



DEVELOPMENT OF MADURA'S KERRABHAN SAPE ETHNOMATHEMATICS E-MODULE FOR TEACHING SPEED, DISTANCE, TIME TO FIFTH GRADERS

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Abstract

Ethnomathematics studies of Madura's kerrabhan sape (traditional bull racing) have primarily explored geometric concepts and numerical operations, with limited attention to integrating race distance and travel time into mathematics instruction. This study aimed to develop a valid and practical ethnomathematics e-module for teaching speed, distance, and time to fifth-grade elementary school students. The study employed Plomp's educational design research model, comprising preliminary research, development or prototyping, and assessment. Media, content, and cultural experts evaluated the module's validity. Practicality was assessed through questionnaires completed by 21 fifth-grade students at SDN Sumedangan 3 Pademawu and their classroom teacher during a limited trial. Data were collected using validation forms and response questionnaires and analysed through qualitative and quantitative descriptive methods. The results indicated validity scores of 92% for media, 91% for content, and 90% for cultural aspects, all classified as highly valid. Student and teacher responses yielded practicality scores of 88% and 90%, respectively, indicating high practicality. The e-module was engaging, user-friendly, and connected mathematical concepts with Madura's cultural heritage. Its novelty lies in integrating race-distance and travel-time measurements from kerrabhan sape into mathematics learning. However, its effectiveness in improving students' mathematical conceptual understanding remains untested and requires further investigation.

Keywords: E-Module; Elementary School; Ethnomathematics; Kerrabhan Sape; Speed, Distance, and Time

Abstrak

Kajian etnomatematika tentang *kerrabhan sape* (karapan sapi tradisional) Madura umumnya mengeksplorasi konsep geometri dan operasi bilangan, tetapi belum banyak mengintegrasikan jarak tempuh dan waktu perjalanan ke dalam pembelajaran matematika. Penelitian ini bertujuan mengembangkan e-modul etnomatematika berbasis *kerrabhan sape* yang valid dan praktis untuk mengajarkan materi kecepatan, jarak, dan waktu kepada siswa kelas V sekolah dasar. Penelitian menggunakan model *educational design research* Plomp yang terdiri atas tiga fase, yaitu penelitian pendahuluan, pengembangan atau pembuatan prototipe, dan penilaian. Validitas e-modul dinilai oleh ahli media, materi, dan budaya. Kepraktisan dievaluasi melalui uji coba terbatas yang melibatkan 21 siswa kelas V SDN Sumedangan 3 Pademawu dan satu orang guru kelas. Data dikumpulkan menggunakan lembar validasi serta angket tanggapan siswa dan guru, kemudian dianalisis secara deskriptif kualitatif dan kuantitatif. Hasil penelitian menunjukkan skor validitas media sebesar 92%, materi 91%, dan budaya 90%, yang seluruhnya termasuk kategori sangat valid. Skor kepraktisan berdasarkan tanggapan siswa dan guru masing-masing mencapai 88% dan 90%, termasuk kategori sangat praktis. E-modul ini dinilai menarik, mudah digunakan, dan mampu menghubungkan konsep matematika dengan budaya Madura. Kebaruannya terletak pada integrasi pengukuran jarak tempuh dan waktu dalam *kerrabhan sape*. Efektivitasnya dalam meningkatkan pemahaman konsep matematika siswa masih perlu diuji lebih lanjut.

Kata kunci: E-Modul; Etnomatematika; Kerrabhan Sape; Kecepatan, Jarak, dan Waktu; Sekolah Dasar.

INTRODUCTION

Mathematics is often perceived as an abstract discipline disconnected from everyday life. However, various cultural communities have incorporated mathematical ideas and concepts into their activities, albeit implicitly and informally (D'Ambrosio, 2007; Risdiyanti & Prahmana, 2018). Ethnomathematics draws on these cultural practices as starting points for learning. Prahmana and D'Ambrosio (2020) used Yogyakarta batik patterns to teach geometry while promoting cultural values, whereas Pathuddin et al. (2021) explored mathematical concepts in the preparation of barongko cakes as learning resources. Mathematical ideas have also been identified in traditional timekeeping practices, such as the pranatamangsa system used in birth and death ceremonies in Yogyakarta (Prahmana et al., 2021), as well as the determination of auspicious days among the Cigugur Indigenous community (Umbara et al., 2021) and the people of Takalar Regency (Ramadhani et al., 2024).

