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Ethnodigital microteaching model through virtual laboratory to improve TPACK of prospective mathematics teachers

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ABSTRACT

The problem and the aim of the study. The low teacher competence is one of the hot topics of discussion in educational issues. Integration of knowledge about technology by prospective teachers into learning needs to be done to improve their competence in facing technological advances, in this case the abilities in question are Technological Pedagogical Content Knowledge (TPACK) especially in microteaching learning. The use of technology in virtual laboratories offers another opportunity to expose prospective teachers to a more realistic context in practicing learning to improve the TPACK of prospective mathematics teachers.

This study aims to develop an ethnodigital microteaching learning model through a virtual laboratory to improve the TPACK of prospective mathematics teacher students.

Research methods. The development model used is the ADDIE model. The stages of model development are Analyze, consist of analyzing objectives and competencies, and analyzing instructional; Design, consist of compiling a conceptual framework for the ethnodigital microteaching model; Development, consist of validation of the ethnodigital microteaching model, Implementation, consist of conducting a trial, and Evaluation, namely evaluating the achievement and feasibility of model development. Data collection techniques in this study are as follows: observation, questionnaire response sheets from prospective teacher students, readability trials, and tests. Data analysis in this study are as follows: analysis of learning device validation, practicality, and effectiveness tests.

Results. With the results of this study, it is expected that it can be implemented by prospective teacher students more widely by using the ethnodigital microteaching learning model so that it can provide contextual-based knowledge of students' TPACK abilities. The syntax of this learning model is 1) identifying learning devices used about the learning process and materials in accordance with the culture of local cultural wisdom (ethnomathematics), 2) exploring the use of devices according to the design virtually and in real terms, 3) implementing devices in the implementation of learning, and 4) communicating learning materials with virtual web-based methods and technologies. The ethno-digital microteaching learning model has several significant advantages, namely the integration of local culture, dual approach (virtual and real), development of TPACK skills, improvement of communication skills, realistic learning environment, flexibility and accessibility, and collaboration and interaction.

The results of the development of the lesson plan that has been prepared have an average total validity value of 96.16. The results of the development of the student worksheet that has been prepared have an average total validity value of 94.61. The results of the development of the virtual laboratory that has been prepared have an average total validity value of 91.93. The results of the practicality assessment of the developed learning devices, namely the lesson plan of 94.25 with a very practical category, student worksheets of 93 with a very practical category, and formative tests of 90.25 with a very practical category, and virtual laboratories of 93.25 with a practical category. Based on the results of the N-gain score test calculation, it shows that the average N-gain score value of the ethnodigital microteaching learning model is 79.7% and is included in the effective category. With a minimum N-gain score value of 64.29% and a maximum of 92.86%.

Conclusion. Based on the results and discussion above, this study produces learning devices consisting of lesson implementation plans, student worksheets, and formative tests using the ethnodigital microteaching learning model that meets the criteria of valid, practical, and effective. The designed learning devices can be used to improve the TPACK abilities of prospective teacher students.

KEYWORDS

ethnodigital microteaching, virtual and real laboratory, TPACK, prospective teacher students, teacher competence

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INTRODUCTION

Teacher professionalism has at least four competencies including pedagogical, personality, social, and professional. In 2020, the teacher competency model includes professional knowledge, professional learning practices, and professional development. However, besides these competency factors, other factors are challenges for teachers, such as the rapid growth of information technology [1]. The low competence of teachers is one of the hot topics of discussion in education problems in Indonesia [2]. This also can be seen from several previous studies, there are 34.95% of elementary, middle, and high school educators who are less proficient in technology [3]. There are 54.2% of high school educators who use whiteboards as learning media, 33.3% use PowerPoint, and 12.5% use interactive applications [4]. Integration of knowledge about technology by teachers into learning needs to be done to improve their competence in facing technological advances, in this case, the abilities in question are Technological Pedagogical Content Knowledge (TPACK).

TPACK is a theoretical framework that describes the components of effective technological integration in teaching and learning activities [5; 6]. TPACK is a framework that introduces the relationships and complexities between the three basic components of knowledge (technology, pedagogy, and content) [7; 8]. TPACK strategic thinking includes knowing when, where, and how to use domain-specific knowledge and strategies for guiding students' learning with appropriate information and communication technologies [7]. TPACK framework can also provide theoretical guidance for how teacher education programs might approach training candidates who can use technology in specific as well as general ways [8]. TPACK model plays a leading role in teachers' needs about technology, pedagogy and content to ensure professional development of teachers [9]. TPACK knowledge must be prepared early on to form professional teachers in carrying out their duties. Before becoming professional teachers, prospective teacher students must be equipped with TPACK knowledge through microteaching learning.

