CIREBON INTERNATIONAL CONFERENCE ON EDUCATION AND ECONOMICS (CICEE)

DESIGN OF ETHNOMATHEMATICS-BASED LEARNING TOOLS VIEWED FROM AN ISLAMIC CULTURAL PERSPECTIVE (CASE STUDY: ISLAMIC BOARDINGSCHOOLS IN CIREBON-INDONESIA AND PENANG-MALAYSIA)

Iyay Robia Khaerudin[1], Herri Sulaiman[2], Muhammad Riyad Ariwibowo[3]

[1]Department Teaching and Learning in Elementary School, Faculty of Education and Science, Universitas Swadaya Gunung Jati, Cirebon, Indonesia
[2]Department Electrical Engineering, Faculty of Technic, Universitas Swadaya Gunung Jati, Cirebon, Indonesia

*Corresponding Authot: iyayrobiakhaerudin2021@gmail.com

Abstract
Learning tools are an important element in teaching and learning in the classroom. Educators should have their own learning tools to be more professional and systematic when teaching. Ethnomathematics-based learning tools are unique and have strengths that can be studied more deeply in this research. The combination of culture-based learning combined with contextual or realistic discoveries of Mathematics concepts makes it a very different field of study and has its own study for students' knowledge. The strong Islamic culture in the Cirebon region creates great potential in creating unique learning device designs that have strong character to develop students' character education. Likewise, the education system in Malaysia is Islamic-based. Of course, teaching and learning activities in schools must require a learning device design that is adapted to the Islamic culture that exists there. This gap is what makes it suitable between the two countries to conduct international collaborative research between schools in Cirebon and in Malaysia. The ethnomathematics context that will be studied is the discovery of ethnomathematics concepts in the Ancient Gamel Mosque in Gamel village, Plered, Cirebon Regency and the discovery of ethnomathematics concepts in the relics of Sunan Kalijaga in Cirebon City. These two places are sufficient for designing ethnomathematics-based learning tools with an Islamic cultural perspective which will later be tested in two countries, namely Cirebon and Malaysia. The design of the learning tools in question starts from the syllabus, curriculum, lesson plans and assessment rubrics. Thus, this study can design this learning tool and at the same time try it out at two boarding schools in Cirebon and Malaysia. Thus, the research data obtained is the result of distributing questionnaires, interviews and tests to subjects, namely junior high school level students (quantitative in nature).
Keywords: *Design, Learning Tools, Ethnomathematics, Islamic Culture*

INTRODUCTION

Sustainable Development Goals (SDGs), which are defined as sustainable development goals, are one of the international agendas prepared by the UN, in order to improve the prosperity of the world community. One of the 17 (seventeen) development goals and targets through the SDGs is ensuring quality education that is inclusive and fair and promoting lifelong learning opportunities (Quality Education). Of course, this can be an opportunity to carry out collaborative research in the education sector in order to realize the SDGs with the achievement of quality education. Of course, to make this happen, there are many aspects that must be measured and observed. Improving the quality of education, especially the quality of teaching, requires continuous reform. One aspect that must be improved is the design or grand design of learning tools as a reference for educators to teach students in class. The development of the grand design is also not haphazard. In designing it, there is a need to first analyze the situation of the conditions and needs at the beginning of the student's learning trajectory, including the background of the learning environment. Culture-based learning, especially Islamic culture, has been embedded in Indonesia and Malaysia. These two countries have the largest Muslim populations, which cannot be separated from the strong and inherent Islamic culture that has been passed down from generation to generation from the past. The strong Islamic culture can influence the education system in the region. This is the basis for the study in this research, which is to improve the quality of teaching for educators and students in order to strive to increase students' abilities in cognitive and affective aspects in the learning process as a stage in the formation of hard skills and soft skills based on character education. Ethnomathematics-based learning device design viewed from an Islamic cultural perspective is an alternative solution that can be offered in order to improve the quality of learning and education as part of fulfilling the achievements of the SDGs program. Ethnomathematics is a study that explores discoveries of mathematical concepts originating from cultures that have been passed down from generation to generation. The discovery of this concept of Mathematics is very unique because actually without realizing it, people have used, built, calculated, measured a concept which is actually Mathematics [1], [2].

