# Development of Discovery-Based Etnobra (Ethnomathematics Geogebra) Geometry Learning Model to Improve Geometric Skills in Terms of Student Learning Styles and Domicile.

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*Abstract: The low knowledge and love of students for culture, plus based on preliminary analysis, it is known that geometry skills are relatively low. The a need for harmony between student and teacher learning styles to maximize student engagement and focus in the classroom. So this study aims to create a culture-based Geometry learning design that effectively improves students' geometry skills in terms of students' learning styles and domicile. Furthermore, specifically examines geometry skills in terms of learning styles and student domicile. The subjects of the study were students of SMP Negeri 1 Ciruas and SMP Negeri 1 Tanara, Serang Regency. The research used the R&D method of prototype development model and quality research method. The results of the study found that the invention-based Ethnobra (Ethnomathematical Geogebra) design was valid, practical, and effective in improving students' geometry skills. The results of the subsequent analysis found that urban students had better geometry skills than rural students. It's also known that students with a tendency towards kinesthetic learning styles have the highest geometry skills. This study recommends that teachers use the Ethnobra model by integrating Geogebra applications in Geometry learning, especially for students who go to urban schools and with kinesthetic learning styles.*

Keywords: ethnomathematics, geogebra, geometric skills, learning styles, domicile

## INTRODUCTION

One of the scopes of junior high school mathematics is Geometry. Geometry is one of the objects of mathematical study that is quite abstract and difficult to understand (Al Afgoni et al., 2020; Karapınar &; Alp İlhan, 2018). In learning geometry, geometry skills are needed, namely the ability of learners to observe objects, build definitions based on the inherent characteristics of things, recognise relationships between objects, and apply them in solving geometry problems (VanHiele, 1959). However, the results of previous studies showed a low level of students' geometry skills (Hamidah et al., 2022; Hamidah &; Kusuma, 2020; Haviger & Vojkůvková, 2014, 2014, 2015; Verner et al., 2019). Van Hiele divided geometry skills into five levels: level 0 (visualization), level 1 (analysis), level 2 (abstraction), level 3 (deduction), and level 4 (rigor). The results of previous it is show that the level of geometry thinking of Van Hiele students is mostly only up to the level of visualization studies (ALTUN, 2018; Asemani et al., 2017; Karapınar &; Alp İlhan, 2018; Şefik et al., 2018).

The initial analysis results found that 48.3% at level 0, 34.5% of level 1 students, and 17.2% at level 2. Based on the interview results, students stated that their difficulties in dealing with geometry problems were drawing objects in geometric shapes from story problems, imagining abstract figures, proof problems, and complications due to forgetting formulas. The results of the initial research on student errors, in general, students make many mistakes in reading and understanding the meaning of the problem. Observations and teacher interviews show that learning habits in the classroom refer to school books without development. The book is very rigid and outdated, that is, it provides definitions and formulas, examples of problems with their solutions, after which practice questions. In the era of Society 5.0, this method is outdated and less optimal for developing student abilities. So in this study, an effective geometry learning design in the era of Society 5.0 will be designed to improve students' geometry skills.

The era of society 5.0, puts humans as the main component and utilizes technology to solve problems. To realize this, learning by utilizing the Geogebra application can optimize students' geometry skills. Geogebra is one of the *tools* that can clarify and facilitate students' understanding of abstract objects (Chivai et al., 2022; Dockendorff &; Solar, 2018; Korkmaz, 2021). Geogebra provides visual experience, develops experimental processes, and draws geometric objects easily and precisely (Alkhateeb &; Al-Duwairi, 2019; Celen, 2020; Yorganci, 2018; Zengin, 2018). So Geogebra was chosen as a tool for learning Geometry to investigate Geometry problems. Technology development is very rapid, accompanied by the demands of technology-based education. Geogebra is one of the learning media that can demonstrate and invite students to be actively involved in constructing Geogebra objects to make them easier to understand and more meaningful. Geogebra is designed to help students develop experimental, problem-oriented, and discover Geometry concepts (Çolakoğlu, 2018). So that the learning design is designed to be problem-oriented and invites students to discover the concept of Geometry.

Furthermore, ethnomathematics is interpreted as the study of mathematics and its relationship with culture in the context of social life in society (Prahmana &; D'Ambrosio, 2020; Verner et al., 2019). Similarly, ethnomathematics is a study that examines mathematical ideas in various cultures that show reciprocal relationships (Pradhan, 2017; Rosa & Gavarrete, 2017). Learning with an Ethnomathematical approach will make learning richer and more meaningful and students' love for their area will emerge (Rosa et al., 2016; Rosa & Gavarrete, 2017). Furthermore, learning with an Ethnomathematical approach that develops in culture in an area will strengthen students with their customs and environment (Prieto et al., 2015). In other words, mathematics and culture will be an interesting scientific context, because students will learn mathematics based on the culture they understand and are relevant to their daily lives.

The design then chose an Ethnomathematical approach by including Geogebra as an application that would invite students to be oriented to Cultural problems in finding Geometry concepts, to improve students' geometry skills. Ethnomathematical studies began to be introduced by (D'Ambrosio, 1985), and continue to be researched and developed (D'Ambrosio, 1999). (D'Ambrosio, 1999) Learning with an Ethnomathematical approach that develops in culture in an area will strengthen students with their customs and environment (Knijnik, 2002; Mosimege, 2012; Prahmana &; D'Ambrosio, 2020; Prieto et al., 2015). So that the Ethnomathematics approach is used to create meaningful learning and increase students' love of their culture.

Previous research has discussed Geogebra to overcome students' difficulties understanding Geometry material. However, no one has used Geogebra with Ethnomathematics as a foundation for designing their learning designs. Therefore, this study intends to find problem-oriented learning designs using Ethnomathematics as a cultural approach and then utilizing Geogebra to manifest the era of society 5.0. The design is called Etnobra, one of this study's novelties. Furthermore, this study uses an Ethnomathematical approach closely related to Culture in the daily student environment. However, it is a well-known tendency that students who live in cities and villages have different understandings of culture and different technological facilities. So the Ethnomathematical approach and the use of applications may have a negative or positive effect on students' understanding of concepts when viewed from their domicile. For this reason, this study will examine whether the domicile of students attending school (cities and villages) affects students' geometry skills using learning with the Ethnobra model (Geogebra Ethnomathematics).

Every child is born with different abilities, especially in terms of absorbing, processing, understanding and conveying information, this ability is called a learning style (Nugraha &; Rahman, 2021; Tatminingsih, 2022). Learning style is called collaboration on how a person absorbs and processes all the information obtained (Chetty et al., 2019; Costa et al., 2020; Leyton-Román et al., 2020; Wang et al., 2019). So the a need for harmony between student and teacher learning styles to maximize student engagement and focus in class to get satisfactory results. There are three learning styles, namely visual, auditorial and kinesthetic learning styles (Buşan, 2014; Chetty et al., 2019; Leasa et al., 2017; Saga et al., 2015).

This study discusses three independent variables, namely Ethnobra learning design, learning style, and domicile, and one dependent variable is geometry skills. The framework of thinking about the relationship between variables, namely, the learning style and domicile of students attending school affects students' geometry skills after being given learning with the Ethnobra model. The following is summarized in the form of a flow chart.

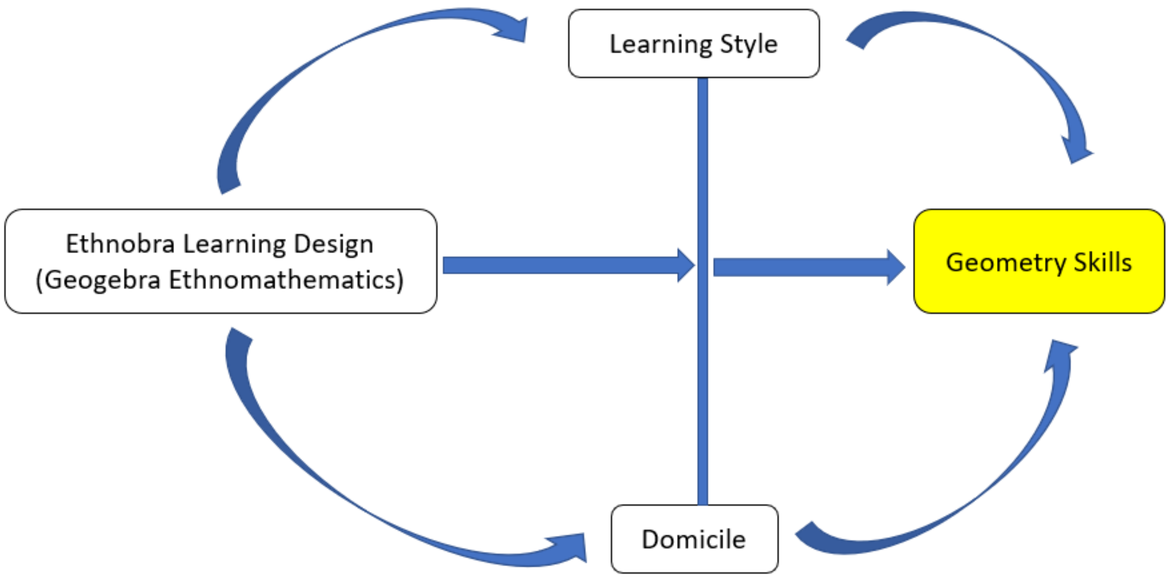



Figure 1: Research Model

Based on the reasons above, it is necessary to develop a culture-based Geometry learning design that effectively improves students' geometry skills regarding learning styles and domicile. The learning design is designed using technology that makes it easier for students to understand geometry lessons, namely the Geogebra application, so the learning design developed is an Ethnobra learning model (Geogebra Ethnomathematics). This research has two objectives, the first is to develop a quality Ethnobra (Ethnomathematical Geogebra) learning model with valid, practical, and effective categories and the second goal is to analyze the geometry ability of students taught with the Ethnobra (Ethnomathematical Geogebra) learning model in terms of student learning styles and domicile.