Ethnomathematics research in Indonesia has predominantly focused on exploration. Of 80 ethnomathematics articles published in Indonesian mathematics education journals between 2016 and 2022, 49 employed qualitative research methods, while only 18 were development studies (Turmuzy et al., 2023). A systematic review of digital ethnomathematics-based learning media in Indonesia also identified geometry as the most frequently addressed topic, with other topics receiving comparatively little attention (Suzuma & Umbara, 2025). In other words, findings from cultural exploration have rarely been transformed into instructional materials, and existing digital materials tend to focus on geometry.

Madura has a rich cultural heritage, including Bull Racing, sapi sonok, rokat, taneyan lanjhang, and Madura batik. Bull Racing, known in the Madura language as kerrabhan sape, is a traditional bull-racing event originating on Madura Island (Direktorat SMP, 2024). In this competition, two bulls pull a small cart and race as quickly as possible from the starting line to the finish line. The tradition, which originated as a popular celebration following the harvest, has been passed down through generations, and is recognized as a distinctive Madura tradition not found on Java Island (Kosim, 2007). For many Madura people, kerrabhan sape also symbolizes prestige, enhancing the social standing of bull owners and their communities (Aini et al., 2019).

Ethnomathematics studies of Madura culture have identified mathematical concepts in various cultural objects and practices. Aini et al. (2019) identified plane geometry, similarity, congruence, and numerical operations in kerrabhan sape, while Hasanah et al. (2024) described the ethnomathematical characteristics of Madura culture in Bangkalan Regency in relation to the Merdeka Curriculum. Findings from bull-racing studies have also been incorporated into classroom learning. Hasanah et al. (2019) developed ethnomathematics-based student worksheets for plane geometry that met validity, practicality, and effectiveness criteria. Hasanah et al. (2020) also incorporated the mathematical values of Bull Racing into plane geometry instruction at SDN Pademawu using the Student Teams Achievement Divisions (STAD) model. Nevertheless, these studies focused primarily on geometry and numerical concepts. An activity central to this competition—covering a specified distance in the shortest possible time—has not been utilized as a learning context for speed, distance, and time, nor has it been developed into digital instructional materials.

An e-module is a self-directed learning resource systematically organized into small learning units to achieve specific objectives and presented electronically. It can incorporate images, photographs, hyperlinks, and navigation features that facilitate students' interaction with the learning material (Direktorat Pembinaan SMA, 2017). The quality of such educational products is commonly evaluated using three criteria: validity, practicality, and effectiveness (Nieveen, 1999). A product is considered valid when its content is grounded in current knowledge and its components are consistently

interconnected. A product is considered practical when users perceive it as easy to use under real-world conditions. Several studies have developed ethnomathematics-based e-modules for elementary school students using these criteria, including a cube and rectangular prism e-module for fifth-grade students (Triwahyuningtyas et al., 2022), a Sasak culture-based solid geometry e-module (Sutarto et al., 2022), and an interactive e-module featuring Balinese *upakara* for second-grade students (Mahardika et al., 2024). All three addressed geometry, and two reported validation by subject matter and media experts without involving cultural experts (Mahardika et al., 2024; Triwahyuningtyas et al., 2022).

Based on this background, the research question is: How can a Madura kerrabhan sape-based ethnomathematics e-module for teaching speed, distance, and time to fifth-grade elementary school students be developed to meet validity and practicality criteria? Accordingly, this study aims to develop a Madura kerrabhan sape-based ethnomathematics e-module that satisfies these criteria. The novelty of this study lies in two aspects: incorporating the measurement of race-course distance and travel time in kerrabhan sape as a learning context for speed, distance, and time, and involving cultural experts to verify the accuracy of cultural representations alongside media and content validation.

METHOD

This study employed a development research approach using Plomp's educational design research model. The model consists of three phases: preliminary research, development or prototyping, and assessment (Plomp, 2013). Product quality was evaluated based on validity and practicality criteria (Nieveen, 1999), while effectiveness was not assessed in this study. The research was conducted during the second semester of the 2024–2025 academic year at SDN Sumedangan 3 Pademawu, Pamekasan Regency, East Java, Indonesia. The limited trial involved 21 fifth-grade students and their classroom teacher.

In the first phase, a field study was conducted to identify the learning conditions and needs of fifth-grade students at SDN Sumedangan 3 Pademawu. Data was collected through interviews with the fifth-grade classroom teacher and a documentary review of the instructional materials used. In addition, field observations and a literature review were conducted to explore Madura kerrabhan sape, particularly practices related to race-course distance, travel time, and bull speed. Interviews were also conducted with H. Slamet, a bull-racing cattle owner. The outcome of this phase was the identification of mathematical content and the cultural context of kerrabhan sape, together with an integration framework for the e-module.

