Development of Online Inquiry Mathematics Learning Model Based on Javanese Culture Ethnomathematics

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Abstrak

Penelitian ini bertujuan untuk mengembangkan model pembelajaran matematika *inquiry* daring berbasis Etnomatematika Budaya Jawa. Untuk mencapai tujuan tersebut dilakukan penelitian pengembangan yang mengacu pada model pengembangan pendidikan dari Plomp dengan tahapan: Tahap Investigasi Awal, Tahap Desain/Perancangan, Tahap Realisasi/Konstruksi, Tahap Tes, Evaluasi, dan Revisi, dan Tahap Diseminasi dan implementasi. Pada penelitian ini dilaksanakan tahap investigasi awal dan tahap desain. Tahap investigasi awal meliputi kegiatan observasi lapangan, studi literatur dan FGD (*Focus Group Disscussion*). Tahap desain dilaksanakan kegiatan merancang buku model pembelajaran pembelajaran beserta perangkat pembelajaran dan dilakukan validasi. Teknik pengumpulan data yang digunakan yaitu wawancara, observasi, dan angket. Data dan informasi yang telah dihimpun tersebut kemudian dianalisis menggunakan teknik analisis deskriptif kualitatif. Hasil penelitian menunjukkan bahwa tahapan pengembangan model pembelajaran telah mencapai tahap desain. Hasil penelitian yang dicapai yaitu setelah melaksanakan observasi di sekolah dan observasi lapangan pada sepuluh situs Budaya Jawa, selanjutnya dilaksanakan FGD hingga diperoleh sintak model pembelajaran inquiri daring berbasis etnomatematika. Adapun sintak model pembelajaran inquiri daring berbasis etnomatematika Budaya Jawa yaitu: Orientasi (*Orientation*); Merumuskan masalah (*Formulating the problems*); Merumuskan hipotesis (*Formulating hypothesis*); Mengumpulkan data (*Collecting data*); Menguji hipotesis (*Test the hypothesis*); Merumuskan kesimpulan (*Formulating conclusions*); dan Mengkomunikasikan hasil (*Communicating results*). Sintak model pembelajaran yang telah ditetapkan dijadikan pedoman dalam mengembangkan buku model pembelajaran matematika inquiri daring berbasis etnomatematika Budaya Jawa. Hasil uji validitas menunjukkan bahwa buku model pembelajaran dinyatakan valid dan layak digunakan.

Keyword: Model_Pembelajaran, Inquiri, Etnomatematika, Budaya_Jawa

Abstract

This study aims to develop an online inquiry mathematics learning model based on Javanese Cultural Ethnomathematics. To achieve this goal, development research is carried out which refers to the educational development model from Plomp with the following stages: Initial Investigation Stage, Design/Design Stage, Realization/Construction Stage, Test Stage, Evaluation, and Revision, and Dissemination and Implementation Stage. In this study, the initial investigation stage and design stage were carried out. The initial investigation phase includes field observations, literature studies and FGD (Focus Group Discussion). The design phase is carried out by designing learning model books along with learning tools and validation is carried out. Data collection techniques used are interviews, observations, and questionnaires. The data and information that have been collected are then analyzed using qualitative descriptive analysis techniques. The results showed

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that the development stage of the learning model had reached the design stage. The results of the research achieved were after carrying out observations at school and field observations at ten Javanese Cultural sites, then FGD was carried out to obtain the syntax of an ethnomathematics-based online inquiry learning model. The syntax of the online inquiry learning model based on Javanese Culture ethnomathematics is: Orientation; Formulating the problems; Formulating the hypothesis; Collecting data; Test the hypothesis; Formulating conclusions; and Communicating results. The syntax of the learning model that has been set is used as a guide in developing an online inquiry-based mathematics learning model book based on Javanese Culture ethnomathematics. The results of the validity test showed that the learning model book was declared valid and feasible to use..

Keyword: Learning_Method, Inquiry, Ethnomathematics, Javanese_Culture

INTRODUCTION

Online learning is experienced by almost all students in Indonesia due to the Covid 19 pandemic, especially from the end of the year academic 2019/2020 to the beginning of the year academic 2021/2022. This is the implementation of the policy by Ministry of Education and Culture through Circular Letter No. 4 of 2020 about the Implementation of Education Policies in the Emergency Period for the Spread of Corona Virus Disease (COVID-19). General and specific in mathematics learning, is facing difficulties and challenges such as low motivation from the students to learn mathematics (Putriana & Noor, 2021), difficulties in understanding the complex mathematics concepts, low attention and concentration of students in learning, and obstacles in instilling social values in students (Hendarman, 2020; Ibrahim et al, 2020). In implementing online learning or learning from home, students become more focused on the virtual world, they have a dependence on technology so they pay less attention to their near environment, especially the local culture in their area. This condition linearly has a negative impact on academic achievement (Nugraha, et al., 2021), and causing an unpleasant mathematics learning process for the students, and the possibility of a decline in social moral competence and socio-cultural competence.