## METHODS

The research began in the odd semester of 2023-2024 in July 2023, the subjects of the study were students of SMP Negeri 1 Ciruas and SMP Negeri 01 Tanara class VIII. The subjects were selected by purposive sampling, considering that SMP Negeri 1 Ciruas represented urban areas and SMP Negeri 01 Tanara represented rural areas. Class VII was selected based on line and flat build materials. Based on the research objectives, this study uses R&D methods to develop learning models and uses a qualitative approach to analyze students' geometry skills regarding learning styles and domicile of students attending school.

**Development Research**

In the Reserarch and Development method, the model development procedure used is a prototype development model, with stages namely (1) preliminary research, (2) prototyping stage, and (3) assessment stage ( Plomp, 2013; Van den Akker et al., 2006). Systematically the stages of his research are described as follows.

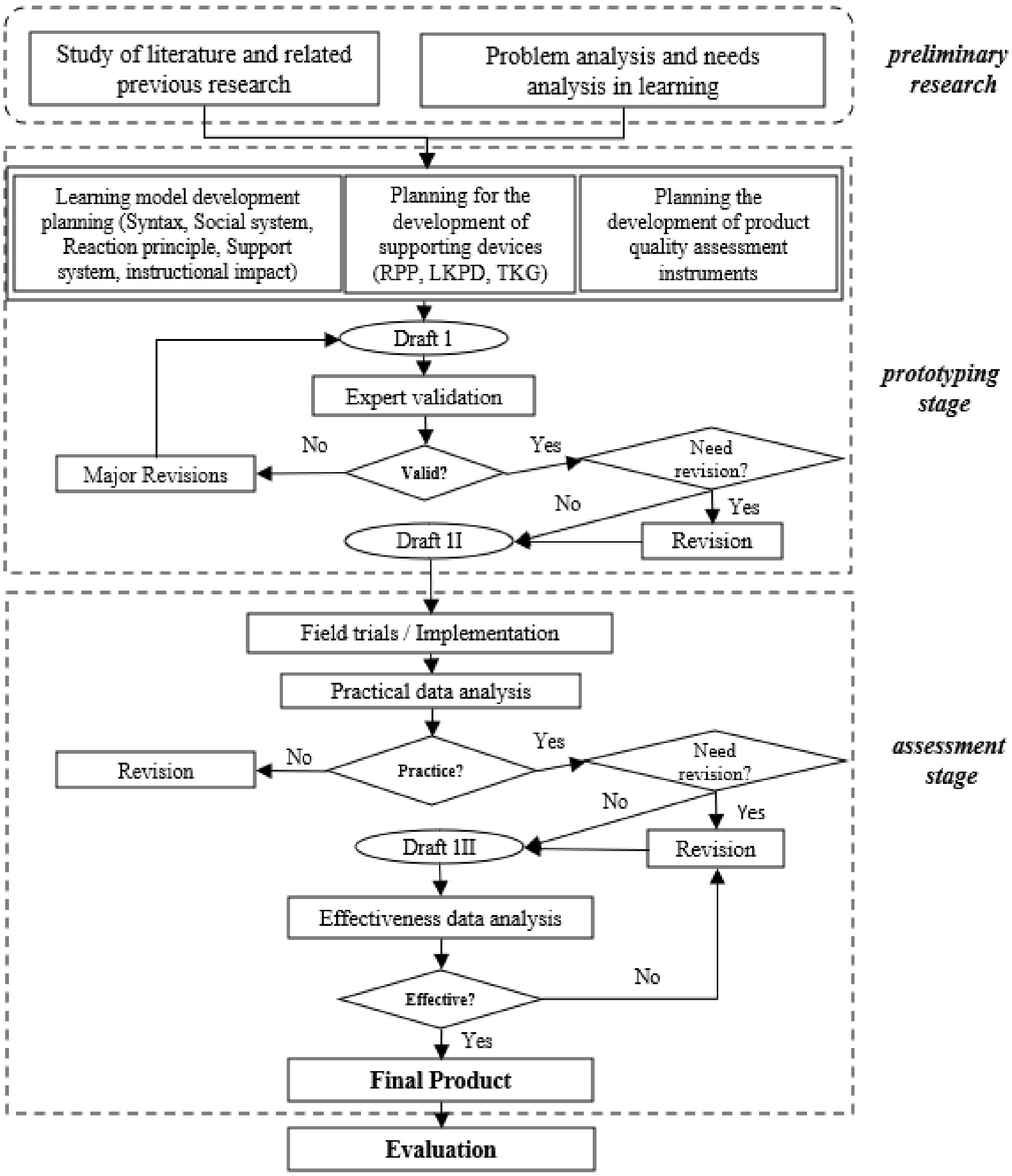



Figure 2: Research Development Model

The first stage, preliminary research, includes the literature and field studies used as a needs analysis on the development of learning designs and comparisons with relevant research. Field studies are conducted to analyze the needs of learning design to measure the initial ability to think the geometry of students and the culture in the student environment so that learning designs are tailored to the needs of students and teachers. The prototyping stage is carried out to produce a draft of learning design in the form of a draft of learning model development planning, a draft of planning for the development of supporting devices (RPP, LKPD, and geometry skill tests), and a draft of product quality assessment instrument development. The product development phase produces draft grids, instruments, and Geometry skill assessment rubrics. The activity continued with testing, namely expert validation and revision.

Furthermore, the assessment stage is carried out field trials, and an analysis of the practicality and effectiveness of the learning design developed. The learning model was implemented on grade VIII junior high school students at SMP Negeri 1 Tanara and SMP Negeri 1 Ciruas. After receiving feedback, the learning design is evaluated and improved to obtain a valid, practical, and effective final product to improve students' geometry skills.

The instruments used in this study include instruments to assess product quality, including three aspects: validity, practicality and effectiveness. Validators use product validity assessment instruments to assess the quality of validity of the product developed. The validator assessment sheet consists of a validity assessment sheet for the learning model and its tools (RPP, LKPD, and geometry skill test). Product practicality assessment instruments are assessed from two criteria, namely based on the results of practicality questionnaires from experts/observers and teachers who state that the learning model developed can be applied and (2) practical questionnaires from students, namely in real-time in the field, students as users state that the developed model is easy to apply. The assessment instrument for the effectiveness of the learning model developed is determined by the criteria for achieving students' geometry skills that are better than students with conventional learning.

**Qualitative Research**

After conducting development research, this study used qualitative research methods to describe students' geometry skills with Ethnobra learning based on visual, auditorial, and kinesthetic learning styles. The instruments used were geometry skill tests and learning style questionnaires. In this study, data were obtained from two schools with urban area school backgrounds and schools with rural backgrounds. The two schools will be given learning with the Ethnobra model, geometry skill tests, and learning style questionnaires. Based on learning style questionnaire data in each school, two students were selected to be interviewed regarding geometry skills and Ethnobra learning models.

The learning style questionnaire consists of 36 statement items prepared based on a grid of visual, auditorial, and kinesthetic learning styles validated and declared valid by experts for use. The preparation of the questionnaire instrument uses the Likert scale with 5 answer choices, namely always, often, sometimes, rarely, and never. The geometry skill test is made based on five indicators of geometry skills, namely those that have been declared valid by validators, namely visual, verbal, drawing, logic, and applied (Connolly, 2010; Jebur, 2020; Molina &; Mason, 2021; Trimurtini *et al*., 2022; Tzagkourni *et al.*, 2021). Furthermore, unstructured interviews were conducted to obtain in-depth information. The interview guidelines used were an outline of questions about the Ethnobra learning model and students' geometry skills asked of the research subjects.