In the second phase, the e-module was designed, followed by a focus group discussion (FGD), expert validation, and a readability test involving teachers and students. The FGD involved three teachers and one lecturer who reviewed the initial design before expert validation. The readability test involved one fifth-grade classroom teacher and five fifth-grade students to assess the clarity of the language and instructions. The outcome was an e-module ready for classroom implementation.

In the third phase, a limited trial was conducted to assess the practicality of using the e-module in classroom instruction. This phase produced a valid and practical mathematics e-module contextualized in Madura kerrabhan sape. The detailed research procedure is presented in the flowchart in Figure 1. The limited trial was conducted over three sessions, each lasting 2×40 minutes. Instruction was facilitated by the classroom teacher or researcher, and students accessed the e-module through a projector, individually or in groups. Student and teacher response questionnaires were completed after the final session.

The instruments used in this study included media validation form, content validation form, a cultural validation form, and teacher and student response questionnaires. The specifications of each research instrument are presented in Table 1.

Table 1. Research Instrument Specifications

Instrument	Aspects Assessed	Number of Items
Media validation form	Display and color, layout, text readability, image or photograph quality, and ease of navigation	10
Content validation form	Alignment with learning outcomes and objectives, conceptual accuracy, presentation sequence, and language	10
Cultural validation form	Authenticity of kerrabhan sape representations, accuracy of cultural terminology and narratives, and alignment of the context with actual racing practices	10
Student response questionnaire	Ease of use, visual appeal, support for understanding the material, and interest in the cultural context	12
Teacher response questionnaire	Ease of operation, alignment with learning objectives, connection between mathematical content and culture, and potential for independent use	12

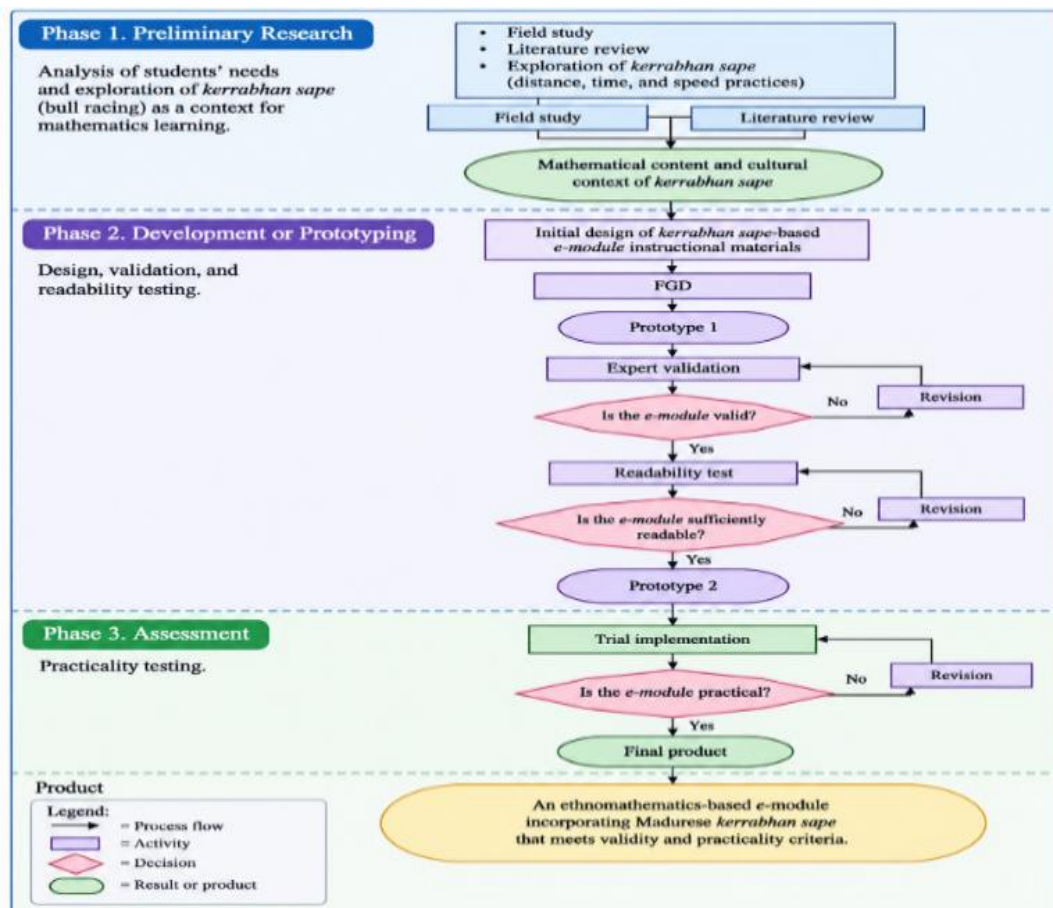


Figure 1. Flowchart of the Development of the Madura Kerrabhan Sape Ethnomathematics E-Module