This unique discovery coupled with Islamic culture also does not escape ethnomathematics, where when a group of Muslim people built a mosque in the past without measuring, calculating or calculating with certainty, but of course the mosque was able to stand and be built firmly and perfectly. Exploring the concepts thought by past communities in building mosques mathematically, that is Ethnomathematics [3],[4]. Furthermore, after discovering this concept, we need to move on to the next stage, namely how this concept can be applied to learning for middle class students so that the hope is that learning outcomes can be achieved and character education of students regarding knowledge of Islamic culture can be realized [5]. Thus, this research can bridge Ethnomathematics-based Mathematics learning with an Islamic cultural perspective as the main element which can design a grand design of learning tools which can later be tested at two Islamic Boarding Schools in Cirebon and Malaysia. The results of this research will

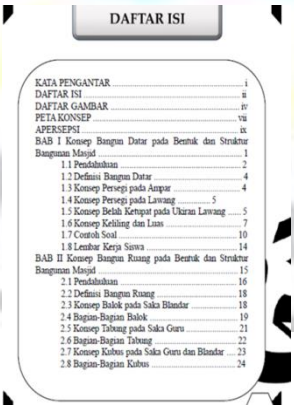
be in the form of quantitative data as a result of testing, namely student activity data, questionnaires, test results and interviews. So with the grand design of this learning tool, it is hoped that both places will be able to know the results of implementing the tool that has been designed.

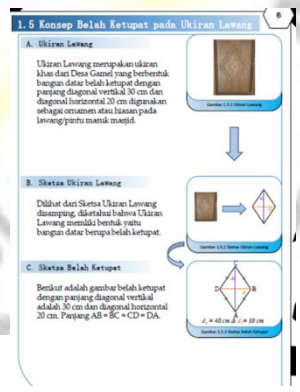
METHOD

In this research, we used a quantitative approach by first designing modules to be used as learning materials. The modules are made in accordance with the curriculum that applies in schools and emphasize the application of digital learning technology, namely Augmented Reality. The module that is ready is first validated by an expert validator with a rating system using a Likert scale. Then, the trial begins by first setting the class for students to become an IoT-based smart class. The trial was carried out in 4 meetings and during this activity observations and pre-test and post-test assessments of students' abilities were carried out.

RESULTS AND DISCUSSIONS

This part of the research aims to: (1) find out the results of the design of Ethnomathematics-based learning tools from an Islamic cultural perspective, and (2) find out the results of the implementation of Ethnomathematics-based learning tools from an Islamic cultural perspective. Learning tools are designed by looking at aspects of the curriculum for basic education. The learning tool design consists of modules in which Learning Outcomes, Competency Standards, Core Competencies and Basic Competencies have been designed. So that when implementing product suitability, students' abilities can be measured properly. Likewise with the practicality of the product. Researchers tested whether the product used was practical as a companion book for students' learning or not. The following is a form of product design, namely an Ethnomathematics-based module viewed from an Islamic cultural perspective and using Augmented Reality (AR) Technology.





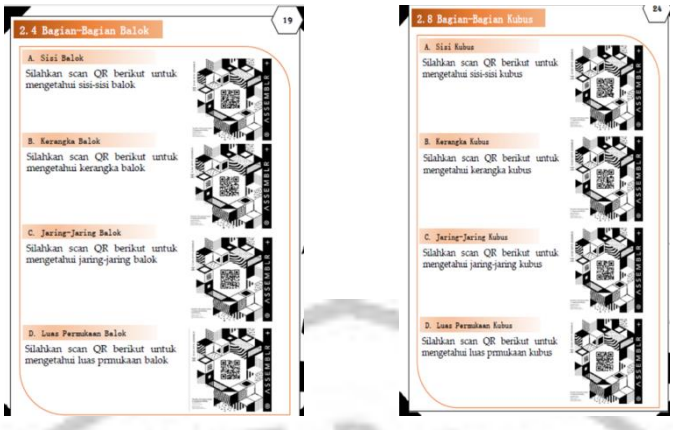


Figure 1. Ethnomathematics Learning Module Design

In the design of the Ethnomathematics learning module above, a validation test has been carried out first by an expert validator whose aim is to determine whether the product is valid and in accordance with the elementary school level curriculum or not and checked for conformity between competency standards, core competencies and learning objectives. In more detail, below are the data results from the validity test assessed by expert validators.