The validity of the data in this study includes the degree of trust (credibility), transferability criteria, dependability criteria (dependability), and certainty criteria (confirmability). Triangulation in research compares data on written test results of geometry skills, observation data of students' geometry skills in class, and data on geometry skills interviews (triangulation method). It also compares data reductions from subjects within the same group of students' geometry skill levels (triangulation of data sources).

## RESULTS AND DISCUSSION

Based on the objectives of this study, the first is to develop a quality Ethnobra (Ethnomathematical Geogebra) learning model with valid, practical, and effective categories and the second goal is to analyze the geometry skills of students taught with the Ethnobra (Ethnomathematical Geogebra) learning model in terms of student learning styles and domicile.

### Development Research Results

The first result is the development of learning models and their tools, which are based on prototyping model procedures including the stages of (1) preliminary research, (2) prototyping phase, and (3) assessment phase.

### Preliminary Research

At the preliminary research stage, namely to find out the problems that occur in the implementation of learning geometry subjects in class. Collect information about the needs in geometry learning, the learning model used, the use of culture in classroom learning, and the learning tools teachers use in the learning process. Pre-field survey and preliminary analysis activities are carried out to achieve the objectives mentioned above.

The results of the pre-survey of classroom learning: show that mathematics teachers in schools carry out classroom learning by applying learning models less relevant to student characteristics and mathematics learning objectives. The current condition of mathematics learning implementation is currently running in schools, has not implemented student-centred learning, and has not paid attention to cultural aspects. Learning also has not utilized social interaction patterns in organizing students to learn to be actively involved in reconstructing geometry knowledge through problem-solving sourced from facts and cultural environments.

Results of curriculum analysis: The study of mathematics should align with the goals and content of the mathematics curriculum, which encompasses: 1) comprehending mathematical principles, involves the capacity to elucidate the connections between these principles and to employ them flexibly, accurately, efficiently, and with precision.; 2) utilizing patterns as hypotheses during problem-solving, and having the capacity to formulate generalizations from existing occurrences or data; 3) applying logical thinking to natural phenomena, conducting mathematical operations for simplification, and scrutinizing constituent elements in problem-solving within mathematical and non-mathematical contexts. This encompasses the capability to comprehend issues, construct mathematical models, resolve these models, and interpret the resulting solutions, all of which are valuable for addressing real-world problems in daily life; 4) effectively conveying concepts, logical reasoning, and crafting mathematical proofs through the use of complete sentences, symbols, tables, diagrams, or other means to elucidate situations or issues; 5) possessing an attitude that values the practicality of mathematics in daily life, which includes curiosity, attentiveness, and enthusiasm for learning mathematics, along with a determined and self-assured approach to problem-solving; 6) exhibit attitudes and conduct that align with the principles of mathematics and learning, including adhering to rules, maintaining consistency, upholding agreements, showing tolerance, respecting diverse viewpoints, displaying politeness, promoting democracy, demonstrating resilience, fostering creativity, valuing the context and environment, fostering cooperation, ensuring fairness, practicing honesty, being meticulous, exercising flexibility and openness, and having a willingness to share emotions with others; 7) engage in physical activities that apply mathematical understanding; 8) utilize basic educational tools and technological outcomes for conducting mathematical tasks. Although there is no firm separation for the compatibility between the goals to be achieved and the domain of competence, it can be identified that the focus of the subject objectives is to be achieved when students learn the basic competencies of a particular domain. By taking into account the description of the competencies learned by junior high school students and the objectives of junior high school mathematics subjects, the following are the focus of subject objectives to be achieved when students learn the basic competencies of junior high school mathematics in certain areas, namely attitudes, knowledge, and skills. Based on curriculum analysis, a learning model is designed that covers these three domains. The material chosen is the subject of Geometry sub-material triangles and quadrilaterals because the development of learning models focuses on students' geometry skills.

Analysis of student characteristics: The outcomes of the examination of student traits are known to students of SMP Negeri 1 Ciruas who come from urban school backgrounds. Students are provided with wifi, a strong network, and infocus facilities in some classes. Meanwhile, students at SMP Negeri 1 Tanara come from rural school backgrounds far from urban areas. There is no wifi in the school, and no infocus can be used to support technology-based learning. However, when conducting direct interviews with class teachers about culture, it was known that most students at SMP Negeri 1 Ciruas preferred foreign cultures due to globalization.

Meanwhile, students at SMP Negeri 1 Tanara are still familiar with regional culture and there are still few who are influenced by foreign culture. One of the reasons is technology that students in rural areas cannot easily access. In other words, technology can have both a positive impact and a negative impact on students.

Preliminary analysis of students' geometry skills: It is known that 48.3% at level 0, 34.5% at level 1 students, and 17.2% are at level 2. Based on the interview results, students stated that their difficulties in dealing with geometry problems were drawing objects in geometric shapes from story problems, imagining abstract shapes, proof problems, and difficulties due to forgetting formulas. The results of the initial research on student errors in solving geometry problems are that students generally make many mistakes in reading and understanding the meaning of the problem. Observations and teacher interviews show that learning habits in the classroom refer to school books without development.

Results of theoretical studies: Based on the analysis above, theories that support overcoming existing problems are studied. One of them is designing an effective learning model for geometry learning. The design of the designed learning model is called Ethnobra. The Ethnobra learning model stands for Ethnomathematics and Geogebra. Ethnomathematics is used to create meaningful learning and increase students' love for their culture and Geogebra is one of the learning media that can demonstrate and invite students to be actively involved in constructing Geogebra objects so that they are easier to understand and more meaningful. In learning, it is designed so that the student centre is discovery-based. The information obtained is used for designing development products, namely learning models, supporting devices, and instruments to assess product quality.

**Prototyping Phase**

At this stage, produce a draft of learning design in the form of a draft of learning model development planning, a draft of planning for the development of supporting devices (RPP, LKPD, and TKG/geometry ability tests), and a draft of product quality assessment instrument development. The product development phase produces learning design drafts, grids, instruments, and Geometry skill assessment rubrics.

The learning model is designed to invite students to make discoveries with the help of the Geogebra application by covering the components of the learning model, which include (1) syntax, (2) social systems, (3) reaction principles, and (4) support systems (5) learning impacts and companion impacts. The design of the Learning model is then presented in the form of Draft I of the Ethnobra learning model. In addition to the components of the learning model, supporting tools are included, namely RPP, Student Worksheets (LKPD), and Geometry Skills Test (TKG).

The design of the learning model is as follows.

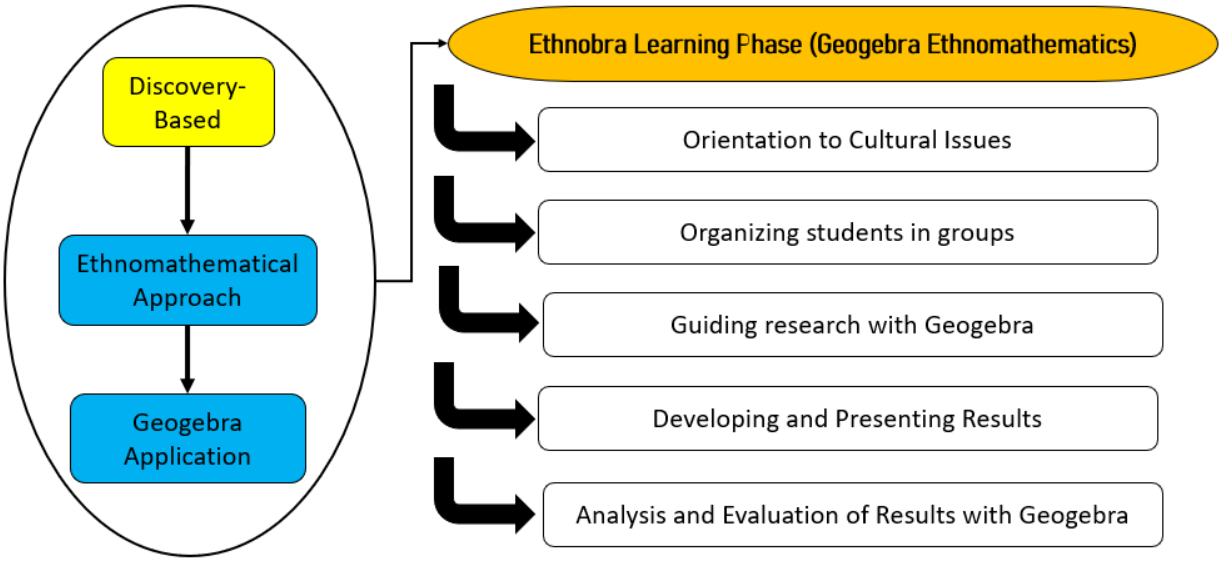



Figure 3: Ethnobra Learning Design (Geogebra Ethnomathematics)

