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Development of Ethnomathematics-based Hybrid Learning Model Using a Cybergogy Approach to Improve Mathematical Proficiency of Prospective Elementary School Teachers

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Abstract

This study aims to develop a hybrid learning model based on ethnomathematics with a cybergogy approach to improve mathematical proficiency of prospective elementary school teachers. This study is an R & D (Research and Development) study using the Plomp model (preliminary research stage, development or prototyping stage, and assessment stage). In data collection, researchers used questionnaires, observations, and tests. Based on the validation results by learning design experts, material experts, and practitioners, the learning model developed meets the criteria of being very feasible. Based on the results of observations of the implementation of lectures, both lecturer and student activities and lecturer and student responses, the learning model developed meets the criteria of being practical. And based on the results of limited trials and expanded trials, it shows that there is a significant difference in the average score of mathematical proficiency of prospective elementary school teachers between those who receive learning with a hybrid learning model based on ethnomathematics ($\bar{x}$ = 84) with the average score of mathematical proficiency of prospective elementary school teachers who receive expository learning ($\bar{x}$ = 75). So, it can be concluded that the hybrid learning model based on ethnomathematics with a cybergogy approach meets the criteria of being feasible, practical, and effective. The implications of the research results indicate that the application of a hybrid learning model based on ethnomathematics with a cybergogy approach can have a positive impact on improving the mathematical proficiency of prospective elementary school teachers in mathematics learning.

Keywords: *hybrid learning model, ethnomathematics, cybergogy approach*.

Abstrak

Penelitian ini bertujuan untuk mengembangkan model pembelajaran hybrid berbasis etnomatematika dengan pendekatan cybergogy untuk meningkatkan kecakapan matematika calon guru sekolah dasar. Penelitian ini merupakan penelitian R & D (Research and Development) dengan menggunakan model Plomp (tahap penelitian pendahuluan, tahap pengembangan atau prototyping, dan tahap asesmen). Dalam pengumpulan data, peneliti menggunakan angket, observasi, dan tes. Berdasarkan hasil validasi oleh ahli desain pembelajaran, ahli materi, dan praktisi, model pembelajaran yang dikembangkan memenuhi kriteria sangat layak. Berdasarkan hasil observasi pelaksanaan perkuliahan, baik aktivitas dosen maupun mahasiswa serta respon dosen dan mahasiswa, model pembelajaran yang dikembangkan memenuhi kriteria praktis. Dan berdasarkan hasil uji coba terbatas dan uji coba diperluas menunjukkan bahwa terdapat perbedaan yang signifikan skor rata-rata kecakapan matematika calon guru sekolah dasar antara yang mendapatkan pembelajaran dengan model pembelajaran hybrid berbasis etnomatematika ($\bar{x}$ = 84) dengan skor rata-rata kecakapan matematika calon guru sekolah dasar yang mendapatkan pembelajaran ekspositori ($\bar{x}$ = 75). Sehingga dapat disimpulkan bahwa model pembelajaran hybrid berbasis etnomatematika dengan pendekatan cybergogy memenuhi kriteria layak, praktis, dan efektif. Implikasi hasil penelitian menunjukkan bahwa penerapan model pembelajaran hybrid berbasis etnomatematika dengan pendekatan cybergogy dapat memberikan dampak positif terhadap peningkatan kecakapan matematika calon guru sekolah dasar dalam pembelajaran matematika.

Kata kunci: *model pembelajaran hybrid, etnomatematika, pendekatan cybergogy*.

INTRODUCTION

The cybergogy approach paradigm is oriented towards learning that meets 21st-century skills, namely life skills, learning and innovation skills, as well as media and information utilization skills. Cybergogy has even been applied to intelligence in rural areas (Malek & Tahir, 2018). This new technology can create meaningful learning because it supports interaction, elegant, representative, and integrated displays; interactive simulations; communication via networks; text support; and storing and presenting the required information because it encourages meaningful learning in all subjects (Ashburn & Floden, 2006; Ghavifekr, 2021; Gultom & Suhartini, 2021).