Various efforts have been made through research to find a solution in online learning to be more interesting, fun, and contribute to the improvement of students' socio-cultural competence. One of the solutions found is by integrating cultural learning into mathematics learning through ethnomathematics. Ethnomathematics is a way of expressing mathematical concepts which grow in various aspects of students' life and contextual experiences (Balamurugan, 2015; Widada, et al., 2018; Rosa & Orey, 2011). Ethnomathematics is mathematics that is practiced among identified cultural groups, such as ethnic groups, labor groups, children with different age groups. certain, professional class, and so on. The identity is highly dependent on the focus of certain interests, motivations, codes, and jargon that are not included in the field of academic mathematics (D'Ambrosio, 1985).

Ethnomathematics objects can be used as a tool in learning mathematics. The strategy helps in developing students' self-conceptions and helps in making learning materials more accessible to students. Ethnomathematics also plays a role in instilling the nation's noble culture in students so that the students can understand, interpret, appreciate, and realize the importance of cultural values in carrying out every life activity (Cahyono & Budiarto, 2020).

The source of ethnomathematics objects can be from various cultures elements, one of which is a cultural site. Indonesia is famous for its various cultures (Falah et al., 2013). One of the cultures that exist in Indonesia is Javanese culture. Javanese culture is a culture that originates from Java and is embraced by the Javanese people, especially in Central Java, Yogyakarta, and East Java. Javanese culture can be studied from the point of view of literature, language, kingdom, architecture, calendar, and art. In this research, Javanese culture is focused on the study of architecture by applying it to the concept of geometry.

In the era of the industrial revolution 4.0, it is no longer relevant if the learning process is defined as the interaction between educators and students with educators are transferring the knowledge while students listen to the explanation correctly. The task of educators in optimizing both the learning process and output is as a facilitator who can develop students' learning abilities to achieve active learning. For this reason, the implementation of learning must be based on several principles. The first principle is student-centered learning. The second principle is to explore students' creativity, and the third principle is to create a challenging and fun atmosphere (Muntari, 2015).

To accommodate these three principles into the learning process, a teacher plays a very important role in determining the strategies, models, and learning methods that will be used (Wahid & Karimah, 2018). In the learning process, the use of suitable learning models or methods in presenting a material to ease the students to understand the studied material. The inquiry learning model is one method that can be applied to overcome student learning difficulties, besides that learning becomes active and effective (Fachri & Farida, 2020). Setiawan & Buditjahjanto (2013) state that the positive impact of the use of the inquiry model in the learning process can generate student activity in following the lessons, and can increase student interest in learning in the next lesson.

The previous research has been applied especially related to ethnomathematical-based mathematics learning by combining inquiry learning models or methods in it. Mardiah, et al. (2018) developed an ethnomathematics-based learning module using the inquiry method. Andriono (2021) in his study has analyzed the role of ethnomathematics in mathematics learning, including ethnomathematics can be used by teachers in conducting effective and fun learning. Besides, ethnomathematics can improve students' mathematical abilities such as the results of research that will be discussed in this discussion. Furthermore, ethnomathematics can increase the love of students to understand their own culture. Considering the importance of the ethnomathematics and inquiry learning model in online training to develop the noble cultural character of students, to overcome the students' learning difficulties, and to create active and effective learning, this research is conducted to improve online inquiry learning model based on Javanese Cultural ethnomathematics.

METHOD

The research applied the development research refers to the educational development model of Plomp (1997). The research stages are (1) Initial Investigation Phase, (2) Design/Design Phase, (3) Realization/Construction Phase, (4) Test, Evaluation, and Revision Phase, and (5) Dissemination and Implementation Phase. In this study, the development stages were carried out in stages 1 and 2, namely the initial investigation and design stage.

