional games

INTRODUCTION

Indonesia has a diverse culture in the form of traditional clothes, traditional houses, regional specialties, traditional ceremonies, even traditional games, and so on. Culture in Indonesia changes every generation due to changes in thinking and the advancement of globalization so that some of the cultures experience changes (Nahak, 2019). To deal with changes that occur in culture, namely by taking concrete actions to study, promote, and empower existing culture so that it becomes an advantage for the nation and a form of love for this cultural diversity (Fatmawati, 2021).

One of the cultures in Indonesia is traditional games that are owned by all regions in Indonesia from various provinces with their peculiarities and various game conditions. Traditional games are games that are used to entertain children and can be learned from generation to generation or from other children (Trajkovik *et al* ., 2018). Traditional games are divided into 2 forms, namely traditional games played indoors, *and* traditional games played *outdoors*. Games that are played indoors *are* games that are played indoors, usually they don't need a spacious place, they are only played by sitting down and so on. As for *outdoor games* is a game that is played outdoors, a game that requires a place such as a field because it is usually played by running, jumping, throwing, kicking and other motor skills. Traditional games both indoors *and* outdoors *are* useful in growing a sense of kinship, fun and honesty. But it is also

useful for training a child's motor skills which are created from agility, strength, endurance, balance and flexibility (Sutini, 2018).

One of the traditional games played in a spacious or *outdoor area* is the Galasin game which is located in Jakarta. Traditional games besides being fun to be played by children, youth and adults can also be used by educators as an *alternative* in the use of innovative learning media in schools for students. Traditional games that can be associated with existing or existing mathematics and will be studied at school. So that students can understand and analyze what is the relationship between traditional games and mathematics material provided by educators at school, one of the traditional games that can be utilized is the Galasin game in Jakarta (Badu, 2011).

In previous research that discussed Galasin, there were various results related to geometric mathematical concepts such as flat shapes. Then in this study it discusses the deepening of mathematical concepts in previous studies, namely *gradients*. Then, in this study other mathematical elements were found, such as distances between points and vectors (Imaniyah & Zuroida, 2020).

Mathematics is an exact science that can hone a person's mindset in carrying out a calculation or operational procedure. Mathematics is also a science that can keep up with developments in each era and is a knowledge that is very much needed in everyday life. Mathematics is very closely related to a number calculation starting from addition, subtraction, multiplication, and division, all of which are mentioned are the basic knowledge of mathematics. Not only the things mentioned earlier, mathematics also studies the shape of flat structures, geometric shapes, line equations or inequalities needed in everyday life, which is why mathematics is called the queen of all sciences (Jalil, 2018).

Learning mathematics that varies such as learning through digital literacy will make students not get bored quickly in learning. In this varied learning it can increase student independence in their curiosity about a mathematical material, increase motivation, and can develop students' mathematical understanding (Ramlah *et al*., 2022). Learning mathematics is also not only taught to students as mandatory material, but is also able to link things in mathematics with human activities so that students are able to fully understand mathematics (Yuwono, 2016). Understanding is a concept that can be understood by students' thinking so that they can understand what is meant and can find ideas or the right way to solve the concept of the problem, so it is not easy to reach understanding let alone mathematical understanding (Wijaya *et al*., 2018). This can be used as evaluation material for educators to create a pleasant atmosphere for learning mathematics without eliminating the material to be taught to students (Ulya, 2017).

In the education curriculum in Indonesia, currently students are emphasized on a learning system that is not only focused on understanding the questions or questions given by educators at school after the educators have explained the mathematics material taught. However, students are focused on analyzing and relating mathematics learning given innovation using local culture. So that it is hoped that students will be able to have good reasoning competence, creative thinking skills, and be critical, this process is called ethnomathematics (Rohayati, *et al* ., 2017). Ethnomathematics according to D'Ambrosio , a Brazilian mathematician, consists of two words, namely " mathema " and " tics " which mean techniques for explaining a model from one culture (Kristia *et al* ., 2021). Ethnomathematics can also be interpreted as an idea or one that bridges the gap between culture and mathematics to use socio-cultural elements in learning mathematics (Ubui *et al* ., 2020).