The concept of the cybergogy approach is an online learning environment that includes three important interrelated factors or domains, namely the cognitive domain, the emotional dimension, and the social dimension (Musthofa & Fauzi, 2021; Heong et al., 2021; Asad & Malik, 2023). The theoretical concept of cybergogy learning will involve someone actively in the online learning process so that it trains someone in which there is cognitive, emotional, and social integration of that person in the relevant learning process (Wang & Kang, 2008). The cybergogy approach leverages digital technology to create a more interactive and flexible learning experience. By combining blended and face-to-face learning, students can learn in a way that suits their learning style.

A learning environment that includes multiple dimensions and variations, such as real environments and virtual environments, will lead to student involvement in getting varied learning experiences. Wang and Kang (2008) stated that student involvement is varied and multidimensional, such as doing assignments, independent learning, the growth of intrinsic motivation from knowledge, the learning environment, and learning outcomes as three important domains of the cybergogy concept, which involves students engaging in cognitive, emotional, and social activation.

Ethnomathematics integrates local culture into mathematics learning, making the material more relevant and meaningful to students. This can increase student motivation and engagement. Amidst technological developments with cybergogy approaches and changes in learning methods, the development of this model allows educational institutions to be more adaptive and responsive to the needs of students and society. However, based on the results of previous studies, students continue to experience difficulties in understanding mathematical concepts (Sartika, 2018; Maghfiroh, 2020; & Mayasari & Habeahan, 2021). According to Erfani et al. (2020), this is caused by students who cannot memorize or remember formulas to solve problems. In addition, they failed to link math sentences to the problem, so they couldn't apply what they knew in the problem. In addition, students do not re-examine the steps taken to complete the plan. However, the results of research by Izzati, Sholikhakh and Suwandono (2016) show that even though students' understanding of mathematical concepts is very low, their independence is considered good. Thus, there is no significant relationship between students' understanding of mathematical concepts and their independence during the learning process. Innovation in learning mathematics that uses technology is needed because of these problems. One of the innovations in learning mathematics using technology is the hybrid learning model based on ethnomathematics.

Hybrid learning is a combination of face-to-face learning in class with learning using computers offline and online (Dwiyogo, 2018; Al-Ataby, 2021). A hybrid learning model can also be defined as combining classroom learning with online learning using currently available technology. Meanwhile, ethnomathematics as a perspective can help elementary school teacher education students as prospective teachers understand the relationship between mathematics and culture and how this impacts mathematics learning (D'Ambrosio, 1985; Pais, 2013; Fendrik, Marsigit, & Wangid, 2020; Anriana et al., 2023). Not all mathematical materials can be directly packaged in the form of ethnomathematics, but most mathematical concepts can be linked to the cultural context, traditions, and practices of community life.

Ethnomathematics is the study of the relationship between mathematics and culture, where various mathematical concepts and principles are discovered or applied in a particular cultural context. Ethnomathematics can bridge cultural education and mathematics education (Adam, 2004; Zhang & Zhang, 2010; Trisnani & Utami, 2021; Fendrik, Andhi, & Nurdiansyah, 2023). Ethnomathematics is still a new research discipline in the field of mathematics education and has enormous potential to be developed into a learning innovation that introduces various cultures through a hybrid learning model and a cybergogy approach as a technology that can be used by students to improve their mathematical competence. Along with the demands of changing times, the use of technology in the world of education is a necessity for progress and convenience in the world of education (Haryanto, 2015; Sudarsana, 2019).

Information and communication technology (ICT) is one innovation that can be applied in the learning process. Septianisha (2021) said that learning mathematics via the internet has many benefits for students, one of which is that it makes it easier for them to learn mathematics. This is due to the fact that this approach emphasizes the use of technology, which allows mathematics learning materials to be packaged in various forms and media, such as textbooks and interactive video animations. At its maximum, the use of information technology can make learning fun and interesting. It can also break the belief that mathematics is complicated and difficult. Mathematics learning in new forms such as games, puzzles, and interesting animated videos can be used in a hybrid model that uses a cybergogy approach. Applications such as WhatsApp, Google Classroom, e-learning applications, online campus websites, Zoom, Webex, Google Meet, and others can enable a hybrid learning model that involves independent and structured assignments. Based on the results of previous research, there is no use of an ethnomathematics-based hybrid learning model at the elementary school level that can help understand mathematical concepts and independence in student learning processes. Therefore, this study aims to develop an ethnomathematics-based hybrid learning model with a cybergogy approach.