Media validation was conducted by three validators, all of whom were lecturers in the Mathematics Education Study Program. Content validation was carried out by two validators, comprising a classroom teacher and a lecturer. Cultural validation was conducted by two individuals who own cattle used in kerrabhan sape (traditional *Bull Racing*). The research data consisted of qualitative and quantitative data. Qualitative data comprised notes and feedback from FGD participants, validators, teachers, and students, which were used to improve the e-module design. Quantitative data consisted of validation scores and response questionnaire scores, which were analyzed by calculating percentages using the following formula:

$$P = (\Sigma x / \Sigma x_i) \times 100\%$$

where (P) represents the percentage score, Σx is the total score obtained, and Σx_i is the maximum possible score. For aspects assessed by more than one validator, the percentage was calculated based on the average scores of all validators. The resulting percentages were then converted into validity and practicality categories, as presented in Table 2, adapted from Akbar (2013). The e-module was considered valid and practical if its percentage score reached at least the practical category threshold.

Table 2. Validity and Practicality Criteria

Percentage (%)	Validity Category	Practicality Category
85,01–100,00	Highly valid	Highly practical
70,01–85,00	Moderately valid	Moderately practical
50,01–70,00	Less valid	Less practical
01,00–50,00	Invalid	Impractical

Source: Adapted from Akbar (2013)

The practicality of the e-module was determined based on teacher and student responses regarding ease of use, attractiveness, and support for learning after using the e-module during the limited trial. Improvements in students' mathematical abilities were not measured in this study. This study obtained permission from the principal of SDN Sumedangan 3 Pademawu. Student participation was approved by the classroom teacher, students' identities were kept confidential, and photographs of kerrabhan sape included in the e-module were taken by the research team with permission from the organizing committee or cattle owners.

RESULT AND DISCUSSION

The development of the e-module in this study was carried out through three phases of Plomp's educational design research model. The stages and activities conducted in each phase are described below.

Phase 1: Preliminary Research

Student Needs Analysis

The Merdeka Curriculum provides opportunities to incorporate local culture into learning, including through the local wisdom theme in the Pancasila Student Profile Strengthening Project (Projek Penguatan Profil Pelajar Pancasila) (Khairunisa & Utami, 2023). However, these opportunities were not reflected in the mathematics teaching materials used in Grade V at SDN Sumedangan 3 Pademawu. The teaching materials for speed, distance, and time used by the teacher were still limited

to the compulsory textbook provided by the Ministry of Education. The textbook introduces the topic by promising students that they can calculate using simple formulas, then immediately directs them to time-unit conversions using illustrations of clocks and calendars (Figure 2). This presentation does not connect the material to students' everyday experiences, let alone to the culture with which they are familiar.

Interviews with the fifth-grade homeroom teacher and students, along with a document review, indicated that students were familiar with using technology, such as computers, laptops, and smartphones. Insert specific interview findings, such as the number of students who owned or had access to smartphones and a brief statement from the teacher. However, students were rarely encouraged to connect mathematical problems with their own cultural practices. Classroom observations or teacher statements also indicated that mathematics instruction provided limited opportunities for active student engagement and that instructional media were rarely used in mathematics lessons.

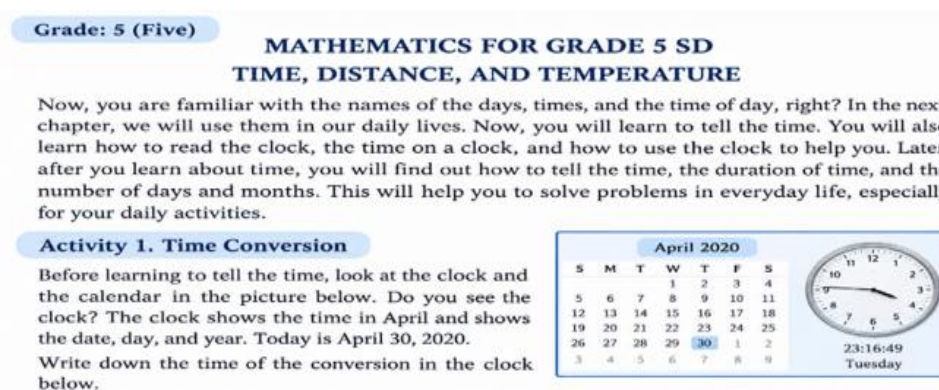


Figure 2. Example of the Teaching Materials on Speed, Distance, and Time Used Before Development