Several studies that discuss local and traditional culture include traditional games, traditional food, traditional clothing, traditional buildings and many others. This study aims to find out and provide information related to the traditional Galasin game in Jakarta with the mathematical concepts learned at school. In addition, based on the research of Kristia *et al* ., 2021 research opportunities related to ethnomathematics are still very large.

METHOD

The research uses an ethnographic approach (Achmad & Ida, 2018), namely by carrying out several steps such as research planning that will be discussed and studied, namely the mathematical concepts in the traditional Galasin game in Jakarta. After determining the research plan, then carried out observations and interviews with one of the native Betawi residents on Jalan Papaya 7 Jagakarsa, South Jakarta regarding the traditional game Galasin and mathematical concepts related to the game. Then the last one is the research report which is finally analyzed and the results are made into the articles that are made (Creswell, 2013). Ethnography is the right method or design in this study which carries the theme of Exploration of Galasin Traditional Games in Jakarta on Mathematical Concepts, because the ethnographic method in this study involves culture and contains mathematical concepts in it.

In this research, the culture studied is the traditional Galasin game which uses mathematical concepts, such as vectors, *gradients*, and point to point distances. In addition, in this study the information obtained came from literature and observations or interviews. So, it can be seen that the traditional game Galasin is a history of traditional games that are not only in Jakarta, but are in several other areas in Indonesia with different names. Then, there are some mathematical concepts or material related to the Galasin game and the researcher assumes and associates some other mathematical material with the game.

In this study the reference literature used to explain culture, mathematics, and the Galasin game, as well as observations and interviews were carried out to find out the mathematical concepts used in the game. The data collection techniques and procedures used in this study were interviews with a native Betawi resident named Mr. Nimun who was at the location of Jalan Papaya 7 Jagakarsa, South Jakarta 12620. He is a native Betawi person who has been working as an entrepreneur selling various kinds of basic needs such as groceries to live and provide for his family. He is an expert in Betawi histories which he has always experienced, and he has played many kinds of traditional Betawi games so that he is no stranger to discussing these matters.

RESULTS AND DISCUSSION

Galasin game is a traditional game from various regions in Indonesia, especially in Java, namely Central Java (Almabruri, Kholifah, & Jannah, 2020). The mention of Galasin itself has many mentions according to regional origin, for example in Jakarta it is called " Galahin " or Galah Asin, while in Central Java it is commonly called "Gobak Sodor", according to the name of the game, namely *gobak sodor*, this comes from the word "Gobak" and "Sodor" which is in where *gobak* likens to moving freely while *sodor* compares to a spear so that when combined the meaning will be moving freely to avoid various spears (Susena *et al* ., 2021). According to the term, the Galasin game requires a square or rectangular area which is drawn on the ground using chalk or something similar (Ekayati, 2015). Two teams are needed to play this game, from each team there are approximately 3-5 people. The Galasin game arena is square or rectangular, with a width of 9 meters and a length of 15 meters (Imaniyah & Zuroida, 2020).

Galasin game, it can be seen that elements related to mathematical concepts according to the reference sources analyzed are the mathematical concepts of *gradients*, distance from point to point, and vectors. The following is a more in-depth explanation of the mathematical concepts of the traditional Galasin game in Jakarta.

Gradient

If it's just for fun or there are only a few more players than specified and the available places are not sufficient, then this game can still be played by reducing the size of the arena and reducing the number of players playing as shown in Figure 1 . The two existing teams consist of the gobak team or the attacking team and the *sodor* team or the guard team. The *gobak* group is the attacking group and the *sodor* group is the guard group. In this game all teams have their own goals. The goal of the guarding team is to catch or hit the players of the attacking

team to win the game and the attacking team has the goal to get past the guards of the guard team. If the attacking team has been touched by the guard team, the game will change, namely the guard team will become the attacking team and the attacking team will become the guard team. If every player from the attacking team manages to get past the guard without being touched by the guard team then the attacking team will get a score of 1 according to the number of players.
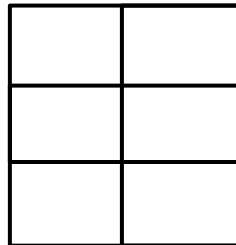