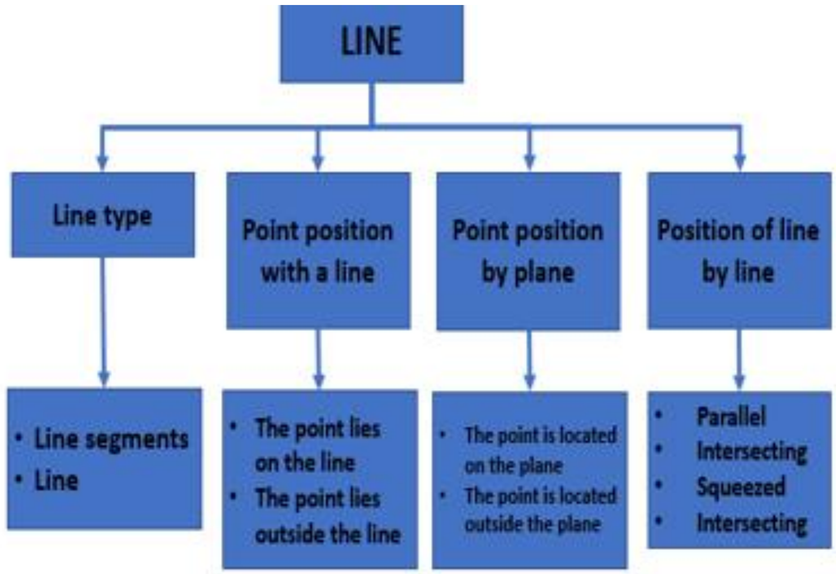
Figure 3 is an Ethnobra learning design design accompanied by discovery-based learning steps. Furthermore, LKPD is prepared as a worksheet containing activities and independent practice questions for students related to geometry material done manually and with the help of the Geogebra application. Student worksheets (LKPD) are arranged into four learning activities, namely learning activity 1 (point, line, field, line ray, line segment, and angle), learning activity 2 (relationship between point, line, and plane), learning activity 3 (congruence and awakening properties), learning activity 4 (flat building). Each learning activity presents problems related to ethnomathematics which then presents the steps of investigation with the Geogebra application. For the learning process, each meeting is carried out based on five stages of Ethnobra learning (Figure 3). The following is an example of LKPD designed in learning activity 1 line material.



**Ayo Kita Mengenal Budaya Banten**

**Batik Banten** memiliki pola pengulangan cap dengan tujuan untuk efisiensi, mempercepat, dan memperbanyak hasil produksi. Motif batik Banten memiliki garis yang tebal, isen-isen kasar, ukuran motif yang cukup besar. Awal mula kemunculan batik Banten adalah keinginan pemerintah Provinsi untuk menginventarisasi kekayaan budaya setempat. Bidaya wilayah setempat menjadi ciri khas batik Banten. Proses pengkajian batik Banten telah dilakukan pada tahun 2002, kemudian diperkuat dengan surat keputusan Gubernur pada tahun 2003 untuk membentuk panitia peneliti. Penelitian dilakukan dengan mengambil sumber data arkeologis untuk menemukan kondisi Banten di masa lalu. Sumber motif berasal dari bangunan arkeologis pada pemerintahan Sultan Maulana Hasanuddin, pendiri kesultanan Banten. Hasil penelitian pada tahun 2004 berhasil mengumpulkan 75 motif batik Banten. Beberapa diantaranya telah diproduksi yaitu Surosowan, Pasulaman, Pasepen, sabakingking, Srimanganti, dan masih banyak lagi.

Motif Srimanganti misalnya, diambil dari nama bangunan istana yang digunakan oleh raja bertatap muka dengan rakyatnya. Warna motif ini adalah merah tua, coklat tua, dan hitam. Makna motif Srimanganti adalah sifat raja yang arif, teguh hati, dan pemberani.





**Let's Get to Know Banten Culture**

Banten Batik has a stamp repetition pattern with the aim of efficiency, speeding up, and multiplying production results. Banten batik motifs have thick lines, rough isen-isen, the size of the motif is quite large. The beginning of the emergence of Banten batik was the desire of the provincial government to inventory the local cultural wealth. Bidaya local area is the hallmark of Banten batik. The Banten batik assessment process was carried out in 2002, then strengthened by the Governor's decree in 2003 to form a research committee. The research was conducted by taking archaeological data sources to find the condition of Banten in the past. The source of the motif comes from archaeological buildings during the reign of Sultan Maulana Hasanuddin, the founder of the Banten sultanate. The results of research in 2004 managed to collect 75 Banten batik motifs. Some of them have been produced, namely Surosowan, Pasulaman, Pasepen, sabakingking, Srimanganti, and many more.

The Srimanganti motif, for example, is taken from the name of the palace building used by the king face to face with his people. The colors of this motif are dark red, dark brown, and black. The meaning of Srimanganti's motif is the nature of the king who is wise, determined, and brave.

Setelah kamu amati, pola batik di atas terdiri dari titik, garis, dan bangun-bangun datar. Gambarkan bentuk apa saja yang ada pada batik di atas!

After you observe, the batik pattern above consists of points, lines, and flat shapes. Describe what shapes are on the batik above!

Sebutkan bagaimana kedudukan dari titik dan garis, kedudukan titik dan bidang, serta kedudukan garis dan garis yang dapat kamu temukan dari gambar batik di atas? Gambar kan!

Mention how the position of points and lines, the position of points and planes, and the position of lines and lines that you can find from the batik picture above? Draw it right!

Figure 4: Example 1 Student Worksheet

Figure 4 is an example of LKPD, a worksheet given to students. The worksheets are packed by introducing Banten culture, namely batik, to attract and provide cultural understanding to students. Furthermore, students are asked to observe and analyze the shape of batik patterns and look for their relation to the teaching material. This activity is directed to be completed in groups to create interesting and memorable discussions and questions and answers.

**Kegiatan 1**

Part 1
1. Buatlah segmen garis AB
2. Buatlah titik C dan titik E yang berada diantara segmen garis AB
3. Buatlah titik D da n titik F yang tidak berada di antara segmen garis AB

4. Kedudukan titik C adalah .......................... segmen garis AB
5. Kedudukan titik D adalah .......................... segmen garis AB
6. Kedudukan titik E adalah .......................... segmen garis AB
7. Kedudukan titik F adalah .......................... segmen garis AB

Part 2
1. Buatlah persegi panjang ABCD
2. Buatlah titik E dan titik F yang berada ditengahpersegi panjang ABCD
3. Buatlah titik G da n titik H yang tidak berada di tengahpersegi panjang ABCD

Tentukan!
a. Kedudukan titik E adalah .......................... persegi panjang ABCD
b. Kedudukan titik F adalah .......................... persegi panjang ABCD
c. Kedudukan titik G adalah .......................... persegi panjang ABCD
d. Kedudukan titik H adalah .......................... persegi panjang ABCD

**Activities 1**

Part 1
1. Create an AB line segment
2. Make point C and point E between the AB line segments
3. Make a point D and a point F that is not between the segments of line AB

4. The position of point C is.......................... against line segment AB
5. The position of point D is .......................... against line segment AB
6. The position of point E is .......................... against line segment AB
7. The position of point F is .......................... against line segment AB

Part 2
1. Create an ABCD rectangle
2. Make point E and point F in the center of the ABCD rectangle
3. Make a point G and a point H that is not in the center of the ABCD rectangle

Specify!
a. The position of point E is.......................... against rectangle ABCD
b. The position of point F is.......................... against rectangle ABCD
c. The position of point G is.......................... against rectangle ABCD
d. The position of point H is.......................... against rectangle ABCD

**Kegiatan 3**

Kerjakan menggunakan aplikasi GeoGebra! Kemudian isilah titik-titik yang disediakan!

1. Buatlah kubus ABCD.EFGH !
2. Berapakah panjang rusuk kubus ABCD.EFGH yang kamu buat?
3. Buatlah titik R yang merupakan titik tengah segmen garis AB!
4. Tentukan jarak antara titik F dengan titik R!
5. Tentukan jarak antara titik R dan segmen garis GH dengan aplikasi Geogebra!
6. Buatlah bidang CDEF, dengan menghubungkan titik C, titik D, titik E, dan titik F!
7. Hitunglah berapa jarak antara titik R dengan bidang CDEF!
8. Buatlah titik S, yang merupakan titik tengah segmen garis GH!
9. Hitunglah berapa jarak antara garis AS dan garis RG!
10. Buatlah segmen garis AC, dengan menghubungkan titik A dan titik C!
11. Hitunglah jarak antara garis AC dan garis DH!

