

Math City Map: Application of Mathematics Outdoor Learning Using Mobile Application

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Abstract

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The purpose of this research is to describe the design of outdoor learning using mathematics mobile application Math City Map (MCM). MCM is one of several application that relevan in mathematics learning. Through several features provided in Math City Map teachers can provide a virtual classroom that serves to support, hone and explore student abilities. This outdoor learning design is the result of the development of learning design in mathematics subjects in elementary and secondary schools. This research uses a qualitative approach, with a descriptive research type. The subjects of this research were teachers and students in Singosari. Data collection techniques using documentation, interviews and observation. The results of the learning design using MCM through four stages, there are 1) determining the learning theme, and outdoor destination or location, 2) briefing all related parties, namely students, teachers and assistants, 3) dividing students into groups, 4) implementing outdoor learning. Implementation of outdoor learning.

Keywords:

learning design, math city map, mobile application, outdoor learning

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INTRODUCTION

Learning outside the classroom is an interesting thing to do by teachers in delivering material as well as a strategy to achieve learning objectives, can stimulate students to be active and increase student creativity and is the right strategy to provide different experiences for students (Agusta & Noorhapizah, 2019). Outdoor learning is a solution to learning activities that are carried out outside the classroom that can hone students' physical activity and creativity.

In the past, out-of-class learning activities have not convinced many people of the academic usefulness of out-of-class learning. More evidence is needed for teachers to adopt outdoor learning because, without strong evidence, teachers will find it difficult to adopt learning from a pedagogical perspective. This literature review emphasizes the advantages and disadvantages of outdoor learning, as well as mathematics learning using Math City Map.

Math City Map is one of the applications that can be used in Outdoor Learning that is easy to install and flexible and easy to carry. MCM can accommodate concepts that will be linked such as Geometry concepts, determining Volume to integrals. The delivery of problems that must be solved by students in the form of missions equipped with instructions on MCM make the concept of meaningful, realistic learning to more fun math learning (joyful learning) (Kelly et al. 2022). Because, during the process in the field students can explore themselves both independently and in groups. Students can conduct direct searches, carry out the process of extracting and collecting data in groups without worrying about making mistakes (Muñoz-Carril et al. 2021). When collecting data, it is possible that each group has different data, which is caused by differences in the tools used and the way of measurement. This will enrich students' knowledge that differences may occur due to several factors that can affect it. The most important thing is not the differences found, but what concepts are found based on the differences in the results obtained by students (Jailani et al. 2020; Waite 2020). In addition, through MCM and outdoor learning activities provide opportunities for subject collaboration (Markowski, Yearley, and Bower 2022). For example, as in Sumberawan Temple, subject collaboration that might be done is collaboration between Mathematics and History subjects. This also does not rule out the possibility of collaboration of other subjects such as Mathematics with Science (Desi Andryani Lubis et al. 2021).

The concept of outdoor learning using MCM purely uses internet access, so it requires a strong connection and data quota, so this activity also requires costs. In addition, because learning is carried out outside the classroom, it requires careful preparation, involving many things, such as transportation and accommodation. Thus, this activity cannot be done every day.

Students' activities are directed to practice what has been learned and assigned. Because, learning strategy by doing or practicing what is being assigned, outdoor learning is one way to engage students. Outdoor learning provides many benefits for student development, including helping students to be more connected to situations outside the home and learning to recognize objects in the surrounding environment. Outdoors learning will make it easier for students to interact with teachers, peers and the material being taught, so that through experiences outside the classroom, students will gain a deepening of the concepts learned in the classroom and practice them when outside the classroom. There are many studies that discuss learning outside the classroom, including (Khoirunnisa & Amidi, 2022; Penazzi et al., 2023; Siskind et al., 2022), but these studies have not discussed outdoor learning in mathematics classes by utilizing the Math City Map application. The other research, there is a significant effect between the problem solving ability of the experimental class, with outdoor learning class in Mathematics, by using Math City Map, mobile application and the control class, mathematics class without using Math City Map, mobile application (Rosanti and Harahap 2022).

In the era of the Internet of Things (IoT), math cannot be separated anymore, in other words, every student must have the ability, and be equipped with sufficient mathematics. Behind the importance of learning math, there are facts and opinions that occur in schools. Based on interviews with several mathematics teachers, there are still many teachers who apply mathematics learning with one-way communication, and teacher-centered learning. Learning is only focused on memorizing formulas, and achieving material according to the syllabus. In fact, the learning process has several principles that must be met in accordance with the student's frame of mind, uphold human rights, religious values, cultural values, and apply realistic problem-based learning. Therefore, there is a need for renewal, outdoor learning in math lessons that can uphold human rights, religious values, cultural values, and realism. When mathematics is presented in learning in a new face openly outside the

classroom that is adapted to the needs and demands will produce meaningful, fun, realistic learning, thus forming students' knowledge and experience into a whole.