The content analysis was guided by the Phase C Learning Outcomes. The topic of speed, distance, and time is related to the Measurement strand, which requires students to calculate time intervals, and the Algebra strand, which requires students to reason proportionally when solving everyday problems involving unit rates (Badan Standar, Kurikulum, dan Asesmen Pendidikan, 2024). Speed is an example of a unit rate because it represents the distance traveled per unit of time. Based on these learning outcomes, two learning objectives were formulated: (1) to understand the concepts of distance, time, and speed; and (2) to solve everyday problems involving movement, travel, and racing within the context of Bull Racing (traditional Madura Bull Racing).

The task analysis resulted in three sequential tasks for students: determining speed from distance and travel time, determining distance from speed and time, and determining travel time from distance and speed. These three tasks were contextualized within the practices associated with Bull Racing. Bull-racing tracks in Madura are generally 80–120 meters long, and trainers measure the time required for the bulls to cover specific distances to monitor changes in their speed during training. Training tracks may also be divided into several segments, while the duration of training sessions is adjusted to the bulls' strength and endurance requirements. These contextual details were obtained through interviews with bull trainers or owners in Pamekasan Regency, Madura, Indonesia.

Phase 2: Development or Prototyping

Design

The selection of media was guided using ICT in learning, namely (a) dynamic and visual tools that can be explored in a shared space, and (b) the provision of variety during instruction so that students' attention is not focused solely on the teacher. The e-module was developed in an online flipbook format that can be accessed through a web browser on smartphones and laptops. The presentation format follows the scientific approach through activities involving observing, questioning, gathering information, reasoning, and networking or sharing. Although this approach is widely associated with the 2013 Curriculum, the Merdeka Curriculum does not prescribe a single specific approach and allows teachers the flexibility to select an approach appropriate to their learning objectives. The scientific approach was selected because its sequence aligns with the ethnomathematical learning process: students first observe kerrabhan sape, then ask questions and gather information about distance and travel time, before reasoning about the relationships among these three quantities.

The initial design was developed by incorporating the findings from the front-end analysis, student analysis, material analysis, task analysis, and specification of learning objectives. The e-module consists of an opening page containing the learning objectives and an introduction to Bull Racing, followed by three subsections: A (speed), B (distance), and C (time). Each subsection begins with a narrative and photographs of kerrabhan sape, followed by guiding questions that students answer in the "My Answer" or "In My Opinion" sections. Examples include identifying the most interesting part of the race and considering whether track length affects the bulls' speed. The "Let's Practice" section presents problems based on Bull Racing and training activities, which students solve in the "My Calculation Method," "My Reasoning," or "My Opinion" sections. Each subsection concludes with an "Independent Practice" section. This initial design resulted in Prototype Draft I of the e-module, as shown in Figure 3.

Some problems in the e-module still involve direct calculations, such as determining the distance traveled by a bull running at 10 m/s for 12 seconds. However, each subsection also includes questions requiring students to interpret their calculation results in the context of Bull Racing. Students are asked to assess whether a bull covering a 100-meter track in 15 seconds can be considered fast, identify factors other than the bull's strength that affect speed, evaluate whether a particular distance is sufficient for warm-up, and determine whether a given travel time is considered fast in a race. Students also formulate their own definitions of speed, distance, and time in their own words after solving the problems. Thus, the kerrabhan sape context serves not merely as a background setting for the problems.