The first stage of this research is investigation. The detailed investigations are field observation, literature study, and Focus Group Discussion. Field observations were conducted through observations at 10 cultural sites located in the Special Region of Yogyakarta, Central Java, and East Java. Observations were also conducted in 10 Junior High Schools to explore information related to the mathematics curriculum and the learning model used. The results of the observations were then used as material for Focus Group Discussion. The Focus Group Discussion focused on identifying ethnomathematical objects found on cultural sites as well as determining the syntax of the learning model be developed.

The next development stage is the design/design stage. At this stage, activities are conducted in designing learning model books, compiling learning tools in the form of lesson plans, modules, learning media, student activity sheets, and evaluation instruments. Furthermore, validation of the learning model book developed by mathematics education lecturers and mathematics teachers was developed to determine the feasibility of the product.

Data collection techniques used are interviews, observations, and questionnaires. Interviews were conducted during field observations, with the headmaster and mathematics teachers. The interview was also conducted during the focus group discussion activities. Site observation culture is aimed to collect data related to information on cultural sites, while observation in school is conducted to collect data related to the condition of the school environment and the implementation of learning. The questionnaire was given in the form of an online questionnaire on the google form,

to collect data related to the practicality of the learning model developed. The data and information collected then be analyzed by using qualitative descriptive analysis techniques. The validity test analyzed through material validity consisted of 3 aspects: feasibility content of the material, the presentation aspect, and the linguistic aspect by giving an assessment score in the range of 1-5 on the validation sheet. The data obtained from the material expert validation are then analyzed to determine the percentage of validity with the following formula:

$$validitas\ (\%) = \frac{\Sigma skor\ keseluruhan}{\Sigma skor\ kriteria} \times 100\%$$

Σ Criteria score = highest score for each item × total validator

The Likert Scale was used to determine the percentage score of the validation data. The results of the validity score assessment obtained are interpreted by using the validity criteria as in Table 1 with the developed e-student activity sheets score criteria being stated to be valid if they meet the minimum valid criteria.

Tabel 1. Validity Category

Percentage	Validity Category
$80\% < V \leq 100\%$	Very valid
$60\% < V \leq 80\%$	Valid
$40\% < V \leq 60\%$	Quite valid
$20\% < V \leq 40\%$	Invalid
$0\% \leq V \leq 20\%$	Very invalid

(Riduwan, 2015)

Based on the above score interpretation criteria table, the developed e-students activity sheet can be said valid if the validity aspect obtained a percentage of > 60%.

RESULT AND DISCUSSION

Description of Learning Model Development

Development research was conducted to stage 2, the initial investigation stage, and the design stage. At the initial investigation stage, observation activities are conducted the observation activity and followed by focus group discussion. The observation was conducted at 10 cultural sites on the Java island and, specifically in the Special Region of Yogyakarta, Central Java, and East Java. The ten cultural sites are the ten cultural sites, they are the Yogyakarta Palace, Yogyakarta Palace Train Museum, Prambanan Temple, Ratu Boko Temple, Yogyakarta Puppet Museum, Surakarta Palace, Borobudur Temple, Dieng Temple, Trowulan Site, and Wringin Lawang Gate. Observations were conducted both online and offline. Some cultural sites that can be directly observed include the Yogyakarta Palace, the Yogyakarta Palace Train Museum, and the Ratu Boko Site which was conducted before the COVID-19 pandemic, while observations on other cultural sites were conducted through searching for information on the official website, YouTube, brochures, and other electronic sources due to the policy of closing tourist sites due to the impact of the COVID-19 pandemic.

Observation of cultural sites is focused to identify the geometric objects which be explored through the architectures found in cultural sites. Based on the observation result through the ten Javanese sites' culture, which can be identified in geometry two-dimension (plane) and geometry three-dimension (space). In a plane geometry, identified by rectangles, squares, rhombuses, triangles, trapezoids, parallelograms, circles, and octagons. For space geometry, the objects of cubes, blocks, rectangular pyramids, prisms, cones, tubes, and spheres have been identified. An example of the identification of geometric objects from the architecture of the Javanese Culture site is shown in Figure 1.

a. Dieng Temple b. The sites of Ratu Boko

Figure 1. Identification of Geometric Objects on Javanese Cultural Sites

Observations in schools were conducted in ten grader students of junior high schools from three provinces. Observations were focused on digging up information related to the curriculum and implementation of mathematics learning through clarifying questions and reflections. The objectives of the observations and the results obtained are set out in Table 2 below.