Table 2. Validation Test Results of the Ethnomathematics Module Based on Islamic Culture

No.	Aspect of Indikators	Score
1.	Module Design	80.22 %
2.	Module Contents	81.41 %
3.	Core Competencies	93.62 %
4.	Basic competencies	91.68 %
5.	Conformity with Syllabus and Curriculum	81.04 %
6.	Has elements of measuring mathematical ability	96.31 %
7.	Has elements of Augmented Reality learning technology and is capable of being run	87.08 %
8.	Knowledge of Local Philosophy and Culture (Islamic Culture)	96.87 %

From the table above, based on the assessment indicators and scores, it can be concluded that the Ethnomathematics Module product can be declared valid. An expert validator is an expert and lecturer who is an expert in their field. In this case, the researchers included two expert validators, namely a Digital Learning Technology expert and a Basic Education Curriculum expert.

Furthermore, the results of the product were implemented with secondary school teachers. The goal is to be able to see the results of responses from product users, namely teachers. The schools that will be used as the locus or object of this research come from 2 schools in two different countries, namely Indonesian schools (in this case in Cirebon) and in Malaysia (Islamic boarding schools). The aim of holding a product implementation locus for these two countries is so that the objects and data obtained are evenly distributed so that collaborative research researchers between

the two countries get complete data in two different places. The first step of this research is to test the product first in schools in Indonesia. In this case, researchers took research data at an Islamic-based school in Pasawahan District, Kuningan Regency, West Java. For more details, below is a picture of when the product trial was carried out.

Figure 3. Ethnomathematics Module Product Trial Using Augmented Reality Learning Technology

In the product trial activity of the Etnomathematics Module using Augmented Reality learning technology with primary (first) users, namely teachers in Islamic-based schools, overall they were very enthusiastic. The researcher intends to collect data by looking at aspects of assessment indicators from several dimensions of skills and cognitive skills of teachers when using products as learning technology in the classroom. In more detail, below are the results of product trial data for primary users, namely teachers in Islamic-based Indonesian schools.

Table 4. Results of Ethnomathematics Module Product Trials for Primary Users (Teachers)

No.	Aspect of Indikators	Score
1.	Mastery of the contents of the Ethnomathematics Module	88.09 %
2.	Mastery of the basic concepts of Mathematics in the Ethnomathematics Module with Augmented Reality	84.66 %
3.	Knowledge and accuracy in integrating simultaneously in terms of syllabus, curriculum, basic competencies, core competencies when using the product	82.38 %
3.	Mastery of basic concepts of local Islamic culture	91.57 %
4.	Mastery in bringing a conducive and positive atmosphere to the classroom	91.43 %
5.	Mastery of the use of IoT devices to support the learning process in the classroom	86.66 %
6.	Management system and appropriate control/control system for students in the learning process in class	94.11 %
7.	Knowledge of Local Philosophy and Culture (Indonesian Islamic Culture)	91.36 %

From the table above, product trials on primary users get data that is evenly distributed. The results of the test data obtained were based on distributing online questionnaires on the basis of knowing the skills and cognitive dimensions of the users. The conclusion obtained by the researchers is that users have mastered the essential concepts of the Mathematics subjects taught to students well, and

are able to integrate and connect the syllabus, curriculum, learning model, competency standards and core competencies in the product well. Mastery of class management and control is also good, but mastery of IoT-based equipment still needs to be guided. Researchers found a significant difference in that IoT principles are very popular with students to support the learning process in class, but teachers need to master IoT devices quickly and precisely. The connection between these two skills needs to be honed more deeply for teachers and students. In more detail, the following describes several devices used to support learning in IoT-based classes.