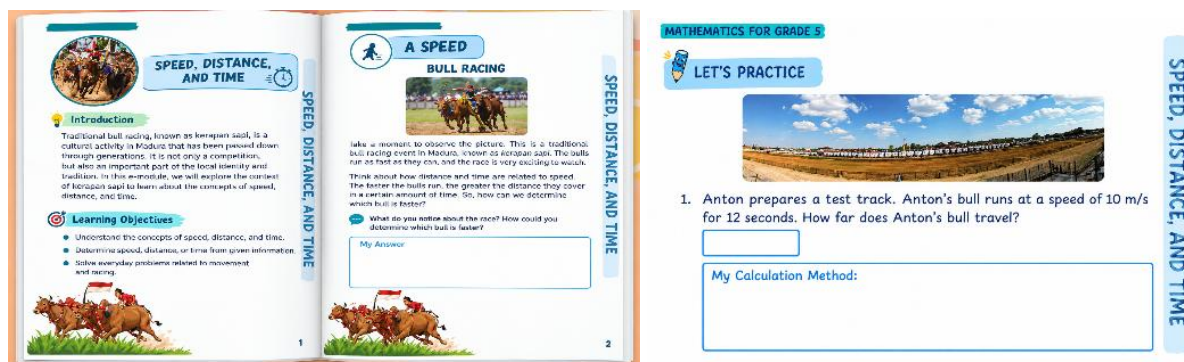


Figure 3. Prototype Draft I of the Kerrabhan Sape Ethnomathematics E-Module

Prototype Draft I was first discussed in a focus group discussion (FGD) involving the researchers, the classroom teacher, two mathematics education lecturers, and a field research assistant.

Validation

Following the FGD, the prototype was validated through expert assessment and a readability test. The e-module was evaluated by media, content, and cultural validators to obtain feedback for revising Draft I into Draft II. A summary of the scores for each aspect and each validator is presented in Table 3.

Table 3. E-Module Validation Results by Aspect and Validator

Validation Aspect	V1 (%)	V2 (%)	V3 (%)	Average (%)
Media	90	94	92	92
Content	90	93	90	91
Culture Aspect	90	91	89	90
Overall Average				91

Note: V1–V3 = validators 1–3

For media validation, Validators 1, 2, and 3 concluded that the e-module was of good quality and could be used with minor revisions. The validation results yielded an average score of 91%, which falls into the highly valid category, with the highest score being 92% and the lowest 90%. The three validators' feedback and the corresponding revisions made to the e-module are presented in Table 4.

Table 4. Revisions to the E-Module Based on Feedback from Media and Content Validators

Before Revision (Draft I)	After Revision (Draft II)
The colors were too soft, using beige tones, whereas the Madura people tend to prefer bold colors (media validator).	The colors were adjusted to reflect Madura's distinctive characteristics by changing them to bright red.
The kerrabhan sape illustrations did not use actual photographs (media validator).	The illustrations were replaced with actual photographs taken during field documentation.
The formulas for speed, distance, and time were presented at the beginning of the lesson, which was considered inconsistent with the characteristics of the Merdeka Curriculum.	The formulas were no longer presented at the beginning. Instead, students first worked on kerrabhan sape problems and then formulated their own definitions of speed, distance, and time in their own words.

In the content validation, the two content expert validators concluded that the material in the e-module was of good quality and suitable for use with minor revisions, awarding it a score of 91%, which falls into the highly valid category. The material was aligned with the curriculum in use, and the concepts presented were accurate. However, a revision was recommended regarding the presentation of formulas, which should not be introduced at the beginning of the lesson (Table 4).

In the cultural validation, the two validators concluded that the cultural elements incorporated into the e-module were appropriate and could be used with minor revisions, with an average score of 90%, which falls into the highly valid category. The cultural expert validators stated that the representation of kerrabhan sape was authentic because it used actual photographs taken during a kerrabhan sape event. The revised version of the e-module is shown in Figure 4.

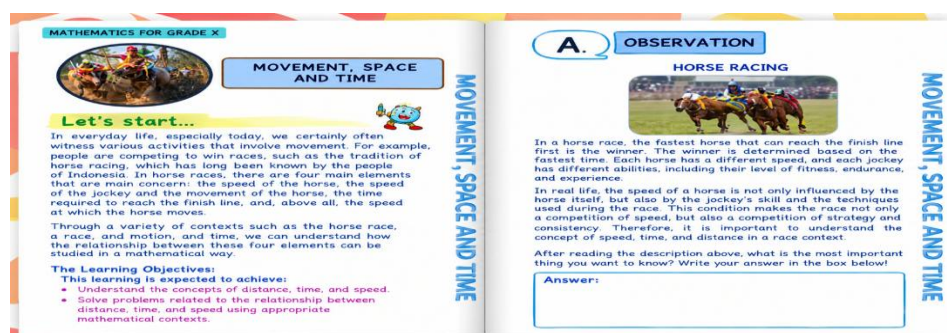


Figure 4. Revised Version of the Kerrabhan Sape Ethnomathematics E-Module (Draft II)

The e-module can be accessed at <https://heyzine.com/flip-book/ebcc56988f.html>. Based on the expert validation results, the kerrabhan sape ethnomathematics e-module met the validity criteria. The average score from the media validators was 92%, that from the content validators was 91%, and that from the cultural validators was 90%. All scores fell into the highly valid category (Table 2).