Table 2. Objectives and Observation Results

Type of Question	Purpose	Result
Classification	- Knowing the conducted implementation of learning whether online or offline during Covid-19 Pandemic - Which platform is used during the online if conducting in online? - The obstacles facing in conducting the online learning	- Obtained data related to the learning process - 10 schools in pandemic Covid-19 condition conducted the online learning by using various platforms, such as Google meet, Google classroom, Whatsapp, and Zoom. - In conducting the online learning, found that all school is facing an obstacle in learning such as unstable internet connection, limited internet data during online learning, and students' less motivation in learning.
Reflection	- Discovering the information that relates to the students' competence in understanding the mathematics concepts. - Students' social competence related to the noble cultural character during online learning	- Obtained data related to the conceptual understanding ability in mathematics. - 90% from 10 schools have the conceptual understanding ability is categorized as moderate, and the rest is relatively low. - Based on the interview result with the mathematics teacher, the student's social competence needs to be developed such as teamwork, responsibility, thoroughness, discipline, caring, and self-confidence.

The results of observations were analyzed and used as capital in carrying out focus group discussion activities. The focus group discussion was held online via the zoom platform. The focus

group discussion focused on formulating the syntax of the inquiry learning model which was carried out online. The learning model in question is based on Javanese culture ethnomathematics, so that learning and learning tools used to integrate elements of Javanese culture, especially in the architectural aspect.

The question of focus group discussion consists of two types, there are reflection questions and exploratory questions. Reflection questions include the various learning model used during mathematics learning in school, whether the inquiry learning model is used in learning, learning stages by using the inquiry model and the obstacles, the knowledge of ethnomathematics, and the internalization in mathematics learning. Exploratory questions were used to discover the technical implementation of the inquiry learning model online learning, the syntax of the inquiry learning model which is effective, and ethnomathematics that can be discovered through Javanese culture and the implementation in the learning process.

Based on the results of the discussion in the focus group discussion activities, the type of inquiry learning implemented in the learning is the guided inquiry learning model. In this type, the teacher plays a big role in the learning process, especially in the investigation. The teacher plays a role in determining the research topic to be conducted, developed questions related to the investigated topic, determined the procedures or steps applied by students, guided students in analyzing data, provided the column worksheets to be filled by the students, and guided them in drawing conclusions (Wisudawati, et al., 2017). The syntax of the inquiry learning model and its learning steps in online learning is described as follows.

1. Orientation
   a. Started the learning through video conference
   b. Showed the video through culture content
   c. Delivered apperception, material and learning objectives
   d. Oriented the student for inquiry learning model
   e. Organized the students to some group
2. Formulate the problem
   a. Provided a problem to be solved related to the plane geometry and space geometry used cultural site image
   b. Students analyzed the problem
   c. Students identified the formulation of the problem
3. Formulating a hypothesis
4. Collecting data
   Students collected the information through various sources needed to test the arranged hypothesis
5. Testing the hypothesis
   a. Students investigated to prove the previous arranged hypothesis
   b. Students discussed to connecting the beginning knowledge with the obtained knowledge from the relevant sources
6. Formulating conclusions
   a. Students described the findings obtained through the result tested hypothesis
   b. Arranged the accurate conclusion
7. Communicating results
   Students reexplained and delivered the investigation result

The developed ethnomathematics-based online inquiry learning is learning that guides students to discover, search for, and understand the concepts of two-dimensional and three-dimensional geometry through observing images and videos related to Javanese culture. In this lesson, students are freed to discover and identify geometric objects, both two-dimensional and three-dimensional from the given image. The identified geometric object are then grouped according to their type, there are plane geometry or space geometry. For plane geometry, then proceed with analyzing the area and circumference. For space geometry, it is continued by analyzing the volume and surface area.

Based on the identification process of geometric objects according to the creativity of students both individually and in groups, students calculated the area and perimeter of the

geometric object and calculated the volume and surface area of the geometric object of each shape that they have identified. Learning through providing the cultural objects on the learning materials ease the students to discover and understand the concepts. It happens due to the teacher helped students construct what they have experienced and then brought it into mathematics learning. The teacher's role in inquiry learning with ethnomathematics is as a facilitator by directing how students understand and discover the concepts of area, perimeter, volume, and surface area and how to calculate them. Furthermore, learning with an ethnomathematical-based inquiry learning model is able to create an interesting learning atmosphere, with a culture that is raised and increases student activity and motivation in learning activities (Asnawati, et al., 2014).