Microteaching is one of the courses that can be used as a forum for prospective teachers to apply the knowledge they have learned [10]. Microteaching is a means to train teaching practices in the classroom for prospective teacher students in a small scheme to prepare students before carrying out real teaching practices in schools [11]. Microteaching is expected to provide basic skills for teaching [12]. Microteaching can be expected to be one of the means in developing TPACK for prospective teacher students to prepare themselves to become professional teachers. However, there are problems in the implementation of microteaching, such as the lack of ability to formulate lesson plans which make teaching practices in the classroom difficult. Therefore, it is important to develop a model that can offer a relatively realistic environment that allows students to interact with students in real, virtual, and inclusive ways.

The need for a development model to improve the TPACK skills of prospective teacher students in developing their competencies. The development carried out in this model is the use of ethnomathematics and technology in microteaching. In addition, in its implementation using virtual and real laboratories. Development of an innovative micro-learning model for improving the pedagogical competence of prospective teachers [13]. Microteaching learning model using the core teaching standard model that refers to constructivist learning [14]. Development of a microteaching learning model based on experiential learning through the role of models and groups to improve teaching skills [15]. Microteaching activity model to develop student-centred mathematics learning skills [16]. Virtual microteaching with all its stages can be used as an alternative in improving the teaching skills of prospective teachers [17]. The use of google classroom for virtual microteaching classes has weaknesses such as the lack of video meeting features and notification of internet signal problems [18]. Research to be conducted is research development of an ethnodigital microteaching model through virtual and real laboratories to improve the TPACK of prospective mathematics teacher students.

The problem-solving approach in improving TPACK skills is the ethnodigital microteaching learning model through a virtual laboratory The syntax of this learning model is 1) identifying learning devices used about the process and learning materials by the culture of local cultural wisdom (ethnomathematics), 2) exploring the use of devices according to the design virtually and in real terms, 3) implementing devices in the implementation of learning, and 4) communicating learning materials with appropriate methods and technologies. Those several learning steps are integrated by using virtual web-based technology to make it easier for students to develop devices and offer a relatively realistic environment that interacts virtually.

The learning design approach has provided a new perspective for the design and implementation of learning environments, which are in line with the changing times. There are various strategies, approaches, methods, frameworks, and models for developing teaching [19; 20]. The use of technology in virtual laboratories offers another opportunity to expose prospective teachers to more realistic contexts for practicing learning. Synchronous virtual classrooms are commonly known as web conferencing systems or e-conferencing [21].

The ethnodigital microteaching learning model has several significant advantages, especially in the context of improving TPACK skills. Here are some of the advantages: 1) Integration of local culture, by incorporating ethnomathematics elements, this model helps students understand the material through the context of local culture, which can increase relevance and engagement in learning. 2) Dual approach (virtual and real), by combining virtual and real laboratories, this model provides flexibility in learning. Students can access learning resources and tools anytime and anywhere through a virtual platform, while real laboratories allow for direct practice. 3) Development of TPACK skills, this model is explicitly designed to improve TPACK skills by emphasizing the integration of technology in learning. Students learn to design, implement, and evaluate learning tools that effectively combine technology. 4) Improvement of communication skills, the process of communicating learning materials with appropriate methods and technologies helps students improve their communication skills, which are important in the ever-evolving world of education. 5) Realistic learning environment, the use of virtual web-based technology offers a relatively realistic learning environment. This allows for deeper and more authentic interactions, which can increase student understanding and engagement. 6) Flexibility and accessibility, with the virtual component, students have easier and more flexible access to learn and practice, which is very beneficial for those who have time or location constraints. 7) Collaboration and interaction, this model encourages collaboration between students through a virtual platform, allowing them to work together and share their knowledge and experiences more effectively. With these advantages, the ethnodigital microteaching learning model can be a very effective tool in improving students' TPACK skills.

Several studies have examined micro-learning to improve the pedagogical competence of prospective teachers, micro-development with core teaching standard models based on experiential learning, as well as the use of google classroom [22] for virtual microteaching classes [17]. However, no one has focused on studying the development of ethnodigital microteaching models through virtual laboratories. Therefore, the purpose of this research is to develop an ethnodigital microteaching learning model through a virtual laboratory to improve the TPACK of prospective mathematics teacher students. The purpose of this study is to describe the development of an ethnodigital microteaching learning model through a virtual laboratory in improving the TPACK of prospective mathematics teacher students that meets the criteria of valid, practical, and effective.