Figure 1. Galasin game arena

In fact, this Galasin game uses a lot of mathematical concepts that we are familiar with, namely ethnomathematics , among which there are elements of geometric shapes, congruence, reflection or reflection, and linear shifts. The flat geometry here can be seen from the shape of the playing field, which is rectangular.
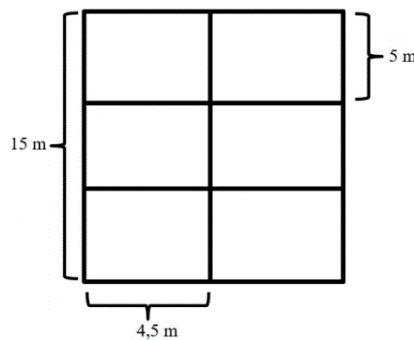

Figure 2. Galasin game arena size

According to Figure 2 it can be concluded that:

The area of one plot is $p \times l = 5\,m \times 4{,}5\,m = 22{,}5\,m^2$

The area of the arena is $22{,}5\,m^2 \times 6 = 135\,m^2$

The circumference of one plot is $2 \times (p + l) = 2 \times (5\,m + 4{,}5) = 2 \times 9{,}5\,m = 19\,m.$

Around the arena is $2 \times (p + l) = 2 \times (15m + 9m) = 2 \times (24\,m) = 48\,m.$

Furthermore, there is the concept of slope (*gradient*) in this traditional Galasin game in Jakarta, as follows: Because in the game Galasin is divided into two teams, namely the attacking team and the guard team, where the guard team is likened to a line- x and y. Because it can only move to keep only in a linear direction, namely in the vertical direction (y) and in the horizontal direction (x) as in the Cartesian diagram (Aisha , Wahyu, & Ambarwati, 2021).
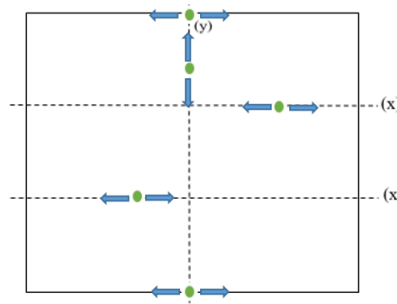

Figure 3. Guard team

Figure 3 is an illustration of the position of the guard team and its direction of movement. Meanwhile, the attacking team can move freely to where they wanted to be and the strategy they used to break through the guards' guard.
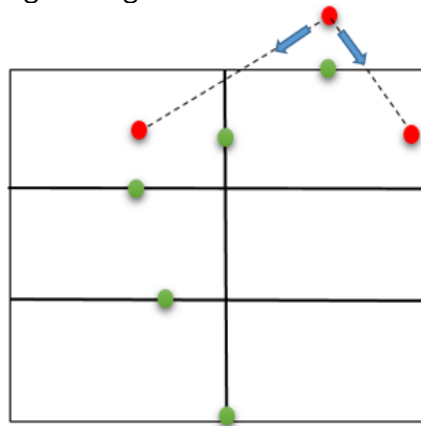

Figure 4. Attack team

Figure 4 is an illustration of the team's position with the red circle representing the attacking team and the green circle representing the guard team. Attackers can speed up their pace by running according to the *gradient line* above, while guards cannot run guarding to form a *gradient line* , because they can only move in horizontal (x) and vertical (y) directions. So it can be likened that the guard team is an x-line and a y-line while the guard team is likened to a *gradient line* .
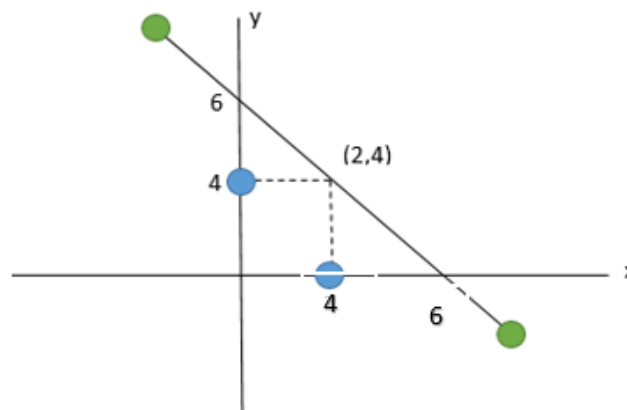
(Note: The green circle is the attacking team, the blue circle is the guard team)