Outdoor learning-based mathematics learning does not abandon providing a new atmosphere in learning realistic mathematics. Outdoor learning is not new, it is just that it has not been familiarized in the presentation of learning which in its learning activities integrates the internet and exploration of abilities in the field. However, learning math outside the classroom still uses assistance to keep students focused on the learning objectives that must be achieved. The help that can be used is to use the Math City Map (MCM) mobile application. MCM is designed for outdoor learning. MCM mobile application is a digital learning application, online, equipped with GPS, has two components that can be installed on IOS or Android devices. MCM can be accessed through the website www.mathcitymap.eu or installed directly on a smartphone through the Play Store.

Learning mathematics outside the classroom has not yet become one of the alternatives to mathematics learning activities in schools, especially in elementary or secondary schools. This research will describe how the stages in carrying out mathematics learning activities outside the classroom by utilizing Math City Map as application of mathematics outdoor learning.

METHODS

This research use a qualitative approach, with a descriptive research type. This research was conducted on 2022. The aims of this research I to describe the outdoor learning planning using MCM application. This research will produce lesson plans that are designed outside the classroom, by utilizing the MCM mobile application. The subjects of this study were elementary school students and teachers in Singosari, Malang. Data collection techniques used documentation, interviews and observation. The documentation used by researchers includes curriculum documents at the primary and secondary school levels, documents on the preparation of teaching tools, and lesson plan documents. the documents collected will be the basis for preparing lesson plans outside the classroom by utilizing the MCM mobile application.

Researchers also used interviews in collecting data. interviews were conducted with teachers in primary and secondary schools. In elementary schools, researchers interviewed class teachers, and 5th and 6th grade math teachers. while in secondary schools, researchers interviewed seventh grade math teachers. interviews conducted by researchers about how the implementation of mathematics learning activities, whether during teaching, already have experience teaching mathematics outside the classroom, if the teacher has done outdoor learning, what applications are used and how the results of outdoor learning activities.

RESULTS & DISCUSSION

The MCM application that has been installed on a smartphone can be directly used according to the instructions or directions given by the teacher. Of course, this learning activity does not take place in the classroom, but outside the classroom or what we know as Outdoor Learning. This learning activity needs to be carefully designed, especially with regard to student safety when following the directions on the map or map that appears on the MCM (Astuti 2020). If this is the first time this learning has been implemented, then there needs to be a special day used for debriefing for students and teachers.

This learning design is divided into several stages. If the class is the first time applying MCM to learning, it is necessary to use the debriefing stage for students. However, if the class has already implemented learning using MCM, then the debriefing stage is no longer used to introduce the application, but rather to discuss the technical implementation of learning activities. The following is a description of each stage in outdoor learning using Math City Map.

Stage I: Determining the Theme and Destination or Objective

Before implementing learning using MCM, teachers must determine the theme or material that will be applied or used during learning activities. The teacher must also ensure that the prerequisite material which is the supporting material in outdoor learning has been delivered to the students. For example, in this lesson, the theme chosen is Geometry. The concept applied is flat shapes. Determining this theme also determines the aspects of learning planning, such as objectives and achievement indicators.

Based on the results of interviews with teachers, 95% of teachers never develop an initial learning design when preparing lesson plans. Teachers only adjust to the lesson plan template., teachers never develop an initial learning design when preparing lesson plans. Teachers only adjust to the lesson plan template. This contradicts the importance of teachers' pedagogical skills in preparing lesson plans. In order to get a good teaching, need to have a mathematics lesson plan in place. Lesson plans allow teachers to share and/or implement their ideas for teaching and adapt them to students and teaching environments for future years (Emre-Akdoğan and Yazgan-Sağ 2018). Many teacher training programmes focus on how teachers can use technology to make learning easier (Njiku, Muturutinya, and Maniraho 2021). Therefore, determining the theme in designing learning outside the classroom is very important so that activities are directed and in accordance with learning objectives.

Stage II: Briefing of students and all involved elements

Briefing activities aim to make students understand what tasks they have to do. Not only that, at this stage the teacher also provides a review of the material, and what must be done by students during the activity. This activity begins with the introduction and installation of Math City Map (MCM). Installing the MCM application can be done through the Play Store on a smartphone or through www.mathcitymap.eu. If students want to install from web, they can register using their google account. After successful registration, try to log in, click Portal, then followed by adding a trail then inputting the code.

Based on outdoor learning framework, outdoor learning allows students to get more hands-on with natural elements (Armbrüster and Witte 2022). Based on Khan et al. (2023), outdoor mobility of individuals with visual impairment is challenging particularly where collision with obstacles can have significant impact on both physical and mental health.