METHODS

In this study, the development model used is the ADDIE model. The ADDIE model is an acronym for Analysis, Design, Development, Implementation, and Evaluation. The reason for using this model is that it is suitable for the current conditions. The ADDIE model can adapt very well to various current conditions [23]. In addition, there are revisions at each stage, so it is suitable for valid, practical, and effective development [24]. This research was conducted at the University of Madura with research subjects of 10 mathematics students who are taking microteaching courses. Of the 10 students, 2 students will become practitioners (teachers) and the rest will be students in the implementation of microteaching. For each implementation of microteaching by practitioners, there is one research team or lecturer from the mathematics education study program as an observer whose job is to provide assessments and comments on the implementation of learning carried out, especially regarding student TPACK which in this case focuses on basic teaching skills.

The stages of developing this model are (1) Analyze, namely analyzing the objectives and competencies, characteristics, and learners and analyzing instruction; (2) Design, namely compiling the content framework, learning materials, compiling instruments and achievement systematics; compiling the conceptual framework of the ethnodigital microteaching model; (3) Development, namely validating the ethnodigital microteaching model and teaching materials and revising the design; (4) Implementation, namely conducting trials and implementation; (5) Evaluation, namely evaluating the achievement, feedback, and feasibility of model development.

Data collection techniques in this study are as follows: 1) Observations were conducted to collect data on the TPACK of prospective students during teaching and learning activities and to determine the validity of the developed learning models and devices. The instrument used in this activity was an observation sheet containing learning activities starting from the introduction, core activities, and closing. In the observation sheet, the observed aspects focused on basic teaching skills. The observation sheet was used to obtain data on the activities of prospective teacher students in managing learning and the use of basic teaching skills aspects. This activity was carried out during the learning process and observations were made by two observers from the lecturer. Furthermore, the learning device was validated using a validation sheet. The validation sheet indicators for the learning device were aspects of format, content, and illustration. The validation sheet indicators for the virtual lab microteaching were user-friendliness, attractiveness of appearance, language, and readability.

Furthermore, the instrument used is a questionnaire response sheet from prospective teacher students, to find out the responses as well as a basis for finding out the practicality of the devices that have been developed. In addition, a readability test will be carried out to determine the level of readability in the development carried out. The indicators of the practicality sheet for learning devices and virtual micro are ease of use, attractiveness, and efficiency. Next, the test instrument, the test used in this study is a test that measures the TPACK abilities of prospective teacher students both in the experimental class (ethnodigital class) that uses virtual laboratories and control classes that use regular learning. To find out the effectiveness of the models and devices that have been developed.

Data analysis in this study is as follows: a validation analysis of learning devices, practicality, and effectiveness tests. This validity test is obtained from the results of the validation of lesson plan, student worksheets, and test questions by the validator. The aspects assessed in the lesson plan are the aspects of format, content, and language used in the learning device. The aspects assessed by the validator are the aspects of format and completeness of components, aspects of material and learning, and aspects of language. The learning device was validated by expert validators consisting of 2 lecturers of mathematics education and 2 expert lecturers in the field of informatics engineering. Analysis of the validity of the learning device [25] using the following analysis

$$\textit{Validation Score} = (\textit{Statement item score}) / (\textit{Highest score of statement item}) \times 100\%$$

Table 1

Classification of Validity Assessment Aspects

Percentage (%)	Classification
90 – 100	Very Valid
80 – 89	Valid
65 – 79	Quite Valid
55 – 64	Less Valid
≤ 55	Invalid

Furthermore, the analysis of the practicality of the learning device by analyzing the results of student responses. The practicality analysis used is adapted from Akbar [26] using the following formula.

Practical score = (Statement item score) / (Highest score of statement item) x 100%

Table 2

Classification of Aspects of Practicality Assessment

Percentage (%)	Classification
90 – 100	Very Practical
80 – 89	Practical
65 – 79	Quite Practical
55 – 64	Less Practical
≤ 55	Not Practical

The analysis of the effectiveness of the learning model was carried out using test result data. The value data obtained was then analyzed by calculating N-gain to determine the increase in students' TPACK which was then used for hypothesis testing [27].

NGain = (Posttest Score-Pretest Score) / (Ideal Score-Pretest Score)

Table 3

Interpretation Categories of N-gain Effectiveness

Percentage (%)	Interpretation
> 76	Effective
56 – 75	Quite Effective
40 – 55	Less Effective
< 40	Ineffective
≤ 55	Not Practical

RESULTS

The purpose of this study is to describe the development of an ethnodigital microteaching learning model through a virtual laboratory in improving the TPACK of prospective mathematics teacher students who meet the criteria of valid, practical, and effective. The following are the results of the development of an ethnodigital microteaching learning model based on the ADDIE stages.