Buat kesimpulan materi dari rangkaian kegiatan yang dikerjakan!

**Activities 3**

Do it using the GeoGebra app! Then fill in the dots provided!

1. Create an ABCD cube. EFGH!
2. What is the length of the ribs of the cube ABCD. EFGH you created?
3. Make the point R which is the midpoint of the line segment AB!
4. Determine the distance between point F and point R!
5. Determine the distance between the R point and the GH line segment with the Geogebra app!
6. Create a CDEF field, by connecting point C, point D, point E, and point F!
7. Calculate the distance between the point R and the CDEF field!
8. Make point S, which is the midpoint of the GH line segment!
9. Calculate what is the distance between the US line and the RG line!
10. Make a segment of the AC line, connecting point A and point C!
11. Calculate the distance between the AC line and the DH line!

Make material conclusions from the series of activities carried out!

Figure 5: Example 2 Student Worksheet

Figure 5 is the next activity sheet on the designed LKPD. In this activity, students were asked to discuss the first activity manually and then do the second activity using the Geogebra application. In the final activity, students are asked to make material conclusions based on the activities carried out. LKPD functions to guide students in the activity of constructing new knowledge in each meeting. The next learning tool is TKG, which is a geometry skill test made based on indicators of geometry skills, namely visual, verbal, drawing, logic, and applied (Connolly, 2010; Jebur, 2020; Molina &; Mason, 2021; Trimurtini et al., 2022; Tzagkourni et al., 2021).

**Assessment Phase**

The activity continued by assessing the quality of the learning model and its tools. Assessing the quality of learning requires instruments of validity, practicality and effectiveness. For the validity of the model and supporting devices for the implementation of the model, validation was requested by three teams of experts.

**Validity Assessment Results**

Validation is carried out on the learning model and its devices. The formula used is (Arikunto, 2012):

$$P = \frac{\sum R}{N} \times 100\%$$

Information:

P : Percentage of score searched

$\sum R$ : number of answers given by validators / selected choices

N : Maximum or ideal number of scores

The criteria or level of achievement of the instruments used in model development are as follows (Arikunto, 2012).

| Achievement Level (P) | Qualification | Information |
|---|---|---|
| 81% – 100% | Excellent | Very well deserved. No revision required |
| 61% – 80% | Good | Feasible, no revision required |
| 41% – 60% | Good enough | Less worthy needs revision |
| 21% – 40% | Not good | Not worth it, needs revision |
| < 20% | Very unfavourable | Very unfeasible, needs revision |

Table 1: Instrument Criteria.

The summary of the validation calculation results is presented in the table.

| Object | Aspects | Attainment Rate (P) | Information |
|---|---|---|---|
| Ethnobra Learning Model | Content validation | 82% | Very decent |
| | Construct validation | 89% | Very decent |
| RPP (Learning implementation plan) | Indicator Formulation | 78% | Proper |
| | Purpose | 85% | Very decent |
| | Time Allocation | 99% | Proper |
| | Material | 82% | Very decent |
| | Learning activities (conformity to Ethnobra syntax) | 89% | Very decent |
| LKPD (Student worksheet) | Content suitability | 78% | Proper |
| | Conformity of construction requirements | 75% | Proper |
| | Technical compliance | 78% | Proper |
| TKG (geometry skill test) | Question items | 88% | Very decent |
| | Time allocation suitability | 85% | Very decent |
| | General validity | 87% | Very decent |

Table 2: Summary of Validity Assessment Results

**Practicality Assessment Results**

The final product's practicality is determined by whether it fulfills the specified criteria of (1) experts/observers and teachers stating that the learning model developed can be applied and (2) in real-time in the field, students as users state that the developed model is easy to apply. The findings from the evaluation of practicality are displayed within the table.

| Assessment | Aspects | Amount That Gives a Minimal Good/Practical Rating (P) | Conclusion |
|---|---|---|---|
| Teacher | Easy to implement | 83 % | According to teachers, the model developed is said to be practical because the average teacher assesses more than 80% with a minimal practical category |
| | Accuracy of time allocation estimates with implementation | 83% | |
| | Possible achievement of learning objectives | 85% | |
| Student | Easy of understanding | 89% | According to students, the model developed is said to be practical because the average student assesses more than 80% with a minimal practical category |

Table 3: Results of the Practicality Assessment

**Effectiveness Assessment Results**

The effectiveness of the learning model developed is determined by the criteria for achieving competence by individual students, as seen from geometry skills results. The results of the assessment of students' geometry skills after being given learning with the Ethnobra learning model compared to conventional learning are presented in the table.

| **Aspects** | **Learning Model** | |
|---|---|---|
| | **Ethnobra** | **Conventional** |
| Average Geometry skills | 83 | 62 |
| Normality Test Results | Sig=0.10>0.05<br>Normal distributed data | Sig=0.55>0.05<br>Normal distributed data |
| Homogeneity Test Results | Sig=0.88>0.05<br>Score variance of both homogeneous classes | |
| Average Difference Test Results (T-Test) | Sig=0.000<0.05<br>Hypothesis rejected | |
| Conclusion | The geometry skills of students provided learning with the Ethnobra model are better than with conventional learning | |

Table 4: Results of the Effectiveness Assessment

The significance test results show that the geometry skills of students given learning with the Ethnobra model outperforms conventional learning methods. This shows that the Ethnobra learning model is more effective for students' geometry skills than conventional learning.

**Qualitative Research Results**

Filling out the learning style questionnaire was carried out to identify each student's learning style. The questionnaire was given to urban area students at SMP Negeri 1 Ciruas totaling 27 students and rural area students, namely at SMP Negeri 01 Tanara totaling 34 students. The results are presented in the following table.

| Learning Style | Number of Students Based on School Domicile | | | |
|---|---|---|---|---|
| | City | | Village | |
| Visual | 14 | 51.85% | 22 | 64.71% |
| Auditorial | 9 | 33.33% | 12 | 35.29% |
| Kinesthetic | 4 | 14.81% | 0 | 0% |
| Sum | 27 | 100% | 34 | 100% |

Table 5: Results of Student Learning Style Questionnaire

Based on the results of the questionnaire data calculation, it is known that the trend of student learning styles varies in each school. In general, it is known that students in urban and rural areas tend to have visual learning styles, however, none of them have kinesthetic learning style tendencies. Furthermore, the geometry skill test results are presented to students and reviewed based on their learning style.

| Learning Style | Average Geometry Skills Test | |
|---|---|---|
| | City | Village |
| Visual | 74 | 70.32 |
| Auditorial | 82.11 | 70.42 |
| Kinesthetic | 88.5 | 0 |
| Sum | 81.54 | 70.37 |

Table 6: The results of students' geometry skill tests are reviewed based on style

From the table above, it is known that the average geometry skill test results of students in urban areas are higher than the average geometry skill test results of students in rural areas. Moreover, considering different learning styles, it's evident that students with a kinesthetic learning preference exhibit superior geometry skills compared to students with other learning styles. However, in rural areas, there are no students displaying a preference for kinesthetic learning style. A statistical test was carried out to determine the significance of the difference in the average geometry skill test of students in urban and rural areas after learning with the Ethnobra model, with the calculation results presented in the following table.

| Normality Test Results | Homogeneity Test Results | Average Difference Test Results (T-Test) | Conclusion |
|---|---|---|---|
| Urban School Class Sig=0.65>0.05 Normal distributed data Rural School Classes Sig=0.25>0.05 Normal distributed data | Score variance of both homogeneous classes | Sig=0.000<0.05 Hipotesis ditolak | There are significant differences in geometry skills of urban and rural students after learning with the Ethnobra model |

Table 7: T-Test Geometry Skills Test Students In Urban and Rural Areas

From the table above, it can be concluded that the geometry skills of urban area students are better than those of rural area students after being given learning with the Ethnobra model. Furthermore, in-depth interviews were conducted with several selected subjects to get more in-depth information. The selection of interview subjects is selected based on the following table.

| Learning Style | School Domicile | Student Code |
|---|---|---|
| Visual | City | VK1, VK2, and VK3 |
| | Village | VD1, VD2, and VD3 |
| Auditorial | City | AK1, AK2, and AK3 |
| | Village | AD1, AD2, and AD3 |
| Kinestetik | City | KK1, KK2, and KK3 |
| | Village | - |

Table 8: Research Subjects Interviews

The subjects in this study were 27 students who went to school in urban areas and 34 students who went to school in rural areas. The results of the descriptive analysis in Table 5 are known to be the distribution of student learning style trends. Furthermore, 15 students were selected to be interviewed, namely three students each representing the student's learning style and domicile. The results of interviews with the 15 students and based on observations concluded that when viewed from a school domicile, rural students stated that it was still difficult to follow the learning process delivered (Ethnobra learning model) because they were not familiar with technology-based learning. However, students claimed to be very interested in learning related to culture, students stated that they became more familiar with their culture and felt that learning became more interesting because the culture they mentioned was recognized. Facts in the field also support this, it is known that to conduct technology-based research, the school must move students to classes with electricity. In the school, almost all classes have no electricity and have never done learning using PowerPoint. Students claimed to be interested in the Geogebra application but stated that they could not use it at home because they did not have a laptop, computer, or mobile phone to install it. So, the teacher must vary learning, one of which is by utilizing the Geogebra application.