An example of a destination in this activity is Sumberawan Temple. Sumberawan Temple is one of the temples located in Sumberawan village, Singosari sub-district, Malang Regency. When the teacher has determined the location, a code will appear that must be inputted after the student enters the portal on the MCM. The code that appears for the Sumberawan location is 232080. The stages and images that appear when installing the application are presented in Figure 1.

Stage III. Dividing students into groups

Outdoor Learning activities are more effective when implemented in groups. Therefore, after installing the application, the teacher gave some directions related to the implementation of Outdoor Learning. Teacher divides the students into groups, for example, one group consists of 4 students. Each group has at least 1 gadget. After dividing

the groups, the teacher explains the equipment that must be brought by the students, namely stationery, meter or ruler, book or HVS paper, chest board. The teacher also needs to emphasize the time of gathering at school, because Outdoor Learning activities are carried out outside the classroom, so it is necessary to prepare for departure.

Tahapan Instal	Tampilan yang muncul
Instal aplikasi melalui www.mathcitymap.eu	
Install aplikasi melalui <i>Play Store</i>	
Klik Portal Kemudian klik trail atau tambahkan <i>trail</i>	
Masukkan kode. Pada pembelajaran ini, kode trail kita adalah 23208	
Tampilan yang muncul setelah kode dimasukkan	

Figure 1. Aplikasi Math City Map

Stage IV: Implementation of Outdoor Learning

At this stage, students and teachers are already at the location. Students gather according to their groups with the required equipment. The teacher needs to convey the duration of the activity, and determine the gathering point after students have successfully solved the puzzle on the application. Students are directed to walk according to the instructions on the MCM application, while solving puzzles on MCM, 2 students make observations according to the instructions, while the other 2 students record the results of the observations. After completing the observations, students completed the commands requested on the MCM and wrote down their conclusions.

The utilization of Mobile Application in the form of Math City Map in culturally integrated Outdoor Learning is rich in advantages. According to Hikmah (2019) learning with this approach has an influence on problem solving skills. On the other hand, learning that is carried out openly, fun, realistically, acting directly is very effective in increasing students' interest and ability to learn mathematics (Bartels, Rupe, and Lederman 2019). The results of research from (Desi Andryani Lubis et al. 2021) who apply Math City Math in the long run has an effect on memory that is stable and long term even though the changes

are small. Through Math City Math and Outdoor Learning with realistic problems, and fun that is done in groups increases positive characters in students both related to math or not, such as group work, foreign language skills, coordination skills, critical in other subjects (Angelini and Álvarez 2018).

When students are at the location, namely Sumberawan Temple, the application will show a picture of the temple and the history of Sumberawan Temple as in Figure 2.

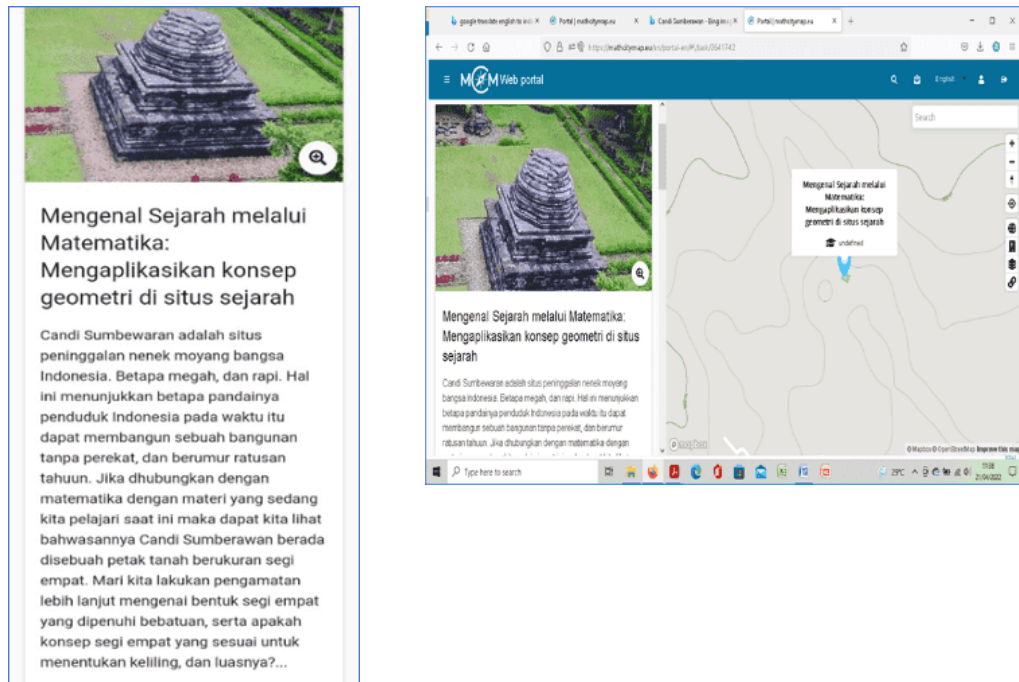


Figure 2. Description Sumberawan Temple from application

After following the instructions on the map, the problem that must be solved by students will appear on the MCM. Not only problems, but MCM also provides problem solving instructions. The display image of the problem and instructions is presented in