The readability test was conducted with five students and two classroom teachers. Several findings emerged from the readability test, such as terms or sentences that students found difficult to understand, along with the corresponding revisions. The readability test results served as the basis for refining Draft II before the trial implementation.

Phase 3: Assessment (Practicality)

A limited trial of the Madura kerrabhan sape ethnomathematics e-module was conducted at SDN Sumedangan 3 Pademawu, involving 21 fifth-grade students and their classroom teacher. The purpose of this activity was to determine the practicality of the developed e-module before its wider implementation. The trial was conducted according to the procedures described in the Methods section, and a summary of the response questionnaire results by aspect is presented in Table 5.

Table 5. Student and Teacher Response Questionnaire Results by Aspect

Aspect	Number of Items	Students (%)	Teacher (%)	Category
Average	12	88	90	Highly practical

Based on the student response questionnaire results, the practicality score was 88%, which falls into the highly practical category (Table 2). The questionnaire responses indicated that students found the e-module easy to use, visually appealing, and helpful in learning the mathematics material.

The teacher response questionnaire yielded a practicality score of 90%, which also falls into the highly practical category. The teacher considered the e-module easy to operate, aligned with the learning objectives, and helpful in connecting mathematical concepts with local Madura culture. The teacher also considered the e-module suitable for use as supplementary teaching material and as a resource for independent student learning. These evaluations were based on questionnaire responses rather than measurements of instructional time or observations of classroom implementation.

Discussion

The findings of this study indicate that the kerrabhan sape Madura ethnomathematics e-module met both validity and practicality criteria. The high validity scores across the three aspects—media, content, and culture—indicate that integrating local cultural contexts into teaching materials does not

compromise the mathematical accuracy of the concepts presented. This finding is consistent with previous studies suggesting that mathematical elements found in cultural artifacts and activities can serve as valid resources for mathematics learning (Khasanah et al., 2022; Pathuddin et al., 2021; Prahmana & D'Ambrosio, 2020). Other studies have also indicated that the more mathematical concepts that can be explored within a culture, the greater the potential for that culture to be incorporated into mathematics instruction (Tupen et al., 2024).

The validity and practicality scores obtained in this study are comparable to those reported in other studies developing ethnomathematics e-modules for elementary schools. Triwahyuningtyas et al. (2022) reported an average validity score of 82.5% and a practicality score of 85% for an e-module on cubes and rectangular prisms for fifth-grade students, while Sutarto et al. (2022) obtained an average validity score of 3.65, categorized as highly suitable, and a practicality score of 89% for a Sasak culture-based geometry e-module. Mahardika et al. (2024) reported a media expert validation score of 99% and a teacher response score of 98% for an interactive e-module featuring Balinese upakara rituals. These numerical similarities should be interpreted cautiously because the scales and criteria used in each study differ. A more distinct difference lies in the types of validators involved. Triwahyuningtyas et al. (2022) and Mahardika et al. (2024) assessed validity through content and media experts, whereas the present study also involved cultural validators to examine the accuracy of the kerrabhan sape representation.

The 92% media score was assigned to Draft I, meaning that it reflected the quality of the initial design rather than the revised version. The validators' feedback identified aspects that still required improvement, namely the use of bolder colors and the replacement of illustrations with actual photographs of kerrabhan sape. These two recommendations indicate that the visual appeal of an e-module cannot be evaluated solely according to general design principles; it must also reflect users' visual preferences and everyday experiences. Authentic photographs are expected to help students recognize objects they encounter in their own surroundings, allowing the visual presentation of the e-module to serve as an introduction to the cultural context being studied. This aligns with the view that ICT in mathematics instruction should support dynamic presentations that can be explored collaboratively rather than merely transferring printed textbooks into digital formats.

Regarding content, the validation score of 91% was accompanied by one important recommendation from the validators: formulas should not be presented at the beginning of the lesson. This recommendation is consistent with the principle of ethnomathematics, which positions cultural activities as the starting point for learning rather than as illustrations introduced after formal concepts have been presented (Pathuddin et al., 2021; Prahmana & D'Ambrosio, 2020). Following the revision, students first encountered problems involving track distance, travel time, and the speed of bulls in kerrabhan sape, and then formulated their own definitions of these three quantities. This sequence was designed to allow formulas to emerge as summaries of students' experiences rather than as rules that must be memorized beforehand. However, whether students actually developed an understanding of the relationships among these quantities through this sequence cannot be concluded from the present data and requires further investigation through an analysis of students' responses or conceptual understanding tests.