From these findings, several appropriate steps are needed to overcome how to control these factors so that students' geometry skills can be developed optimally. The steps are to familiarize students who go to school in rural areas with technology-based learning. The school should be given an understanding of the importance of involving technology in the learning process in this growing era, so they will try to facilitate. At least every classroom has electricity, and schools have at least one infocus that teachers can use to implement technology-based learning. Based on input from teachers when interviewed, that teachers want to develop their abilities in technology-based learning but school facilities are still limited. In other words, students will get used to using technology in understanding the material if the teacher familiarizes technology-based learning. Then, teachers will familiarize technology-based learning if the school facilitates supporting facilities and infrastructure. Furthermore, in addition to supporting facilities and infrastructure, teachers also need knowledge in the form of training on how to use technology in learning, one of which is using the Geogebra application in explaining Geometry material. Geometry is an abstract lesson, so it will be more optimal if the learning process is technology-based.

Another thing that catches the eye is the colloquial language in which students in rural areas speak most regional languages. Students are very comfortable and relaxed with friends and teachers in regional languages during the learning process. This certainly needs to be a concern because there are good and bad sides. The good side is to preserve regional languages, and support for learning with the Ethnobra model (Ethnomathematical Geogebra). The student's understanding becomes more profound because the use of regional languages makes the student comfortable and confident thus helping him understand concepts in a more familiar and familiar context. However, the downside is that there are limited learning materials, learning materials in regional languages may be more limited than in national or international languages. This can limit students' access to a wider and more diverse range of information. Further, the downside is the possibility of an inaccurate understanding of the material. Students who are very thick in regional languages sometimes do not understand Indonesian, so it can sometimes cause inaccurate understanding or defects in learning materials. Some specific terms or concepts in certain subjects may not have direct equivalents in regional languages, as a result, students encounter challenges comprehending the content presented by the teacher. In other words, a solution is needed to overcome it, namely as a teacher needs to understand very well how the characteristics of the students he teaches before deciding to use regional languages or Indonesian when teaching. Because the use of regional languages when teaching is not always bad nor always good, so choosing the right time in the use of regional languages or not has a major influence on optimal student understanding.

Furthermore, another interesting fact is known otherwise in students of urban areas. Students stated that they follow the technology-based learning process because they are accustomed to using technology-based learning and are often taught with mathematics applications. Students claim to be interested in the Geogebra application. This is supported by the student stating that they will install the Geogebra application after school. This student statement also proves that at home students are facilitated with technology-based learning, and few students have mobile phones with wifi networks at home. Nevertheless, students expressed less interest in material associated with culture. Students state that the culture conveyed is unknown, so having to understand is twice as difficult as understanding the culture and the material. According to students, this is considered ineffective for understanding the material. The solution, Culture-based modules/textbooks that will be used is designed as well as possible so that the development is focused on attracting students' attention and introducing Culture. In other words, there is no presentation in the module that asks students to solve questions about Culture.

Another found that students in urban areas tended toward kinesthetic learning styles, and had a much better average score on geometry skills than other learning styles. This can contribute to the high average geometry skills of students in urban areas compared to those in rural areas. The learning process with the Ethnobra model directs students to understand the material by practising the Geogebra application. So that students with kinesthetic learning styles understand the material presented more than others. This finding is important information for teachers, in particular, that it is very important to know the tendency of the learning styles of students taught in order to choose the right learning model. Teachers can also combine several different learning methods to embrace all varied student learning styles so as to help increase the understanding of the material to the maximum.

Furthermore, it is analyzed based on the results of students' work solving geometry skill problems. Based on the student's answers to question number 5, the indicator of geometry skills is applied.

The problem is: Pak Ali has a rectangular coffee plantation with a length of 35 m and a width of 25 m. Around the garden, the road will be widened, with a widening of 1.5 m.

a. Sketch a flat wake based on the information above!
b. If Mr Ali wants to sell his coffee plantation at a price of Rp.3,000,000 per m2, then how much money should Mr Ali receive after widening the road?

The results of students' answers are reviewed from the following learning styles and domicile.

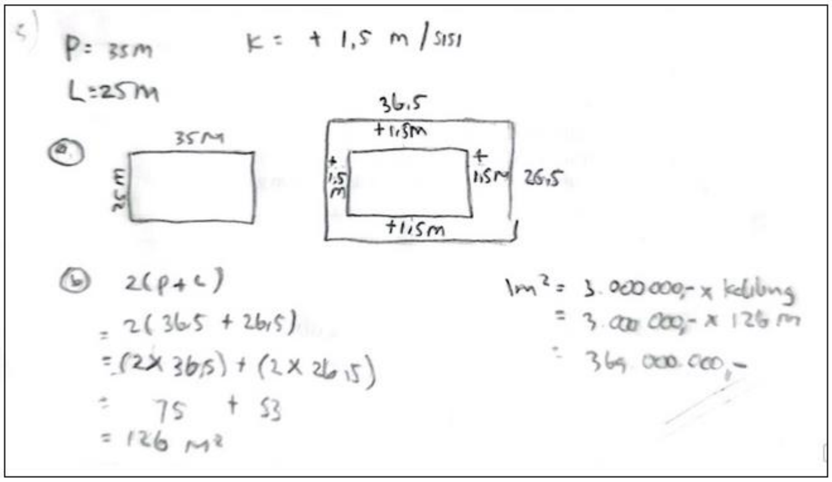



Figure 6: Student Work Results from KK1 Code

Figure 6. Is the result of the work of students with kinesthetic learning style tendencies and schooling in urban areas. Of all the students' answers, only a small part answered correctly and close to correct, the rest answered incorrectly question number 5. The results of this work show that students with kinesthetic learning styles have good understanding skills in solving problems. As Hernandez et al. (2020) mentioned kinesthetic learners have a broader understanding. This student is called KK1, according to him to solve question number 5 the first step that comes to mind is to draw it. From the sketches given, it shows that students understand the problem and know what to do to solve it.

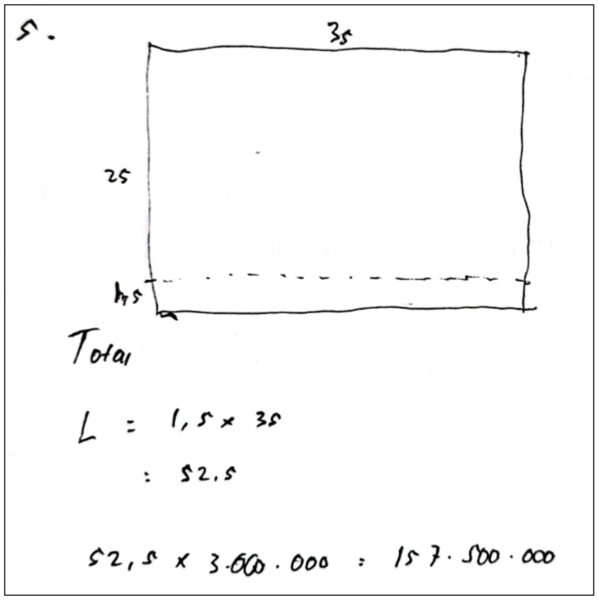



Figure 7: Student Work Results from VD1 Code

Figure 7 results from the work of students with visual learning style tendencies and rural schools. The results of students' answers show that students do not properly understand the instructions on the questions. It is stated that "Around the garden will be widened the road, with a widening of 1.5 m". However, students describe the dilation on only one side. Furthermore, determining the square area is still wrong so the final result written is also wrong. When asked, the student stated that "determining the area of a rectangle is length times width, and in the problem, it is known that the length is 35m and the width after widening is 1.5m". This student's statement informs that students have not been able to think realistically, because the width of the 25m road that has widened has shrunk to 1.5m. This is an expert opinion that one of the characteristics of someone with a visual learning style is to understand images better than written instructions (Chetty et al., 2019).