Learning Model Book

The second stage of development is the design stage. At this stage, conducted the activities in designing an online inquiry-based mathematics learning model book based on Javanese Culture ethnomathematics, compiling learning tools in the form of Learning Implementation Plans, teaching materials, learning media, electronic student activity sheets, evaluation instruments, and compiling instruments. study. Furthermore, validation is conducted on the product development, learning tools, and research instruments.

The learning model book is arranged as guidance in implementing the online learning model. The learning model referred to the inquiry learning model based on Javanese culture ethnomathematics. The learning model book compiled contains two sub-titles. The first subtitle is a theoretical study related to the inquiry learning model (understanding of learning models, understanding of inquiry learning models, basic concepts of inquiry learning, principles of inquiry learning, steps of inquiry learning models, objectives of inquiry learning), online mathematics learning in the 4.0 era, ethnomathematics, and ethnomathematics of Javanese Culture. The second subtitle is related to the learning model which includes the syntax of the learning model, the social system, the principles of learning, the learning support system, the instructional impact, and the accompaniment impact. An example of a display of an online inquiry-based mathematics learning model book based on Javanese Culture ethnomathematics is shown in Figure 2 below.

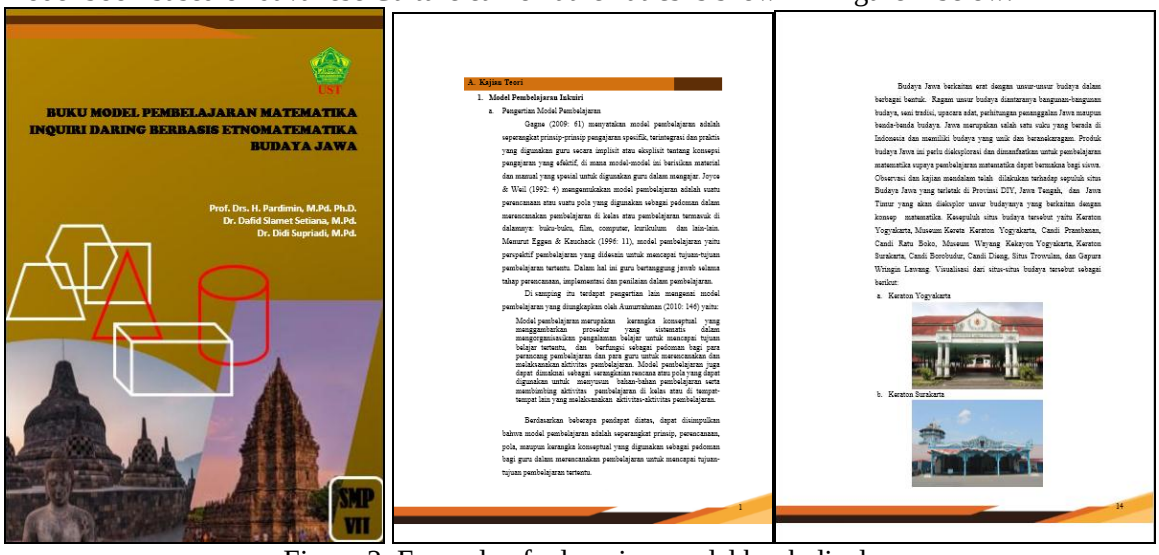

Figure 2. Example of a learning model book display

Based on the results of the validity test through the learning model book, obtained the summary of the calculation results of the percentage of validity in Table 2 are as follows.

Table 3. Summary of the Percentage of Validity of electronic student activity sheets

Indicator	Validity Percentage(%)	Category
Eligibity of content	80,23	Very valid
Presentation	78,91	valid
Language	82,06	Very valid

Based on Table 2 about the product validity, the validity percentage is valid and very valid. Thus, the learning model book is valid and eligible to use to the next stage of the developing learning model, it is a small-scale trial stage and large-scale trial.

CONCLUSION

The result of the research shows that the development stage of learning model achieved the design stage. The achieved result is conducted the observation in schools and field observation to the 10 Javanese Cultural sites. Hence, the focus group discussion obtained the syntax of the ethnomathematics-based online inquiry learning model. The syntax of the inquiry learning model is orientation, formulate the problem, formulating a hypothesis, collecting data, testing the hypothesis, formulating conclusions, communicating results. The syntax of the inquiry learning model as a guidance in developing an online inquiry learning model book based on Javanese Culture ethnomathematics. The learning model book is declared valid and feasible to use.

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