METHODS

This study is a type of research and development. In this research, the development model used is the Plomp model (2013), which establishes three phases of development research: preliminary research, development or prototyping, and assessment. The two types of data collected are quantitative and qualitative. Quantitative data comes from instrument validation, observations of model implementation, mathematical ability tests, and student and teacher responses to the practice of the models developed. Qualitative data comes from input and suggestions from validators regarding the practice and validity of the models developed, document analysis, and the results of focus groups regarding the product. The techniques used to analyze the data consist of three techniques, namely qualitative descriptive analysis techniques, quantitative descriptive analysis techniques, and descriptive statistical analysis techniques. Qualitative and quantitative descriptive analysis are used to process data in the form of input, criticism, suggestions and responses. Descriptive statistical data analysis is used to process data obtained from questionnaires and test sheets.

In the preliminary research stage, the researcher conducted two stages of analysis, namely problem analysis and curriculum analysis. In the development or prototyping phase, researchers carry out two stages, between formative assessment or validation and the prototype development stage. The prototype development stage is carried out with five elements of the learning model: syntax, social system, reaction principle, support system, and instructional and accompanying impacts. Meanwhile, in formative assessment or validation, researchers carry out feasibility tests, starting from prototype I and prototype II until the product can be tested. Finally, in the assessment phase, researchers conducted a trial of the ethnomathematics-based hybrid learning model to determine the level of practicality of the model developed and carried out a pretest and posttest to see the effectiveness of the model developed. Researchers conducted trials on lecturers and students and got products in the practical category. Researchers also conducted pretest and posttest tests on limited tests and expanded tests. Based on tests carried out in limited tests and expanded tests, it was found that the hybrid learning model based on ethnomathematics with a cybergogy approach can effectively improve the mathematical proficiency of elementary school teacher education students.

RESULTS AND DISCUSSION

In this research and development, an ethnomathematics-based hybrid learning model was developed using the Plomp development model in three stages: initial research, development or prototype, and evaluation stage. At each stage of the process, research and development products resulting from the development of ethnomathematics-based hybrid learning models can be described as follows: needs analysis, learning model planning, learning tools, instruments, product development realization, and product development revisions

Preliminary Research

The preliminary study will analyze the problems of elementary school teacher education students and analyze the curriculum. The aim of the preliminary study is to obtain information about problems that occur in the field. Problem analysis was carried out through interviews with elementary school teacher education students, lecturers, and alumni who have become teachers; observing the implementation of lectures; and examination of supporting documents, including syllabi and lesson plans developed by elementary school teacher education students and alumni of the Educational Personnel Education Institute. The results show that (1) courses that facilitate mathematics material have been well designed and that the course process has been well programmed. However, based on learning tools made by lecturers, there are still deficiencies in assessing the content to be taught that is relevant to the level of understanding and difficulty of elementary school teacher education students; (2) the use of learning models has not been carried out optimally; (3) the lecture system is carried out in large study groups, namely with the ratio of lecturers and students being 1:50.

In addition, based on observation and investigation of documents regarding the mathematics learning development course in elementary schools, it was found that: (1) elementary school teacher education students who take this mathematics learning development course often experience difficulties in creating and developing ethnomathematics-based mathematics learning in elementary schools; 2) mathematics learning development course content does not specifically include aspects of the hybrid learning model; (3) the ability of elementary school teacher education students to design and apply ethnomathematics-based mathematics learning in elementary schools in microteaching practices is not in accordance with the characteristics of the hybrid learning model; (4) documents of learning tools, including lesson plans from several elementary school teachers who were alumni of the elementary school teacher education study program who were the subjects of the study, show that ethnomathematics-based mathematics learning in elementary schools is still limited to lectures, discussions, and short exercises. Analysis of the curriculum is used as a basic framework in compiling lecture support tools. The results of the curriculum study show that universities use the Indonesian National Qualification Framework curriculum.

Development or Prototyping

In the prototype development stage, there are two stages, namely the prototype development stage and formative assessment or validation. The five components of the learning model are used to develop a prototype model. They are (1) syntax MODARET which is the flow or stages of learning activities from start to finish designed and synthesized from the theory underlying the ethnomathematics-based hybrid learning model; (2) the social system, which is a class atmosphere that has roles and relationships between lecturers and students as well as normal roles; (3) the principle of reaction, which places students in a different position in the class than in the same class; (4) The support system includes the required facilities, tools, tools, materials, and learning resources, such as lesson plans, LTM, and teaching materials; and (5) instructional impact and accompaniment: this model teaches students to design and implement mathematics learning in a way that suits their needs. While the accompanying impact is the positive attitude of students towards learning.