Analysis

This activity analyzes the objectives, competencies, and characteristics of students and analyzes teaching. Two learning objectives are the focus of this activity, in general regarding student literacy and numeracy. 1) After going through a literature study (discourse) on teaching materials, students can determine and identify the meaning and terms in arithmetic sequences (literacy). 2) By analyzing images, students can determine the difference of arithmetic sequences and series to solve real problems and find new problems (numeracy). 3) Through the provision of LKPD, students can solve solutions to contextual problems related to arithmetic sequences and series (numeracy). Furthermore, the basic competencies targeted are 1) analyzing arithmetic sequences and series, and 2) solving contextual problems related to arithmetic sequences and series.

The goal is to deeply understand what users and educational institutions need to create an effective virtual microteaching laboratory. 1) Users, 2) Definition of learning objectives: learning skills that need to be developed and assessment and feedback methods, 3) Analysis of technical features, capacity, and limitations of the Spatial.io platform, 4) Instructional design, 5) Scalability and future development, 6) Definition of success criteria, and 7) Documentation of needs. In detail as in Table 4 below.

Table 4

Analysis of virtual needs for microteaching laboratories

No	The needs analysis of virtual lab	Description
1	Users	- Microteaching lecturer/instructor - Student prospective teachers - Technical support team
2	Definition of Learning Objectives	- Learning skills that need to be developed - Assessment and feedback methods
3	Technical Features Analysis	- Spatial.io platform capacities and limitations - Hardware, software, and network requirements
4	Instructional Design	- Simulated teaching scenarios - Methods of interaction in virtual environments - Tools, objects, or resources needed in virtual space
5	Scalability and future development	- Ability to add new features or capabilities - Potential integration with existing learning management systems
6	Definition of Success Criteria	- Metrics to measure application effectiveness - Key performance indicators (KPIs) for evaluation
7	Documentation Requirements	Preparation of requirements specification documents - Creation of use cases and user scenarios

Design

This stage consists of preparing the content framework, and learning materials, instruments, and achievement systematics, preparing the conceptual framework of the ethnodigital microteaching model. Preparation of the content framework and learning materials based on ethnodigital microteaching learning. The syntax design of the ethnodigital microteaching learning model through a virtual laboratory are as follows.

Table 5

Syntax design of the ethnodigital microteaching learning model through virtual laboratory

No	Syntax	Virtual Laboratory Learning Activities
1	Identifying	a. Identifying learning tools used regarding the use of information technology, learning processes, and materials by local cultural wisdom (ethnomathematics) [28; 29].
2	Exploring	b. Designing learning devices with technology media that are adapted to virtual learning methods and materials [21]. c. Compiling and exploring learning tools according to designs made by paying attention to facts, concepts, theories, and procedures.
3	Applying	d. Designing learning devices that are studied and arranged by existing virtual culture [18]. e. Implementing devices in virtual learning implementation.
4	Communicating	f. Communicating learning materials using virtual methods g. Conducting virtual assessments and reflections [30] h. Asking for learning feedback virtually

In this study, the learning tools designed include learning implementation plans, student worksheets, and formative learning tests as follows.

a. The learning implementation plan is designed with a learning model from the acronym identify, explore, apply, and communicate. The learning implementation plan contains the identity of the learning implementation plan, basic competencies, learning objectives, media and learning models, learning steps, and assessments. The identity of the learning implementation plan consists of the name of the school, class, semester, material, and time allocation. In addition, there is ethnomathematics content in the designed learning implementation plan. In the learning implementation plan, the material can be through the local cultural context (ethnomathematics) [31; 32] at the identifying syntax stage, as in Table 6 below.

Table 6

Syntax of the Ethnodigital Microteaching Learning Model

No	Syntax	Virtual Laboratory Learning Activities
1	Identifying	a. The teacher asks students to identify images related to the material on arithmetic sequences & series in everyday life.   b. The teacher asks students to create questions related to figures 1 and 2 by giving them lead questions so that the students ' questions do not become too broad (numeracy). For example: • In figures 1 and 2, is there anything unique that you got? • In figures 1 and 2, what information can you get? • In figures 1 and 2, can you determine the arithmetic sequence pattern in the figure?
2	Exploring	a. Students plan possible answers to questions that have been created by reading the material and example questions in the teaching materials. b. Students create new arithmetic sequences and series based on arithmetic sequences they discover themselves based on the problems they encounter. c. Teachers use the Quizizz application as a tool for students to work on questions.
3	Applying	a. Teachers distribute LKPD for students which can be accessed via the Quizizz application. b. Students work on questions on the LKPD using the Quizizz application in groups.
4	Communicating	a. Students present LKPD and group discussions (numeracy). b. The teacher and students conclude the concept of arithmetic sequences and series from the results of the image analysis and answers to the questions in the LKPD. c. Teachers and students formulate principles and generalizations of the results of their findings, including making conclusions. d. How to solve the solution of contextual problems related to arithmetic sequences. e. The teacher together with the students identifies the strengths and weaknesses of learning activities by identifying the difficulties experienced by the students, answering questions with information obtained by showing what is written in the book.