Table 5. IoT Device Specifications for Student Learning

No.	Spesification Tolls	Function	Picture example
1.	LoadCell weight sensor	A transducer that measures power, and presents the results as a signal	
2.	Mikrokontroller ESP8266	ESP8266 is a Wi-Fi chip for serial modules with high performance systems, part of Espressive System's 'Smart connectivity platform' aims to provide a mobile model platform to innovate with Wi-Fi embedded system capabilities at a low cost but have different abilities	
3.	RFID Card	Used for student attendance during teaching and learning activities in class digitally. RFID Card specifications include: Arduino UNO, RFID Module and RFID Tag 5V Buzzer, DS1302 RTC Module, 16x4 I2C LCD, A6 MINI SERIAL GPRS GSM MODULE, 5V 2A Adapter, Jumper Cable	

In the table above, IoT devices are very complex to use as learning activities in class. By using the IoT device system, researchers can find out whether the learning system carried out by teachers and students is effective and analyze the learning activities carried out in the classroom. The hope is that teachers can control the class comprehensively without having to attend class regularly. The use of IoT devices can make it easier for teachers to control or manage classes with a large number of students. Researchers took data for student learning activities (only 1 class) when testing the products presented in the table below.

Table 6. Data on student learning activities when walking IoT devices

No.	Student Learning Activities	Score
1.	Listen to teacher explanations in audio and virtual (IoT based devices)	92.16 %
2.	Carrying out project assignments with focus (Knows being supervised by teachers and observers using IoT-based devices)	88.11 %

3.	Conduct discussions with fellow group teams	93.15 %
3.	Focus on lessons and use the Ethnomathematics Module and not play	96.22 %
4.	Don't make noise in class	91.87 %
5.	Complete project tasks on time	92.05 %
6.	Don't leave class	94.33 %
7.	Overall learn independently and feel supervised	90.05 %

In the table above, data on student learning activities is very effective with the application of IoT devices when learning activities are taking place in the classroom. Teachers can control class conditions not only when they are in class, but also when they are in the teacher's office or other places. The use of Ethnomathematics Module products assisted by Augmented Reality with IoT devices really helps teachers and students carry out the process of teaching and learning activities in the classroom. Digital-based educational technology should be applied continuously in each school. In the 5.0 era, smart class technology is now commonly applied in various fields, one of which is education. Sensory devices can be applied optimally in various areas of life. The Indonesian people should be well aware of smart technology. So, there is no longer the term technological stupor experienced by Indonesian people at all levels (both in terms of age, occupation, profession, education, background and ethnicity), all of whom can use digital-based smart technology well. Below is a table regarding the analysis of student learning outcomes when testing the Ethnomathematics Module product assisted by Augmented Reality with IoT devices. Analysis of learning outcomes is carried out by observing the results of students' ability tests after treatment in testing the product. Before learning begins, class conditions are set first by installing CCTV cameras, RFID cameras, televisions, sound systems, audio systems and other devices that support IoT. Apart from that, the Ethnomathematics Module product assisted by Augmented Reality was also prepared in detail and systematically. Before teaching and learning activities begin in the classroom that has been set up, the teacher as a model for teaching students is given training in using IoT devices first, apart from that, before the trial is carried out, a week beforehand, a simulation is carried out first. This is intended so that teachers and students are very ready to start learning activities later. During the trial, the students were very enthusiastic and enthusiastic about using the ethnomathematics digital comic book. All tasks and projects in it can be followed and completed on time.