Prototype I of the ethnomathematics-based hybrid learning model was then validated by three experts and four practitioners. Their validation results are used as a basis for changing the product models that have been developed. Researchers' efforts to produce quality products began with focus group discussion (FGD) activities in order to provide input on this research instrument.

Based on the results of the FGD activities, which were attended by student representatives and lecturers in accordance with their areas of expertise, it was explained that all products could be used. However, before being tested in the field, researchers made improvements first based on suggestions and input from the validator. Improvements are made with the aim of increasing the quality of the products made. Prototype II model with one cycle of development and revision after the assessment of experts and practitioners. The following shows the MODARET website that was developed.

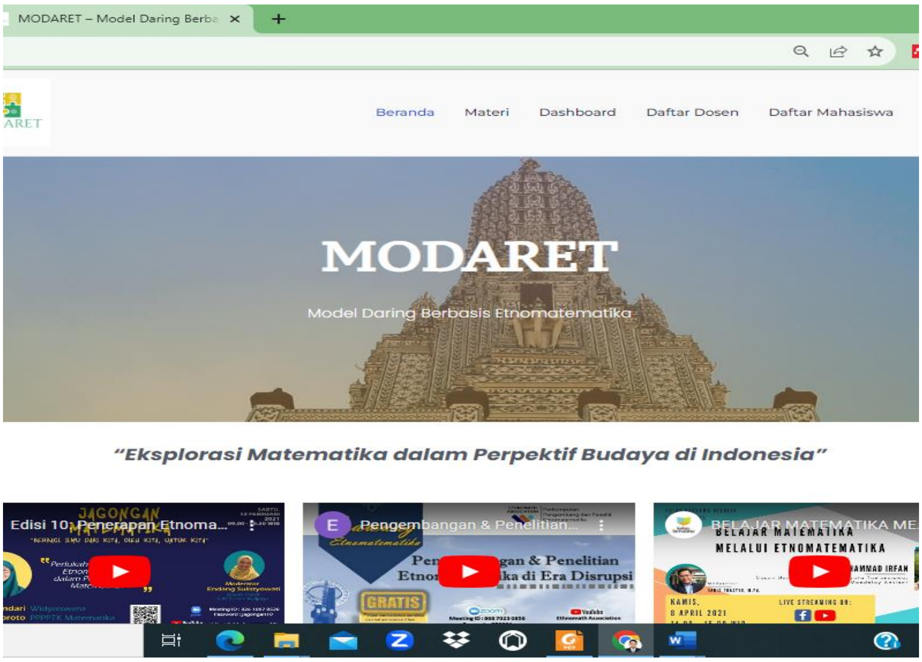

Figure 1. Display of the Developed MODARET Website

Feasibility Test Results of the Ethnomathematics-Based Hybrid Learning Model

The validated model components are listed on the website https://www.modaret.web.id/. Based on the results of the validation, it shows that the product developed fulfills the valid requirements and has a high level of validity, with an average score of 141.4 for the assessment of model components by practitioners and experts. The details of the assessment of model components by learning design experts is 149, material experts are 151, and practitioners are 134.75. Table 1 shows a recapitulation of the results of the model component assessment.

Table 1. Recapitulation of Validation Results for Model Components

No	Assessment Aspects	Validator Assessment							Average
		1	**2**	**3**	**4**	**5**	**6**	**7**	
1	Rational Development	22	23	22	20	18	22	20	21
2	Supporting Theory	21	22	23	20	17	19	20	20,2
3	Syntax	17	17	17	16	16	15	16	16,2
4	Social Systems	18	17	18	16	14	18	16	16,7
5	Reaction Principle	18	18	18	16	14	18	16	16,8
6	Support System	13	13	14	12	12	13	12	12,7
7	Instructional Impact	13	13	14	12	12	11	12	12,4
8	Implementation Instructions	27	26	27	24	24	24	24	25,1
	Total score	149	149	153	136	127	140	136	
	Expert/Practitioner Score	**149**	**151**			**134,7**			
	Average Rating Score				**141.4**				**VG**