b. The student worksheet is designed with number pattern material. There are 3 problems given in the LKPD with each problem themed on ethnomathematics [32], one of which is about traditional houses, as in figure 1. Houses can be used as one example of problems in student worksheets [31]. These student worksheets must be done individually followed by group discussions.

c. The preparation of formative tests to determine students' understanding of the material given. Before the implementation of the formative test, students are given teaching materials to support students' understanding.

Problem 3:

Krong Bade is a traditional Acehnese house. In this traditional building, there are quite high supporting pillars to avoid attacks by wild animals and floods. For a traditional house with 3 rooms, there are usually 16 supporting pillars. While for 5 rooms, there are 24 supporting pillars. If the total number of rooms is 9, then how many supporting pillars are needed?

Figure 1 One of the problems in designing student worksheets

In addition, at this stage microteaching learning is designed using unity and spatial.io. Virtual microteaching learning is a subject doing virtual learning in a microteaching class with an ethnodigital microteaching learning model. The integration of ethnomathematics into the virtual is like figure 2.

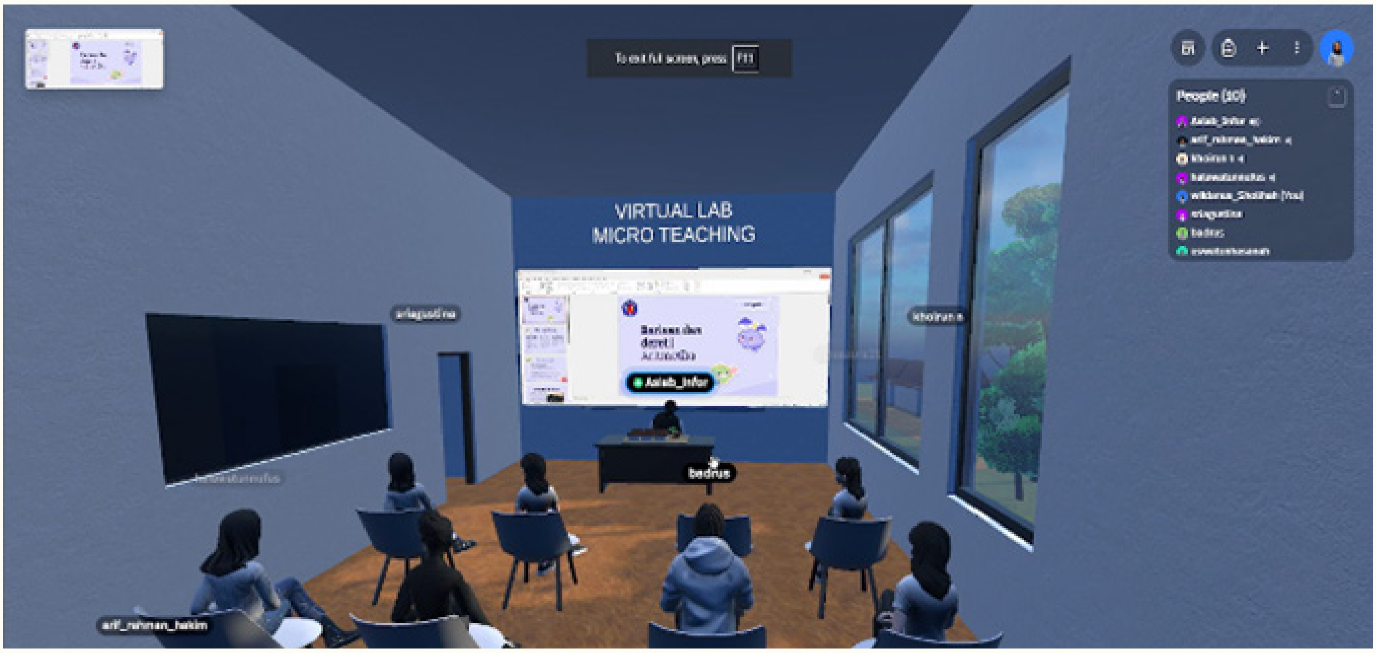


Figure 2 Virtual lab microteaching

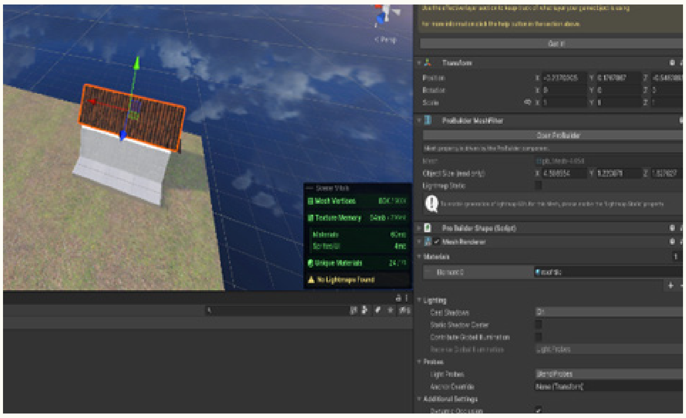
Development

This development stage is the validation of the ethnodigital microteaching model and teaching materials and design revision.

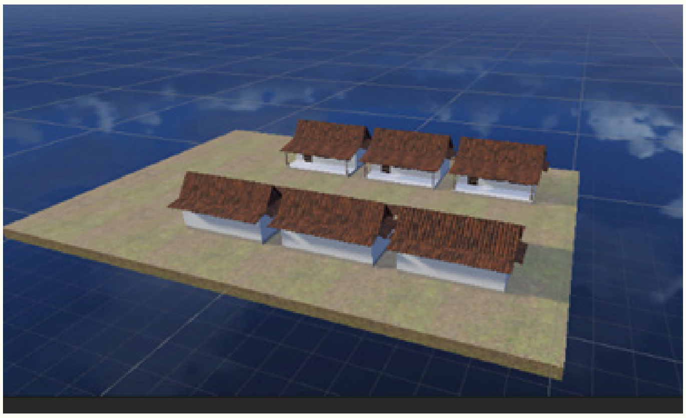
Validation

The purpose of this stage is to produce a draft of a revised mathematics learning tool based on input from experts, readability tests, and data obtained from trial results.

3D Content Development of Miniature Tanean Lanjeng Houses (ethnomathematics)



(a)



(b)

Figure 3 Tanean Lanjeng miniature design (a)

a. Lesson plan

The results of the development of the learning implementation plan that has been prepared have an average total validity value of 96.16. This shows that the learning implementation plan is valid by fulfilling the "Valid" category. It proves that the learning implementation plan is declared valid and can be used [29]. This can be seen in Table 7.

Table 7

Results of validity testing by experts

No	Rated aspect	Validity Value	Criteria
1	Format	95	Very Valid
2	Contents	96	Very Valid
3	Illustration	97,5	Very Valid
		96,16	Very Valid