Table 7. Measures of Student Learning Data Results

No.	Indicators of Mathematical Ability	Score
1.	Understand the basic concepts of flat shapes and building space.	71. 31 %
2.	Linking the Basic Concepts of Flat Buildings and building space with Cases in Islamic Cultural Building Forms	77. 26 %
3.	Measuring the shape of flat shapes and spatial shapes precisely and accurately in accordance with known basic concepts (Method for Discovering a Mathematical	81.57 %

	Concept)	
4.	Apply knowledge of plane shapes and space shapes to similar cases	83.22 %
5.	Solve problems in the form of case studies based on the context of Islamic cultural buildings	87.80 %
6.	Can analyze the concept of flat shapes and space shapes when discovering a phenomenon in the form of Islamic cultural buildings.	81.55 %
7.	Can calculate and convert units of length and width accurately.	92.85 %

From the table above, the product trials carried out can indeed increase student learning outcomes. The Ethnomathematics Module product assisted by Augmented Reality is very good as a companion book (supplement) for additional learning activities in class or at home. Researchers concluded that product trials were successfully carried out in Indonesia. Students can learn more deeply about Islamic cultures around their environment. Apart from that, the product is packaged in an attractive and fun way, making students very comfortable learning while using the product being tested.

CONCLUSION

Based on the results of the presentation in the discussion section above, it can be revealed that digital ethnomathematics modules based on intelligent Augmented Reality (AR) technology can increase students' learning activities in class. This also affects learning outcomes. When implementing it in the classroom, it is set to be a smart class as a place for teaching and learning activities. Sensor and camera equipment is installed in the smart class, then teachers are given training and assistance in designing the smart class. Furthermore, teachers can use ethnomathematics-based digital modules designed in smart classes.

SUGGESTION

The implementation of Ethnomathematics-based digital module products with Augmented Reality (AR) intelligent technology should be expanded to more schools, so that the research data obtained is more valid. This is the same with schools in Malaysia, because implementation trials were carried out in two countries that collaborate on scientific research.

REFERENCES

Muhtadi, D. (2017). Etnomatematika Sunda: Matematika Aktivitas dalam Ertimaasi, Pengukuran, dan Pembuatan Pola. *Journal on Mathematics Education, 8*(2), 185-198.

Seiva Subramaniam, R. (2015). *Pemikiran masyarakat Tamil awal dalam kesusasteraan Tamil klasik/Seiva Subramaniam a/l Ramiah* (Doctoral dissertation, University of Malaya).

Abdullah, S.A. (2017). Ethnomathematics In Perspective of Sundanese Culture. *Journal on Mathematics Education*, 8(1), 1-15.

Nugroho, G. N. Penanaman Pendidikan Karakter Melalui Pembelajaran Etnomatematika. Prosiding Seminar Nasional Pendidikan FKIP Universitas Muhammadiyah Cirebon 2018 Cirebon, 212-247.

Ubayanti, C. S., Lumbantobing, H., & Manurung, M. M. (2016). Eksplorasi Etnomatematika pada Sero (Set Net): Budaya Masyarakat Kokas Fakfak Papua Barat. *Jurnal Ilmiah Matematika dan Pembelajarannya, 1*(1), 12-21.

Hariastuti, R. M. (2017). Permainan tebak-tebak buah manggis: Sebuah inovasi pembelajaran matematika berbasis etnomatematika. *JMPM: Jurnal Matematika dan Pendidikan Matematika*, *2*(1), 25-35.

Arwanto. (2016). Eksplorasi Etnomatematika Batik Trusmi Cirebon untuk Mengungkap Nilai Filosofi dan Konsep Matematis. *Jurnal Nasional Pendidikan Matematika*, 40-49.

Francois, K., & Kerkhove, B. V. (2010). Ethnomathematics and the Philosophy of Mathematics (education). *Philosophy of Mathematics*, 121-154.

Bashori, M. H. (2013). *Penanggalan Islam, Peradaban tanpa Penanggalan Inikah Pilihan kita ?* Jakarta: Elex Media Komputindo

Febriyanti, C., Prasetya, R., & Irawan, A. (2018). Etnomatematika Pada Permainan Tradisional Engklek dan Gasing Khas Kebudayaan Sunda. *Jurnal Ilmu Matematika dan Terapan, 12*(1), 1-6.

Iqbal, M., Hamdani, H., & Rustam, R. (2018). EKSPLORASI ETNOMATEMATIKA PEKERJA BANGUNAN DALAM MEMBANGUN RUMAH ETNIS MELAYU KETAPANG. *Jurnal Pendidikan dan Pembelajaran*, *7*(11).