Figure 5. Cartesian diagram illustration of a team of guards and attackers

Based on Figure 5 , if it is known that the positions of the guard players are (4.0) and (0.4) and the positions of the attacking players are at points (0.6) and (6.0). To find the equation of the line above, you can use the formula $\frac{y-y1}{y2-y1} = \frac{x-x1}{x2-x1}$:

$$\frac{y-6}{6-0} = \frac{x-0}{6-0} \leftrightarrow \frac{y-6}{6} = -\frac{x}{6} \leftrightarrow -6y + 36 = -6x \leftrightarrow x - y + 6 = 0$$

From the equation of the line formed by the attacking team, we can find the *gradient* by forming $y = mx + c$.

$$y = mx + c$$
$$x - y + 6 = 0$$
$$y = x + 6$$

then *the gradient* of the equation is m = 1.

Point to point distance

Furthermore , this game contains mathematical elements including the distance from point to point using theorems *pythagoras* who if you want to know the distance from a guard player to another guard player, we can use this theorem formula.
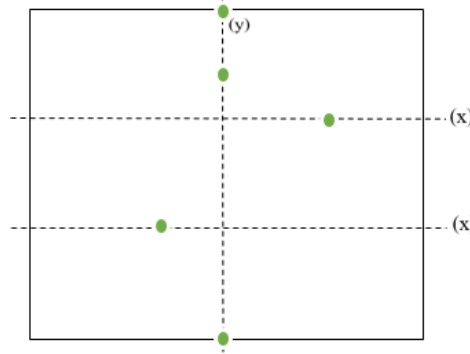

Figure 6. Guard team area

Figure 6 is an illustration of the traditional game Galasin in where the green dot is the guard team moving according to the dotted line
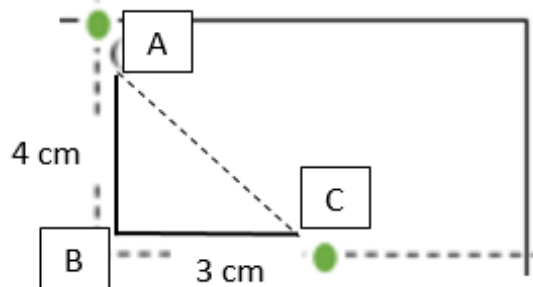

Figure 7. Theorem Pythagoras in the game of Galasin

Based on Figure 7, find the distance from player A to player C using the theorem *Pythagoras* namely:

Line AB = 4 cm
Line BC = 3 cm
Line AC = ...?
What is sought is the length of line b.

Because the angle formed by the lines a and c forms a 90 degree angle, the triangle to be formed must be a right triangle so that we can find the distance between points A and C using the theorem *pythagoras* (Manullang *et al* ., 2017). $a^2 + b^2 = c^2$ (Theorem *pythagoras*) so that , obtained $AC = 5$cm . So, it can be concluded that the distance from player A to player C is 5 cm.

Vector

Rectangular game plan of Galasin it can be seen that there are vector concept elements in the game arena. If you pay attention, for example in Figure 8 . Based on Figure 8 , the vector is $\vec{a}$ in the direction of the x-axis at coordinates with a unit length of 4.5 meters to the right. This is called a basis vector, which means it has one unit and is in the direction of the coordinate axis. This can also be referred to as a position vector, if the end of the vector is at point O (0,0) and the end of the arrow is at another point, namely point 4,5.
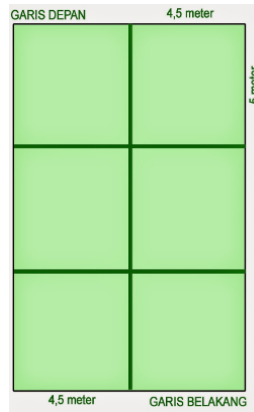
Figure 8. Galasin game plan

There are vector operations on fields in this Galasin game. Vector operations include addition, subtraction, vector multiplication with scalars and vector multiplication twice (Sari *et al* ., 2017). In this Galasin game , you can calculate the addition operation of two vectors in a triangular way, namely:
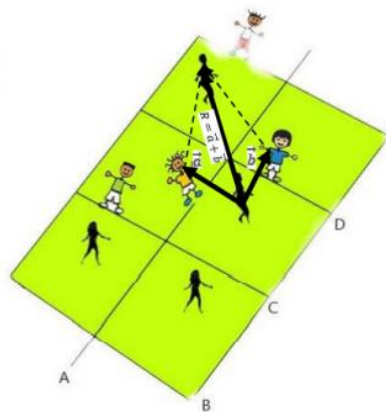