Then based on the results of the FGD, the FGD participants generally gave a general assessment that the model developed in the form of the MHLBE website was very good and good, as well as the course was also good, but the input was that the website logout was not visible and needed to be checked again. Then it is necessary to pay attention to the uploaded video space because it will affect the speed of access. Details of improvements to the MHLBE website components are as follows:

Table 2. Details of Revisions to the Developed Model

Revised Aspects	Initial Product	Enter Validators	After Repaired
Registration on the MHLBE website	Difficulty registering on the MHLBE website	The website must be ensured to be more friendly, especially during registration	Create and improve usage guidelines the MHLBE website

The improvement process before the product being developed is tested is known as product revision at the validation stage. The product that was developed first was improved on the parts that were given input and suggestions from the validators. After being repaired and declared feasible, the product was tested in the mathematics learning development course. The activities carried out during the product revision process were based on the validators' input and suggestions as well as the trial results.

Assessment

Prototype II, the product being developed, is assessed through a cumulative assessment. Therefore, a prototype II model was made at this stage, and analysis was carried out to find out how practical and effective the model is. After prototype II was used in the mathematics learning development class, a summative evaluation was carried out to collect information about the practicality and effectiveness of the model made.

The assessment of the effectiveness of the developed model is reviewed from the increase in students' mathematical competence after the implementation of the ethnomathematics-based hybrid learning model. The instrument for assessing the effectiveness of the ethnomathematics-based hybrid learning model to improve mathematical competence was developed based on the research instrument writing grid from the components of mathematical thinking, mathematical modeling, mathematical reasoning, mathematical communication, and mathematical representation in the form of essay-shaped test questions of 15 question items. The test instrument writing grid can be explained in the following table.

Table 3. Test Instrument Writing Indicators

No	Mathematics Competence	Indicator	Item
1	Mathematical thinking	a. Awareness of the types of questions and the ability to find answers that can be expected from ethnomathematics-based mathematics learning in elementary schools. b. Recognizing, understanding and handling the scope of mathematical concepts obtained from ethnomathematics-based mathematics learning in elementary school. c. Expanding the scope of the concept by abstracting several artifacts that are the objects of ethnomathematics.	3
2	Mathematical modeling	a. Able to break down the shape of the artifact and interpret it into a model of the results of a real situation. b. Applying ethnomathematics mathematization in the form of understanding objects, relationships, problem formulations, and others in mathematical terms to produce mathematical models. c. Can solve mathematical problems with models generated internally (in relation to the mathematical properties of the model) and externally (in relation to the area or situation being modeled) in ethnomathematics.	3
3	Mathematical reasoning	a. Expressing basic ideas in mathematical proof, including distinguishing between arguments and ideas in ethnomathematics. b. Designing and implementing informal and formal arguments in ethnomathematics.	4
4	Mathematical	a. Studying and interpreting mathematical	2

No	Mathematics Competence	Indicator	Item
	communication	expressions in the form of written, spoken or visual 'texts' from ethnomathematics objects in the form of artifacts. b. Expressing oneself in different ways and levels of understanding in theoretical and technical precision about ethnomathematics-based mathematics learning, both in writing, orally or visually for various types of audiences.	
5	Mathematical representation	a. Understanding and utilizing various types of ethnomathematics object representations in the form of decoding, interpreting, differentiating, phenomena, problems or situations in ethnomathematics-based mathematics learning. b. Understanding the reciprocal relationships between different forms of representation of the same entity, as well as knowing about the strengths and weaknesses of the information obtained from ethnomathematics objects. c. Choosing between different forms of representation for a particular entity or phenomenon, depending on the situation and the objectives of ethnomathematics-based mathematics learning.	3
		Total	15

Practicality Test Results of the Ethnomathematics-Based Hybrid Learning Model

Trial data consists of product assessments by lecturers and students and observations of lecture implementation. To get a practical assessment of the product being developed, we asked lecturers to assess the implementation of the model using the product. The results show that the average assessment score is 127.5 and is in the very good category. Table 3 shows a recapitulation of lecturers' practicality assessments.