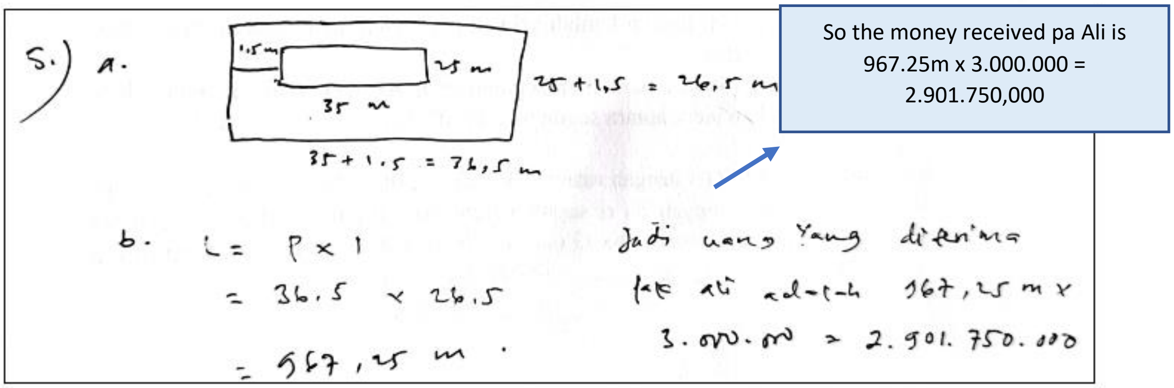
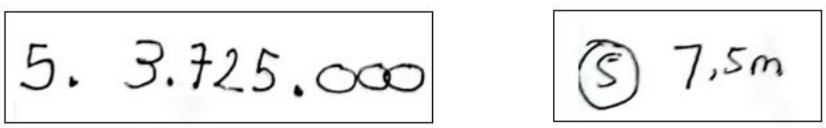



Figure 8: Student Work Results Code VK1

Figure 8 shows students' work with trends in visual learning styles and urban schools. The sketch of the picture made is not much different from the student in figure 7 which shows that students do not properly understand the instructions on the problem. The difference is that urban students are more realistic in the square area written by increasing the width on two sides, but the answer is still wrong. So it is very important to understand the problem to provide the right solution correctly.




a) b)

Figure 9: Student Work Results Code AK1 (a) and AD1 (b)

Figure 9 shows the answers of students with auditorial learning style tendencies who go to school in urban and rural areas. Interestingly, almost all answers of students with auditorial learning styles give answers that are direct to the results and wrong. When asked how to get these results, both students gave a long presentation even though it was still incorrect. However, from this fact, it is known that students with auditorial learning style tendencies can provide much exposure but it is not easy to write it down. This is by the opinion of Kusumawarti &; Subiyantoro (2020), that one of the characteristics of auditorial people is that they like to talk, discuss, and explain things at length.

Another interesting thing was that students who go to rural schools have shy characteristics when asked and use the regional language (Javanese) more often in class. Meanwhile, students who go to urban schools have the characteristics of talking a lot and do not hesitate to joke when discussing, and no students are found who use regional languages when learning. This also needs attention for future research to consider the good and bad sides of using culture (regional languages) in classroom learning, both for students who go to school in urban and rural areas.

**Ethnobra Learning Implementation Results**

Learning with the Ethnobra model was carried out in both schools, namely SMP Negeri 1 Ciruas which represented urban area schools and SMP Negeri 01 Tanara which represented rural area schools. Here is the implementation of Ethnobra in schools.

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Figure 10: Material Delivery with Ethnobra Model in Urban Classroom

Figure 10 shows how the material is delivered with the Ethnobra model (Ethnomathematical Geogebra) to students who go to school in urban areas. Previously, the material was presented in worksheets displaying various related cultures. then the concept is explained in detail through the Geogebra application. Figure 10 is one of the concept displays of finding the area of a triangle with the Geogebra application.

Figure 11: Material Delivery with Ethnobra Model in Rural Classroom

Figure 11 shows how the material is delivered with the Ethnobra model (Ethnomathematical Geogebra) to students who go to school in rural areas. In urban areas, learning is carried out in ordinary classes with facilities that support technology-based learning, namely with electricity and infocus already available in class. However, unlike classes in rural areas, learning was moved to the hall because none of the classes had electricity. This is an obstacle that requires improvement because technology-based learning requires electricity.

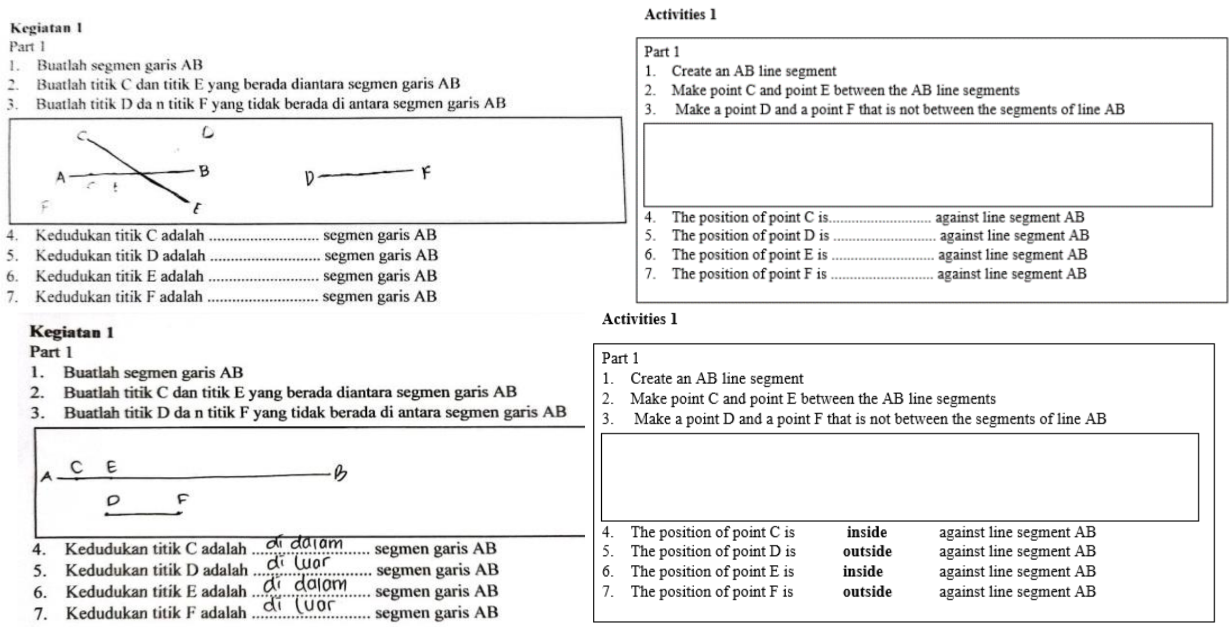
The series of learning activities with the Ethnobra model is in the LKPD (student worksheet) which is designed to invite students to find material from the activities provided as shown in Figure 4 and Figure 5. Activities are made in the form of two steps to complete, namely manually and with the Geogebra application done in discussion. The activity sheet is also designed based on culture by relating the material to the surrounding culture, one of which is Banten batik.

The results of interviews with teachers are known several important points about the effectiveness of learning Geometry with the Ethnobra model (Geogebra Ethnomathematics). The teacher stated that the Ethnobra model is learning that combines Ethnomathematics-based learning with the help of the Geogebra application. Teachers admitted that they were very enthusiastic about the new approach because they could see the value in integrating culture, traditions, and social contexts in mathematics learning then teachers were given the convenience of visualizing the material with the help of the Geogebra application. According to him, students seem more motivated and happy when learning takes place because students associate mathematical material with their daily experiences and realities, and students can be interactively involved in exploring their skills solving geometry problems. However, teachers also stated several obstacles and challenges faced when applying learning with the Ethnobra model, including a feeling of lack of experience so that sometimes there is a sense of uncertainty about how to integrate cultural aspects into mathematics learning effectively. Another challenge is a technical challenge, according to the teacher the use of technology in the classroom is a challenge, because they have no previous experience with the GeoGebra application. So the teacher stated that it was necessary to spend additional time to understand and master this tool before delivering the material to students.

Figure 12: Students Discuss LKPD Ethnobra (Geogebra Ethnomathematics)

In rural and urban schools, students are enthusiastic about discussing the worksheets distributed. The discussion lasts 10-15 minutes, finds the results of the answers and concludes the expected material. The worksheet design is made culturally, making it more interesting and familiar to students. However, there are facts in the field that state that the cultural aspect helps it understand geometry material and there are also those who feel disturbed and complicated by the cultural aspect. In this case, it is known that the use of Culture provides two arguments, namely students feel helped and feel difficult. Thus, in implementing the Ethnobra model, teachers should know the characteristics of the students taught first. If students find it helpful, then the use of Culture in understanding teaching material can continue to be explored more. However, if students find it difficult then the teacher still uses Culture as a variation of learning and attracts students' interest and love for Culture, but it can be reduced exploration and balanced by exploring more Geogebra applications.