Figure 9. Addition of two vectors

In Figure 9 , it can be seen that in the plot CD is the main point in a vector O (0,0). Then from that point there are vectors a and vectors b. For example, if vector a is 5 units away and vector b is 6 units away, the vector addition can be calculated by adding up the coordinates of the center point of the vector with its endpoints.

$$\vec{a} = (Xa + Ya) = (0,5)$$
$$\vec{b} = (Xb + Yb) = (0,6)$$
$$\vec{a} + \vec{b} = (Xa + Xb, Ya + Yb) = (0 + 0, 5 + 6) = (0,11)$$

So, the result of adding the two vectors in the image is (0.11).

In general, these findings are in line with Marcia Ashcer 's ideas about *The Organization and Modeling of space* (Ascher, 1991). The results obtained in this study can be used in the process of learning mathematics as well as introducing the traditional Galasin game culture (Rosa & Orey, 2011).

CONCLUSION

Based on the results and discussion, it can be concluded that the mathematical concepts in the traditional Galasin game in Jakarta include slope (*gradient*), distance from point to point, and vectors. The mathematical concepts contained in the traditional Galasin game can be used as a medium for learning mathematics through traditional culture so that this traditional culture remains sustainable and does not become extinct in the future and learning mathematics will be more fun if learned in the form of a game. Because studying mathematics requires deep enough concentration to understand the material, but it also takes a sense of joy and curiosity

about the material you want to learn, therefore, to be able to control students' curiosity in learning mathematics, fun and exciting games are needed to be able to understand. and learn a math material. Based on the results of this study, the researcher hopes that there will be further research that examines the ethnomathematics concept in the traditional Galasin game or research that examines the mathematics learning model with local traditional culture.

REFERENCES

Achmad, Z. A., & Ida, R. (2018). Etnografi Virtual Sebagai Teknik Pengumpulan Data Dan Metode Penelitian. *The Journal of Society & Media*, *2*(2), 130. https://doi.org/10.26740/jsm.v2n2.p130-145

Aisyah, Wahyu, R., & Ambarwati, R. (2021). *Ringkasan Materi, Soal, dan Pembahasan Gradien dan Persamaan Garis Lurus Berbasis HOTS*. Thesis. UIN Raden Intan Lampung.

Almabruri, M.L., Kholifah, N., & Jannah, R. (2020). Pendidikan dan Budaya: Studi Fenomena Gobak Sodor Sebagai Media Pembelajaran Pendidikan Karakter Bagi Anak-Anak Bondowoso. *Jurnal Ilmiah Al-Hadi*, *5*(2), 142–154. Available at: https://jurnal.pancabudi.ac.id/index.php/alhadi/article/view/927

Ascher, M. (1991). *A Multicultural View I of Mathematical Ideas*. Brooks Cole Publishing Company.

Badu, R. (2011). Badu, R. W. (2011). Pengembangan Model Pelatihan Permainan Tradisional Edukatif Berbasis Potensi Lokal dalam Meningkatkan Pengetahuan dan Keterampilan Orang Tua Anak Usia Dini. Jurnal Ilmiah Visi, 6(2), 180-188. https://doi.org/10.21009/JIV.0602.8

Creswell, J. W. (2013). Qualitative Inquiry Research Desaign Choosing Among Five Approaches. In *SAGE* (Third Edit). SAGE Publications, Inc.

Ekayati, I. A. S. (2015). Pengaruh permainan tradisional "gobag sodor" terhadap kecerdasan intrapersonal dan interpersonal pada anak usia dini. *Didaktika*, *13*(3), 1–10.