Based on the assessment of the two validators, it can be concluded that this learning implementation plan has a "Good" category and can be used with a few revisions. One of the things that need to be revised is 1) The planned time allocation is adjusted to the activities carried out, 2) Based on the syntax design of the learning model, in the syntax of exploring there are learning activities to design/explore learning devices with technology [33; 34], it should be shown in the learning implementation plan at that stage as in the following table.

b. Student Worksheet

The results of the development of the student worksheet that has been prepared have an average total validity value of 94.61. This shows that the student worksheet is valid by fulfilling the "Valid" category. Based on the assessment of the two validators, it can be concluded that this student worksheet has a "Good" category and can be used with minor revisions.

Test in this development has been valid with the category "valid". In addition, the assessment of the language and writing components of the test has been understood with the category "can be understood". However, validator 1 advised on question number 1 because 2 questions should be made in points a and b, to make it easier for students to understand the test.

Table 8

Validation of learning implementation plan

Before Revision	After Revision
Stage 2: Exploration c. Students plan possible answers to questions that have been made by reading the material and sample questions in the teaching materials (attached). d. Students create new arithmetic sequences and series based on arithmetic sequences that they themselves find based on the problems they find	**Stage 2: Exploration** c. Students plan possible answers to questions that have been made by reading the material and example questions in the teaching materials (attached) d. Students create new arithmetic sequences and series based on arithmetic sequences that they themselves find based on the problems they find e. The teacher uses the quizizz application as a tool for students to work on questions
Stage 3: Application e. The teacher distributes the LKPD (attached) to the students f. The students work on the questions on the LKPD	**Stage 3: Application** f. The teacher distributes LKPD to students which can be accessed via the quizizz application g. Students work on the questions on the LKPD via the quizizz application in groups

Table 9

Results of validity testing by experts

No	Rated aspect	Validity Value	Criteria
1	Format	95,71	Very Valid
2	Language	95	Very Valid
3	Illustration	94	Very Valid
4	Contents	93,75	Very Valid
		94,61	Very Valid

c. Virtual laboratory

The results of the development of the virtual laboratory that has been prepared have an average total validity value of 91.93. This shows that the virtual laboratory has been validated by fulfilling the "Valid" category. Based on the assessment of the two validators, it can be concluded that this virtual laboratory has a "Good" category and can be used [32].