The following picture presents one of the results of the student's answers to completing the activity sheet.


Kegiatan 1
Part 1
1. Buatlah segmen garis AB
2. Buatlah titik C dan titik E yang berada diantara segmen garis AB
3. Buatlah titik D da n titik F yang tidak berada di antara segmen garis AB
4. Kedudukan titik C adalah .......................... segmen garis AB
5. Kedudukan titik D adalah .......................... segmen garis AB
6. Kedudukan titik E adalah .......................... segmen garis AB
7. Kedudukan titik F adalah .......................... segmen garis AB

Activities 1
Part 1
1. Create an AB line segment
2. Make point C and point E between the AB line segments
3. Make a point D and a point F that is not between the segments of line AB
4. The position of point C is.......................... against line segment AB
5. The position of point D is .......................... against line segment AB
6. The position of point E is .......................... against line segment AB
7. The position of point F is .......................... against line segment AB

Kegiatan 1
Part 1
1. Buatlah segmen garis AB
2. Buatlah titik C dan titik E yang berada diantara segmen garis AB
3. Buatlah titik D da n titik F yang tidak berada di antara segmen garis AB
4. Kedudukan titik C adalah ...di dalam... segmen garis AB
5. Kedudukan titik D adalah ...di luar... segmen garis AB
6. Kedudukan titik E adalah ...di dalam... segmen garis AB
7. Kedudukan titik F adalah ...di luar... segmen garis AB

Activities 1
Part 1
1. Create an AB line segment
2. Make point C and point E between the AB line segments
3. Make a point D and a point F that is not between the segments of line AB
4. The position of point C is **inside** against line segment AB
5. The position of point D is **outside** against line segment AB
6. The position of point E is **inside** against line segment AB
7. The position of point F is **outside** against line segment AB

Figure 13: Results 1 of Student Discussion to solve one of the LKPD Questions Before Being Explained Using Geogebra

Figure 13 shows that students do not understand the basic concepts of geometry before being explained using Geogebra. One of the commands in the worksheet is to create point D and point F. Almost all students draw the DF line. This clearly shows that students have been unable to follow the worksheet's instructions. So that the learning process becomes longer than planned. However, almost all students become more understanding and interested when practising with the Geogebra application using a laptop or mobile phone as shown in Figure 14 and Figure 15.

Figure 14: Students Practice Geogebra Applications to Solve Geometry Problems

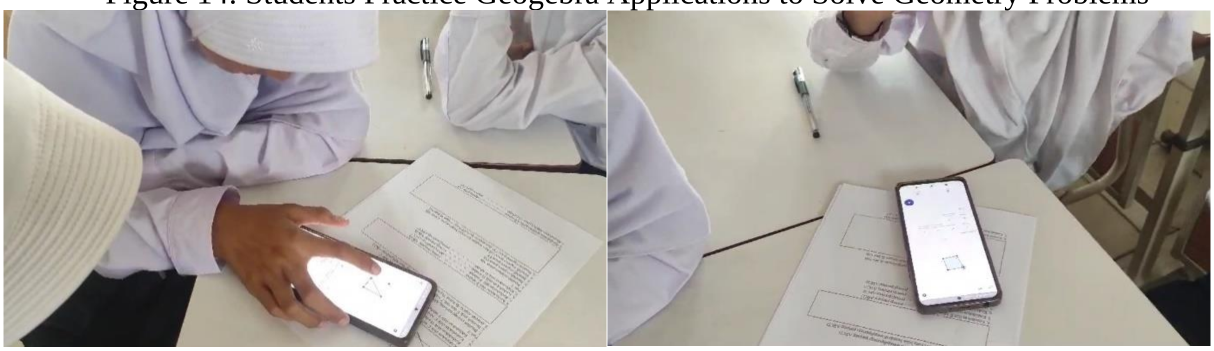
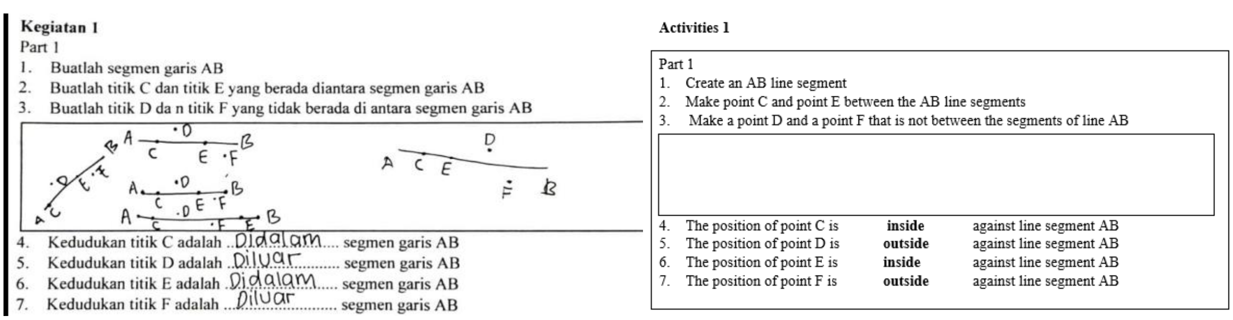


Figure 15: Students Try to Use Geogebra to Complete LKPD

Figure 15 is a student activity discussing completing activities in LKPD using the Geogebra application on a mobile phone. Before using a cellphone, students are explained how to use the Geogebra application to solve Geometry problems and then practice directly as shown in Figure 14. At the beginning of the activity, there were still many obstacles because students were not used to it, so they spent much time explaining how to use the Geogebra application instead of explaining the material. However, after students get used to it, they become faster at solving questions and LKPD activities. Furthermore, students claimed it was easier to solve geometry problems and the visualization was clearer with the Geogebra application. That is, at the beginning of learning to apply the Ethnobra model requires additional time to explain how to use the Geogebra application so that at the next meeting learning becomes smooth. As revealed by previous researchers Geogebra can make it easier for students to solve geometry problems and improve their abilities significantly (Adelabu et al., 2022; Yimer, 2022).



**Kegiatan 1**

Part 1

1. Buatlah segmen garis AB
2. Buatlah titik C dan titik E yang berada diantara segmen garis AB
3. Buatlah titik D da n titik F yang tidak berada di antara segmen garis AB
4. Kedudukan titik C adalah ..Didalam.... segmen garis AB
5. Kedudukan titik D adalah ..Diluar.......... segmen garis AB
6. Kedudukan titik E adalah ..Didalam..... segmen garis AB
7. Kedudukan titik F adalah ...Diluar............ segmen garis AB

**Activities 1**

Part 1

1. Create an AB line segment
2. Make point C and point E between the AB line segments
3. Make a point D and a point F that is not between the segments of line AB
4. The position of point C is **inside** against line segment AB
5. The position of point D is **outside** against line segment AB
6. The position of point E is **inside** against line segment AB
7. The position of point F is **outside** against line segment AB

Figure 16: Results 2 of Student Discussion to solve one of the LKPD Questions

Figure 16 is one of the results of student discussion after being explained about the position of points on lines with the Geogebra application. Students give correct answers and show understanding of the commands on the questions given.

Figure 17: Students actively ask questions during learning

The picture above shows the activeness of students responding to the material being delivered in both rural and urban classes. Not a few students ask questions and give answers when asked. This shows that the purpose of developing a learning model has succeeded in inviting students to be actively involved during the learning process.

## CONCLUSION

This study concludes that a valid, practical, and effective Etnobra (Ethnomathematical Geogebra) learning model was developed to improve students' geometry skills. The validity of the learning design and the tools developed is indicated by the average score of 3 material and media expert validators, each of which falls into the very valid category. The practicality of the learning model is evidenced by the average score of teacher and student assessments, each of which is included in the very practical category. At the same time, its effectiveness is demonstrated by improving students' geometry skills after learning with the Ethnobra model. The subsequent analysis concluded that urban students have better geometry skills than rural students. Urban and rural students have the most visual learning style, then rural students do not have a kinesthetic learning style. Students with kinesthetic learning styles have the highest geometry skills than students with other learning styles. Students with auditorial learning styles who go to school in rural and urban areas have the characteristic of talking a lot but have difficulty writing. So the development of the Ethnobra model is very effective for improving students' geometry skills in urban areas, especially for students with kinesthetic learning styles.

The involvement of Ethnomathematics in learning makes learning more memorable and increases students' knowledge about culture. Furthermore, learning using the Geogebra application is more interesting and trains students to learn with discovery. In addition, the use of this application invites students and teachers to be technologically literate which is a significant advantage. Teachers must be familiar with using technology, especially the application of Geogebra in geometry teaching and learning. In addition to geometry learning, Geogebra applications can also be applied in learning algebra material.

**Acknowledgements**

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