Fatmawati, E. (2021). Strategies to Grow a Proud Attitude Towards Indonesian Cultural Diversity. *Linguistics and Culture Review*, *5*(S1), 810–820. https://doi.org/10.21744/lingcure.v5ns1.1465

Imaniyah, A., & Zuroida, R. (2020). Eksplorasi Etnomatematika Konsep Geometri dan Bilangan dalam Permainan Gobak Sodor. In *Prosiding Seminar Pendidikan Matematika dan Matematika (Vol. 2)*. http://prosiding.himatikauny.org/index.php/prosidinglsm/article/view/96

Jalil, A. (2018). Matematika Dalam Perspektif Sosial Budaya. *Prosiding SNPMAT 1 Tahun 2018*, *1*, 35.

Kristia, D., Soebagyo, J., & Ipaenin, H. (2021). Analisis bibliometrik dari istilah "Etnomatematika." *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, *1*(2), 178–190. https://doi.org/10.51574/kognitif.v1i2.62

Manullang, S., Kristianto, A., Hutapea, T. A., Sinaga, L. P., Sinaga, B., Marianus, M., & Sinambela, P. (2017). *Buku Siswa Matematika Wajib Kelas 11*. Kementerian Pendidikan dan Kebudayaan Republik Indonesia.

Nahak, H. M. . (2019). Upaya Melestarikan Budaya Indonesia Di Era Globalisasi. *Jurnal Sosiologi Nusantara*, *5*(1), 65–76. https://doi.org/10.33369/jsn.5.1.65-76

Ramlah, R., Riana, N., & Abadi, A. P. (2022). Fun Math Learning For Elementary School Students Through Interactive Puzzle Media. *SJME (Supremum Journal of Mathematics Education)*, *6*(1), 25–34. https://doi.org/10.35706/sjme.v6i1.5775

Rohayati, S., Karno, W., & Chomariyah, I. (2017). Identifikasi Etnomatematika Pada Masjid Agung Di Yogyakarta. *Prosiding Seminar Nasional Pendidikan Matematika*, 1–8.

Rosa, M., & Orey, D. (2011). Ethnomathematics: the cultural aspects of mathematics. *Revista Latinoamericana de Etnomatemática*, *4*(2), 32–54. http://www.revista.etnomatematica.org/index.php/RLE/article/view/32

Sari, W. P., Suyanto, E., & Suana, W. (2017). Analisis Pemahaman Konsep Vektor pada Siswa Sekolah Menengah Atas. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, *6*(2), 159–168. https://doi.org/10.24042/jipfalbiruni.v6i2.1743

Susena, Y. B., Santoso, D. A., & Setyaningsih, P. (2021). Ethnosport Permainan Tradisional Gobak Sodor. *Jurnal Pendidikan Kesehatan Rekreasi*, *7*(2), 450–462. https://ojs.mahadewa.ac.id/index.php/jpkr/article/view/1185

Sutini, A. (2018). Meningkatkan Keterampilan Motorik Anak Usia Dini Melalui Permainan Tradisional. *Cakrawala Dini: Jurnal Pendidikan Anak Usia Dini*, *4*(2), 67–77. https://doi.org/10.17509/cd.v4i2.10386

Trajkovik, V., Malinovski, T., Vasileva-Stojanovska, T., & Vasileva, M. (2018). Traditional games in elementary school: Relationships of student's personality traits, motivation and experience with learning outcomes. *PLoS ONE*, *13*(8), 1–15. https://doi.org/10.1371/journal.pone.0202172

Ubui, F., Ledi, R., Kusmanto, B., & Agustito, D. (2020). Identifikasi Etnomatematika pada Motif Kain Tenun Sumba Barat. *UNION: Jurnal Ilmiah Pendidikan Matematika*, *8*(1), 87–95. https://doi.org/10.30738/union.v8i1.5338

Ulya, H. (2017). Permainan tradisional sebagai media dalam pembelajaran matematika. *Prosiding Seminar Nasional Pendidikan*, *6*, 371–376.

Wijaya, T. T., Dewi, N. S. S., Fauziah, I. R., & Afrilianto, M. (2018). Analisis Kemampuan Pemahaman Matematis Siswa Kelas IX Pada Materi Bangun Ruang. *UNION: Jurnal Ilmiah Pendidikan Matematika*, *2*(2), 77–83. https://doi.org/10.35706/sjme.v2i2.1317

Yuwono, A. (2016). Problem Solving Dalam Pembelajaran Matematika. *UNION: Jurnal Ilmiah Pendidikan Matematika*, *4*(1), 6–7. https://doi.org/10.30738/.v4i1.420