Table 4. Practicality Assessment Recapitulation by Lecturers

No	Assessment Aspects	Lecturers Assessment				Average
		1	2	3	4	
1	Tools for lecturers	28	28	29	28	28,2
2	Device for students	56	61	58	60	58,7
3	Implementation of learning	40	41	40	41	40,5
	Total scoring score	124	130	127	129	127,5
	Assessment category					Very Good (VG)

Looking at students' responses to the implementation of the ethnomathematics-based hybrid learning model to improve PGSD students' mathematical abilities, the practicality assessment shows that the ethnomathematics-based hybrid learning model has met the practicality criteria. Of the 42 students, the average assessment score was 56.7. The assessment results show that the products used in the mathematics learning development course in elementary school are included in the practical category. The number of students who answered about the practicality of studying with the model developed showed that 36 of them, or 85.7 percent, gave practical responses. This shows that the criteria set at least 75% of students gave a positive response and have been fulfilled. Therefore, it can be concluded that the model created fulfills the practical requirements. Table 4 below shows a recapitulation of student responses regarding the practicality of the developed model.

Table 5. Recapitulation of Practicality Assessment by Students

Interval	Criteria	Code	Students Responded
X > 60	Very Practical	VP	10 (23,8%)
55 < X ≤ 60	Practical	P	26 (61,9%)
40 < X ≤ 55	Practical Enough	PE	6 (14,3%)
30 < X ≤ 40	Less Practical	LP	0
X ≤ 30	Not Practical	NP	0
Average = 56,7	**Practical**	**Good**	

Ethnomathematics-Based Hybrid Learning Model Effectiveness Test Results

Data on the effectiveness of the ethnomathematics-based hybrid learning model can be seen from the pretest and posttest improvement scores in elementary school teacher education students' mathematical competence. Effectiveness testing is carried out in two stages of product testing, namely limited testing and expanded testing. Data from limited group trials were used for both initial and final mathematics competency trials. This trial involved a class of elementary school teacher education students; mathematics competency test data is used to measure how effective the ethnomathematics-based hybrid learning model is. The average value (M), standard deviation (SD), and the same average mathematics competency score before and after the implementation of the ethnomathematics-based hybrid learning model were evaluated. As a similarity test, the t-test with a significance level of 5% was used. Table 5 below shows a description of the average value (M) and standard deviation (SD) of mathematics competency before and after implementation.

Table 6. Before and After Average Value and Standard Deviation of Mathematics Competency

After			Before		
M	**SD**	**Category**	**M**	**SD**	**Category**
77,12	6,27	Good	62,79	6,26	Less

The average value (M) for mathematical competence before applying the model is 62.79, with the less category; after applying the model, the average value (M) is 77.12, with a good category. Therefore, it can be concluded that the application of the model increases the average mathematical competency score.

Product Effectiveness Test Results in Expanded Test

The aim of the extended trial was to provide an explanation of the average score and determine whether the experimental group and the control group had the same average score of mathematics competence. For the experimental group, a hybrid model based on ethnomathematics was used, while for the control group, an expository learning model was used.

Students who were tested were tested on their mathematical abilities before the mathematics learning development lecture with the developed model began. As a result of data analysis, the experimental class has a pretest average of 57.5 and a posttest average of 84. The control class has a pretest average of 54 and a posttest average of 75. The average shows that your mathematical abilities are pretty good. However, after noticing, only 14 students (33.33%) completed, and the rest were still below the minimum grade.

Students are tested again for their mathematical competence after the model created is used in mathematics learning development lectures. The purpose of this study, using the model that has been developed, is to determine whether elementary school teacher education students have better mathematical abilities before they start college. The results of the data analysis of the mathematics competency test show an average progress from 57.5, which is an ineffective category, to 78.9, which is an effective category.

The effectiveness of the ethnomathematics-based hybrid learning model was analyzed using a t-test. The purpose of this analysis was to determine whether the developed model was effective in improving mathematical competence or not. The t-test was conducted on the data on the increase (N-gain) in students' mathematical competence. The output results of the t-test for N-gain mathematical competence obtained a t value of 19.593 at a significance value of 0.000. This shows that the H0 criterion is rejected (sig value $< \alpha = 0.05$) is met, meaning that the average final mathematical competence score is more than the average initial mathematical competence score.

Testing the effectiveness of the ethnomathematics-based hybrid learning model to improve the mathematical competence of elementary school teacher education students was tested after students participated in learning using an ethnomathematics-based hybrid learning model. In table 6 it can be seen the average increase in the mathematics competence of elementary school teacher education students.