Lestroyani, R. D. (2014). *Peningkatan Kemampuan Berpikir Kritis Matematis Siswa SMK Melalui Pembelajaran Konflik Kognitif.* Universitas Pasundan, Pendidikan Matematika. Bandung: Tesis.

Mursy & Triyunono. 2014. Eksplorasi Makna Laba dengan Pendekatan Etnografi. Jurnal Aplikasi Manajemen (JAM), (66), 503–511.

Prawiraredah, M. S. (2005). *Cirebon : Filsafah, Tradisi, dan Adat Budaya.* Jakarta: Percetakan Negara RI.

Syahrin, M. A., Turmudi, & Puspita, E. (2015). Studi Etnomatematika pada Aboge (Alif,Rebo,Wage) Kalender untuk Menentukan Hari Baik Islam dan Upacara Tradisional di Keraton Kesepuhan Cirebon.

Rubio, J. S. (2016). The Ethnomathematics of the Kabihug Tribe in Jose Panganiban, Camarines Norte, Philippines. *Malaysian journal of mathematical sciences*, *10*, 211-231.

Kusuma, D. A., Dewanto, S. P., Ruchjana, B. N., & Abdullah, A. S. (2017, October). The role of ethnomathematics in West Java (A preliminary analysis of case study in Cipatujah). In *Journal of Physics: Conference Series* (Vol. 893, No. 1, p. 012020). IOP Publishing.

Muhafidin, I., Nurlaelah, E., & Sudihartinih, E. (2018, December). Ethnomathematics study: revealing mathematical aspects in determination of a good daily activities in indigenous societies of paseban and cikondang west java. In *International Conference on Mathematics and Science Education of Universitas Pendidikan Indonesia* (Vol. 3, pp. 614-620).

Imswatama, A., Saprudin, S., & Widyanto, R. (2017). Etnomatematika: Arsitektur Lumbung Padi "Leuit" di Kawasan Geopark Ciletuh Sukabumi Sebagai Bahan Pembelajaran Matematika di Sekolah Dasar. Prosiding Seminar Nasional Pendidikan Berkemajuan dan Menggembirakan (The Progressive & Fun Education Seminar) ke-2.

Pratikno, H. (2018, February). Etnomatematika pada bregada prajurit Keraton Yogyakarta. In *Prosiding Seminar Nasional Pendidikan Matematika Etnomatnesia*.

Hariastuti, R. M. (2017). Permainan tebak-tebak buah manggis: Sebuah inovasi pembelajaran matematika berbasis etnomatematika. *JMPM: Jurnal Matematika dan Pendidikan Matematika*, *2*(1), 25-35.

Mahpudihn , & Yulianti, Y. (2019). Peran Budaya Lokal terhadap Literasi Matematika Siswa Sekolah Dasar di Cirebon. *Proceeding of the ICECRS, 2*(1), 287-292.

Rosa, M., & Orey, D. C. (2011). Ethnomathematics: The Cultural Aspects of Mathematics. Revista Latinoamericana de Ethnomatematica. *4*(2).

Rahayu, D. P., Setiawani, S., & Murtikusuma, R. P. (2018). Etnomatematika Pada Aktivitas Pasca Panen Tembakau Masyarakat Pendalungan dan Penerapannya Sebagai Lembar Kerja Peserta Didik. *Kadikma, 9*(3), 85-96.

Mahpudihn , & Yulianti, Y. (2019). Peran Budaya Lokal terhadap Literasi Matematika Siswa Sekolah Dasar di Cirebon. *Proceeding of the ICECRS, 2*(1), 287-292.

Bashori, M. H. (2013). *Penanggalan Islam, Peradaban tanpa Penanggalan Inikah Pilihan kita ?* Jakarta: Elex Media Komputindo.

Hariastuti, R. M. (2017). Permainan tebak-tebak buah manggis: Sebuah inovasi pembelajaran matematika berbasis etnomatematika. *JMPM: Jurnal Matematika dan Pendidikan Matematika*, *2*(1), 25-35.