The cultural aspect received a score of 90%, with the validators emphasizing the authenticity of the kerrabhan sape representation. The use of photographs taken directly at the event was a primary consideration because inaccurate cultural representations may lead students to develop misconceptions, even when the mathematical content is correct. In ethnomathematics research, mathematical concepts are derived from cultural forms and practices themselves, as demonstrated in studies of the traditional clothing of Mee women (Doo et al., 2023), Gedongsongo Temple (Khasanah et al., 2022), and

traditional Toraja houses (Sari, 2023). Therefore, the accuracy of the mathematical concepts derived from a cultural context depends on the accuracy of its cultural representation. For this reason, cultural validation in the present study was treated as equally important as content and media validation, rather than as a supplementary component.

The student response score of 88% indicates that the e-module could be used without significant difficulties. This finding may be associated with two factors. First, students at the research site were already accustomed to using smartphones and laptops, as revealed during the preliminary study, so the digital format did not pose a barrier. Second, kerrabhan sape is a widely recognized tradition in Pamekasan, making the situations presented in the problems familiar to students. Using cultural contexts closely connected to students' lives may also help them relate mathematical concepts to relevant everyday experiences (Ramadhani et al., 2024). Studies exploring traditional games (Asriyani & Setyadi, 2023; Maulida, 2020) and regional foods (Pusvita et al., 2019) have likewise demonstrated that familiar objects and activities contain mathematical concepts that can be used as learning contexts. However, this study did not measure student interest or understanding; therefore, these explanations remain tentative and should be examined in future research.

The teacher response score of 90% provides a different perspective on practicality, namely that of the person responsible for managing classroom instruction. The teacher considered the e-module helpful in connecting mathematical concepts with local culture, an aspect that had previously been difficult to address because of the limited availability of teaching materials incorporating Madura culture. In other words, this e-module addresses a need identified during the preliminary study: the lack of mathematics teaching materials incorporating Madura cultural elements in the classroom, despite the opportunities for local wisdom integration provided by the Merdeka Curriculum (Hasanah et al., 2024; Khairunisa & Utami, 2023). Nevertheless, the teacher's evaluation reflects perceptions, as classroom implementation using the e-module was not systematically observed.

The novelty of this study lies in the mathematical context explored and the form of the resulting product. Previous ethnomathematics studies in Madura have largely focused on exploring mathematical values embedded in the culture, including kerrabhan sape (Aini et al., 2019) and the cultural characteristics of Bangkalan Regency (Hasanah et al., 2024). Hasanah et al. (2020) had applied the mathematical values of Bull Racing to plane geometry using the Student Teams Achievement Division (STAD) model, while Hasanah et al. (2019) developed ethnomathematics-based student worksheets incorporating mathematical content and cultural contexts. The present study extends these findings by exploring another aspect of kerrabhan sape: the practice of measuring track distance and travel time. This context is used to teach speed, distance, and time and is developed into an e-module whose validity and practicality have been evaluated by media, content, and cultural experts.

Nevertheless, this study has several limitations. The trial was conducted with only 21 students at one elementary school; therefore, the practicality findings cannot yet be generalized to schools and students with more diverse characteristics. Practicality was also measured solely through response questionnaires, without observations of classroom implementation. In addition, the study examined only the validity and practicality of the e-module, while its effectiveness in improving students' mathematical abilities has not been empirically tested. The developed material was also limited to a single topic. Therefore, future research should examine the effectiveness of the e-module through an experimental design involving a broader range of schools and expand the material to include other aspects of Madura culture.

CONCLUSION

This study developed a Madura ethnomathematics e-module based on the kerrabhan sape tradition for teaching speed, distance, and time to fifth-grade elementary school students. First, the e-module met the validity criteria, with scores of 92% from the media validator, 91% from the content validator, and 90% from the cultural validators, all of which were categorized as highly valid. Second, the e-module met the practicality criteria based on responses from 21 students and their classroom teacher during a limited trial, with practicality scores of 88% and 90%, respectively, both categorized as highly practical. Further research is recommended to examine the effectiveness of the e-module in improving students' understanding of speed, distance, and time through an experimental design, involve more schools with diverse characteristics, and expand the learning materials to incorporate other aspects of Madura culture, such as sapi sonok (beauty contests for female cattle) and Madura batik.

ACKNOWLEDGMENTS

We would like to express our gratitude to the Institute for Research and Community Service (LPPM) of Universitas Madura for facilitating and providing funding through its internal research funding program to support the implementation of this research and the publication of the article.

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