Table 7. Average Increase in Mathematics Competency of PGSD Students

Class	**N**	**Average Pretest**	**Average Posttest**	**AverageGain (Δ)**
Experiment	42	57,5	84	0,78
Control	42	54	75	0,53

Based on table 6 above, the increase in mathematics competency of elementary school teacher education students with the ethnomathematics-based hybrid learning model is higher than the learning model usually used by lecturers, namely the expository learning model. Based on the results of data analysis, the average pretest was 57.5, and the average posttest was 84 in the experimental class. Then, in the control class, the average pretest was 54, and the average posttest was 75. These averages indicate that mathematics competence is included in the fairly good category. Based on the results of the analysis of the final mathematics competence test data, there appears to be an average progress from 57.5 (not yet effective category) to 78.9 (effective category).

This research was carried out with the aim of developing a hybrid learning model product based on ethnomathematics using a cybergogy approach to improve mathematics competence for prospective elementary school teachers as well as carrying out validation, product trials, and tests to see the effectiveness of the model being developed. The development of this ethnomathematics-based hybrid learning model is the same as online learning models in general. However, in this research the researchers included cultural elements in mathematics learning as a new innovation that had not previously existed. Cultural elements related to this research are in the form of artifacts found in the Siak Sri Indrapura Palace, such as the Sultan’s Throne, the Bronze Statue of Queen Wilhelmina, antique compasses and ancient clocks, comet musical instruments, heirloom weapons and jewelry, historical manuscripts and documents, and glassware.

Hybrid learning is closely related to learning opportunities, both when and where the learning takes place. According to Muresan (2014), this self-formation paradigm is closely related to the intensive use of virtual environments where students can solve personal, social problems and support their professionalism. This view shows that the concept of cybergogy is a concept of utilizing ICT services in a digital-based learning process aimed at creating hybrid learning that is involved in improving students’ cognitive, emotional, and social aspects (Satria et al., 2024). Through cybergogy learning strategies, it can provide new, enjoyable learning experiences for students to achieve their learning goals dynamically.

Wang & Kang (2008) determined that involved learning will improve students' cognitive, emotional, and social outcomes. Learning steps can be carried out, namely the teacher designs interesting learning, designs a learning atmosphere and material that is mysterious by considering student curiosity, designs messages that evoke positive emotions, including images that evoke feelings so that through messages and media displays, they can build dialogue, formulate goals, and activities and assessments, designing interactive, cooperative, and collaborative learning that suits learning styles. According to Palincsar & Herrenkohl (2002), Laal & Laal (2012), and Fendrik et al. (2018), collaborative learning is a learning approach that involves students collectively working together to solve problems or create a product.

Online collaborative learning can foster social roles and build online communities. Apart from that, teachers also need to increase their self-confidence, competence, and communication in using digital devices. The teacher identifies student emotional cues in online interactions both symbolically and through facial expressions such as smiling, sad, bored, confused, or surprised. Teachers facilitate students in online communication through a warm, communicative, and empathetic impression. Teachers must be wise, build a healthy and intimate learning community, communicate honestly, support dynamics, and create a sense of security and comfort. Teachers facilitate online communication and software that can connect with social networks; teachers involve students from various backgrounds, social, cultural, and linguistic contexts so as to create shared learning and cultural situations that are mutually acceptable (Wang & Kang, 2008; Fendrik et al., 2023).

CONCLUSION

The results of the research and development show that the ethnomathematics-based hybrid learning model with a cybergogy approach has a feasibility level with a very feasible category. The scores for the implementation of lectures, lecturer activities, student activities, and lecturer and student responses are included in the practical category to assess the practicality of the hybrid learning model based on the ethnomathematics with the cybergogy approach. These results can be seen from the lecturer's assessment, which shows practicality with very practical criteria, and student responses that show practicality with practical criteria. As shown by the results of observations of the implementation of lectures, the ethnomathematics-based hybrid learning model with a cybergogy approach meets the practicality criteria. Finally, research on how effective the ethnomathematics-based hybrid learning model is in improving the mathematical abilities of students shows that there is a significant difference between the ethnomathematics-based online learning model and the expository learning model. The hybrid learning model based on ethnomathematics with a cybergogy approach is able to improve the mathematical abilities of students compared to the expository learning model. Therefore, it can be concluded that the hybrid learning model based on ethnomathematics with a cybergogy approach is effective in improving the mathematical abilities of students.

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