Table 10

Results of validity testing by technology experts

No	Rated aspect	Validity Value	Criteria
1	User convenience	93,75	Very Valid
2	Appealing appearance	92	Very Valid
3	Language	89	Valid
4	Legibility	90	Very Valid
		91,93	Very Valid

Practicality Analysis Results

The questionnaire response sheet from prospective teacher students, to know the responses as well as a basis for knowing the practicality of the devices that have been developed. The results of the practicality assessment of the developed learning devices, namely the Learning Implementation Plan, Student Worksheets, and Formative Tests, are as in the following table.

Table 11

Results of the analysis of the practicality of learning devices

No	Learning Tools	Rated aspect	Validity Value	Criteria
1	Lesson Plan	Ease of use	95	Very practical
		Attractiveness	94	Very practical
		Efficiency	93,75	Practical
2	Student Worksheet	Ease of use	94	Very practical
		Attractiveness	93	Very practical
		Efficiency	92	Very practical
3	Formative Test	Ease of use	88	Practical
		Attractiveness	93,75	Very practical
		Efficiency	89	Practical
4	Virtual laboratory	Ease of use	93,75	Very practical
		Attractiveness	92	Very practical
		Efficiency	94	Very practical

Based on Table 11, it can be concluded that overall the validator's assessment of the learning implementation plan, student worksheets, formative tests, and virtual laboratories states that they can be used [35] with few or no revision so that the learning tools can be said to be "practical".

Implementation

The trial at this implementation stage is to analyze students' TPACK abilities with the ethnodigital microteaching learning model through a virtual laboratory. Ordinary microteaching learning is where the subject carries out learning normally in a microteaching class using a lecture learning model which in this case is called the control class. Virtual microteaching learning is where the subject carries out learning virtually in a microteaching class with an ethnodigital microteaching learning model which in this case is called the experimental class.

Figure 4 Ethnodigital microteaching learning through virtual lab (experiment class)

Figure 5 Regular microteaching learning (conrol class)

Evaluation

At this stage, the evaluation of the achievement in the development is carried out. After the implementation stage of students carrying out ethnodigital microteaching learning through virtual and real laboratories, then a TPACK understanding test was given. The test used in this study was a test measuring the TPACK abilities of prospective teacher students both in the experimental class (ethnodigital microteaching) and the control class (regular learning). Then, it was analyzed using the N-gain score test, the following are the results of the analysis.

Table 12

Descriptives N-gain score analysis for experiment and control class

Descriptives					
	Class			Statistic	Std. Error
N-gain persen	Experiment	Mean		79.7032	2.39482
		95% Confidence Interval for Mean	Lower Bound	74.3672	
			Upper Bound	85.0392	
		5% Trimmed Mean		79.8290	
		Median		80.0000	
		Variance		63.087	
		Std. Deviation		7.94271	
		Minimum		64.29	
		Maximum		92.86	
		Range		28.57	
		Interquartile Range		12.38	
		Skewness		-.277	.661
		Kurtosis		.230	1.279
	Control	Mean		29.5066	3.40377
		95% Confidence Interval for Mean	Lower Bound	21.9225	
			Upper Bound	37.0906	
		5% Trimmed Mean		28.7829	
		Median		27.7778	

		Variance	127.442	
		Std. Deviation	11.28904	
		Minimum	15.79	
		Maximum	56.25	
		Range	40.46	
		Interquartile Range	6.25	
		Skewness	1.338	.661
		Kurtosis	2.537	1.279

Table 13

Descriptives N-gain analysis

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
N-gain score	22	.16	.93	.5460	.27398
N-gain persen	22	15.79	92.86	54.6049	27.39800
Valid N (listwise)	22				