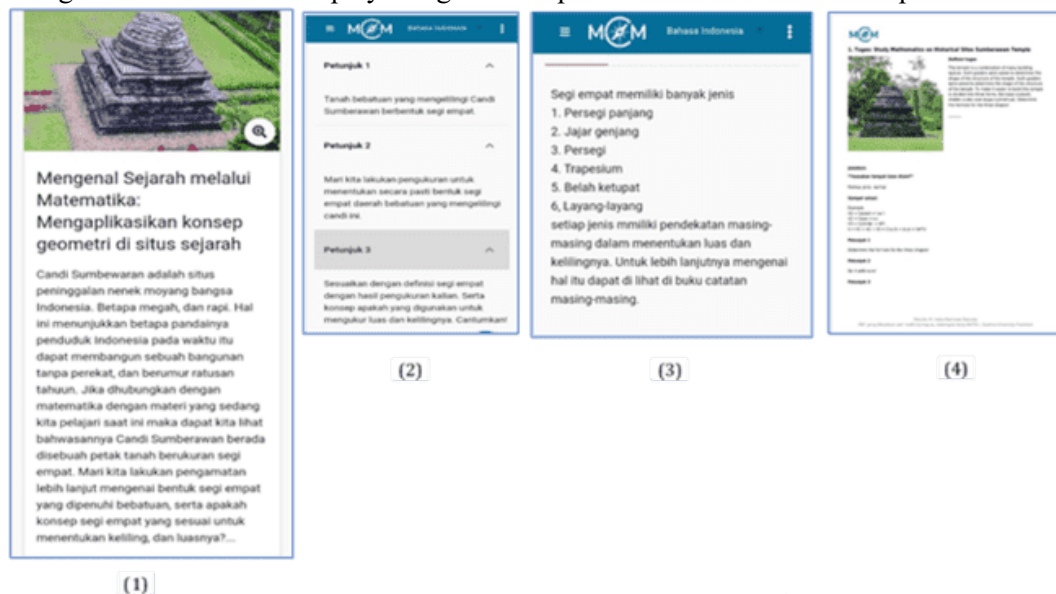


Figure 3. MCM is Active

When the map has been run at the location, a description of the history of Sumberawan Temple will appear as well as a mission or task that the group must complete. Based on Figure 3 (1), a brief history of Sumberawan Temple appears, which is then followed by a task that must be carried out by the group, namely the group is asked to observe the rectangular shapes on the rocks around the temple. Then, after making observations, the group was asked to find the area and perimeter of the walls around the temple. MCM not only provides historical descriptions and questions for groups, but MCM is also equipped with instructions for doing the tasks given. This aims to keep students connected to the MCM and focused with their groups so that they slowly reduce dependence on teacher explanations.

Based on Figure 3(2), instructions will appear on how to complete the task. There are three instructions listed by the teacher on the MCM, first, the rocks are rectangular (but does not mention the type of rectangle), second take measurements of each rock found and third determine the type of rectangle found and then find the area and perimeter. When students have done according to the instructions, students will be reminded of the concept of quadrilateral types, such as parallelogram, square, rectangle, trapezium, kite and rhombus, this is shown in Figure 3(3). With going to temple, students didn't realize that they can make connection many concept (Mettis, Våljataga, and Uus 2023). Students with their groups will relate the measurement results of the rocks they find to the types of quadrilaterals.

The design of learning mathematics outside the classroom using the Math City Map application is carried out in four stages, first stage is determining the theme and objectives, which are equipped with location points on the map, the second stage is debriefing to students and all elements involved, the third stage is dividing students into groups, and the fourth stage is the implementation of outdoor learning. Through Math City Math and Outdoor Learning, math is presented with realistic and fun problems. Outdoor learning activities are carried out in groups which can improve positive characters in students such as the ability to communicate, collaborate, think critically and train student creativity, besides that through outdoor learning students are also trained to use foreign language vocabulary

CONCLUSION

Learning mathematics outside does not mean giving up on creating a fresh environment for studying practical mathematics. Students will find it simpler to engage with peers, teachers, and the material being taught through experiences outside of the classroom when they learn outside of the classroom. Based on result and discussion, learning design using MCM through four stages, there are 1) determining the learning theme, and outdoor destination or location, 2) briefing all related parties, namely students, teachers and assistants, 3) dividing students into groups, 4) implementing the outdoor learning. Therefore, the recommendation for the next researcher is to modify this research with the concept of collaborative learning.

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