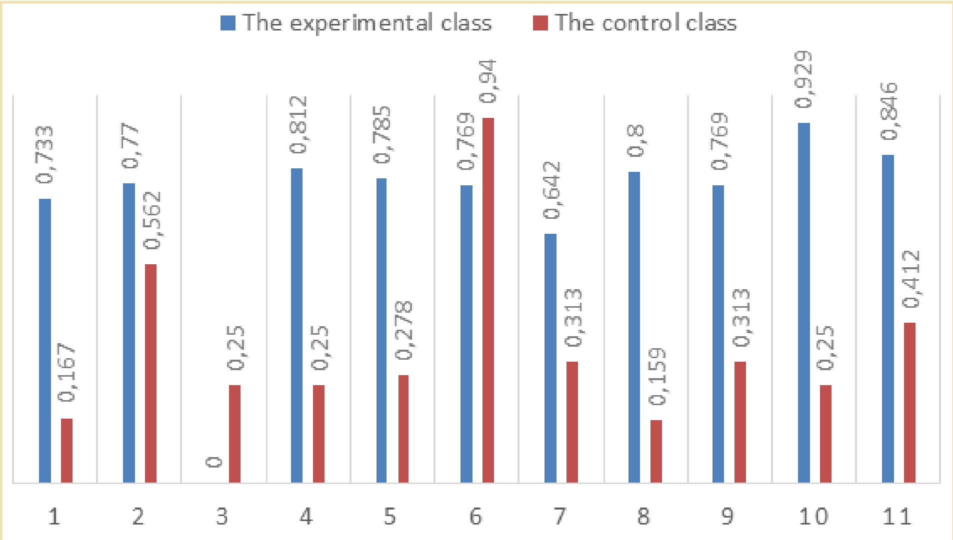


Figure 6 N-gain score results

DISCUSSION

The learning tools that have been developed pay attention to the diversity of diverse mathematical abilities. This is in line with the results of the development carried out [28; 29] which considers the characteristics of the students who are taught are students who have diverse mathematical abilities. In addition, needs analysis was conducted as an early and critical stage in the development of the application [36]. Some of the pages that were analysed were users, definition of learning objectives, analysis of technical features, instructional design, scalability and future development, definition of success criteria, and documentation of needs. In addition, this device contains ethnomathematics content in the designed lesson plan. Other research states that ethnomathematics can be integrated into lesson plans [37; 38]. In the lesson plan, the material can be through the context of local culture (ethnomathematics) [31; 32].

Furthermore, the results of the expert test in Table 10 that user-friendliness, attractiveness of appearance, language, readability are declared valid. Other research [39] states that content criteria, user-friendliness, and readability have the most influence on satisfaction followed by user interface design, performance and effectiveness as well as navigation and links. In addition, the use of technology in learning tools can help with the quality of teaching practice. This is also in line with [40]improving the quality of teaching practice through building virtual learning communities. With technology, it can provide a viable alternative to bring classroom realism for prospective teachers to practice teaching skills [41].

Practicality Analysis Results Based on Table 11, it shows that it is included in the practical category. It can be said that the learning tools produced are easy to use, have attractiveness and have efficiency. This is in accordance with [42] the research conducted that learning tools including media must be easy to operate, the instructions are easy to understand, interactive, interesting, and in accordance with the learning topic.

Based on the results of the N-gain score test calculation, it shows that the average N-gain score value of the ethnodigital microteaching learning model is 79.7% and is included in the effective category. With a minimum N-gain score value of 64.29% and a maximum of 92.86%. Therefore, it can be concluded that the use of ethnodigital microteaching learning model is effective in improving the TPACK ability of prospective teacher students. In addition, students understand the basic teaching and professional skills [43] needed in actual learning in educational units. In addition, with the use of virtual microteaching, students know the utilisation of technology used as support in the implementation of learning [41; 44]. This is in accordance with the knowledge of the utilisation of technology used as a support in the implementation of learning by students [45]. In addition, the use of a project-based scaffolding TPACK model to improve the learning design skills and TPACK of prospective teachers [46; 47]. In general, the findings in the study are the use of virtual laboratories with ethnodigital microteaching learning models can improve the TPACK skills of prospective teacher students.

The use of virtual laboratory with ethnodigital microteaching learning model has several positive impacts on improving TPACK skills in student teachers in a holistic way, integrating aspects of technology, pedagogy, and content with deeper cultural awareness. Student teachers are expected to become more proficient in using technology in the learning process by practising the integration of technology into teaching materials. This model helps prospective teachers understand how to deliver materials contextually according to a more culturally relevant approach for students. In addition, through this simulation, prospective teachers can try out various teaching scenarios without physical restrictions. It also allows for quick and iterative feedback in the microteaching process, which accelerates the improvement of TPACK abilities. In addition, this model provides an opportunity for self-improvement through analysing the way of teaching, the use of technology, and cultural approaches to learning.

CONCLUSION

Based on the results and discussion above, this study produces learning devices consisting of lesson implementation plans, student worksheets, and formative tests using the ethnodigital microteaching learning model that meets the criteria of valid, practical, and effective. The designed learning devices can be used to improve the TPACK abilities of prospective teacher students.

With the results of this study, it is hoped that it can be implemented by prospective teacher students more widely using the ethnodigital microteaching learning model so that it can provide contextual-based knowledge in students' TPACK abilities. In addition, virtual laboratory technology can provide a viable alternative to present real learning for prospective teachers to practice teaching skills virtually.

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