Innovation in Geometry Problem-Solving Through Ethnomathematics-Based Digital Teaching Materials for Junior High Students

Andang[1], Arnasari Merdekawati Hadi[1], Sowanto[1], Nur Rahmi Akbarini[2], Juryatina[1], Fajar Budiyono[2], Muh. Fitrah[2]

[1]Faculty of Teacher Training and Education, Nggusuwaru University, Bima, Indonesia
[2]University Negeri Yogyakarta, Yogyakarta, Indonesia
Email: andangumm@gmail.com

Abstract

This research develops an ethnomathematics-based e-module that integrates Bima local wisdom into geometry teaching for eighth-grade students at SMP Negeri 1 Kota Bima. Using the 4D development model (Defining, Designing, Developing, Disseminating), the e-module connects mathematical concepts with local culture, such as tembe nggoli motifs, sarau, wonca, and doku household tools, uma lengge house structures, and mpa'a gopa traditional games. The study shows that the developed e-module is valid, practical, and effective in enhancing students' geometry problem-solving abilities. Data from the trials demonstrate a significant improvement in geometry problem-solving skills in the experimental group compared to the control group. The novelty of this research lies in the deep integration of Bima local cultural elements into geometry teaching materials, which has not been extensively explored in previous studies. This approach offers relevant and contextual solutions in junior high school mathematics education in Kota Bima.

Keywords: Ethnomathematics, Geometry, Problem-solving, 4D Models.

Mastery of mathematics has become essential in the era of globalization, serving as a foundation for understanding science and technology (Weng, 2017; Semenov et al., 2023). However, at SMP Negeri 1 Kota Bima, students still face challenges in solving geometry problems, mainly due to the limitations of conventional teaching materials that lack relevance to the local cultural context (Cardona et al., 2023; Dwirahayu et al., 2022).. The implementation of the "Merdeka Curriculum," which requires the use of digital teaching materials, has not yet been fully optimized. Observations indicate that many eighth-grade students have not met the Minimum Competency Criteria (KKM), highlighting the need for a more innovative and contextual teaching approach.

The integration of ethnomathematics into geometry learning presents a potential solution, as it can link geometric concepts with local cultural elements such as the motifs of tembe nggoli (traditional woven cloth), household tools like sarau, wonca, and doku, traditional house structures like uma lengge, and traditional games such as mpa'a gopa. This approach not only makes learning more engaging but also more meaningful for students by connecting mathematical concepts to their daily lives and local wisdom (Oco et al., 2023).

Several previous studies have developed ethnomathematics-based modules to enhance students' mathematical abilities. For instance, Indriani et al., (2024) focused on developing an ethnomathematics learning module based on Jam Gadang architecture to enhance critical thinking skills in fifth-grade elementary school students. Sutarto et al., (2022) developed and tested the effectiveness of an ethnomathematics-based e-learning module related to Sasak culture to improve students' speculation skills in object configuration material. Putri & Junaedi, (2022) developed a mathematics learning module integrating mathematical concepts with local culture (ethnomathematics) to improve students' critical thinking skills. However, these studies have not specifically targeted geometry problem-solving skills and have not deeply integrated Bima cultural values into the learning process.

In addition to the limited integration of local cultural elements in previous studies, the growing digital literacy of students further highlights the need for innovative learning materials that are accessible and relevant. With the rapid development of information and communication technology, digital modules have become a strategic medium for enhancing learning outcomes. However, the challenge lies in designing content that not only meets the technological demands but also remains grounded in students' cultural realities. In the context of Bima, where traditional arts and cultural practices still play a significant role in community life, the integration of local wisdom into educational content is crucial. This study aims to address this gap by creating digital teaching materials that merge ethnomathematics with modern technology, thereby offering a unique approach that is both culturally relevant and technologically appropriate.

This study differs in two significant aspects. First, it focuses on developing the ability to solve geometry problems, particularly in the areas of solid shapes and forms. Second, the digital teaching materials developed in this study specifically integrate Bima's cultural elements, such as tembe nggoli, sarau, uma lengge, and mpa’a gopa, which have rarely been highlighted in previous research. Through this approach, the study aims to provide a contextually relevant contribution to culturally-based mathematics education.

Based on this background, the study aims to examine the effectiveness of the developed ethnomathematics-based digital teaching materials in enhancing the geometry problem-solving skills of eighth-grade students at SMP Negeri 1 Kota Bima.

Method

This research utilizes the 4D research and development (R&D) model, which consists of four key steps: identification, design, creation, and dissemination (Thiagarajan, Semmel, & Semmel, 1974). The aim of this research is to develop a high-quality e-module that meets the standards set by Nieveen (1991), specifically in terms of validity, usability, and effectiveness.

2.1 Research subject.

The study was conducted from June to August 2024 at a junior high school in Bima City, West Nusa Tenggara, targeting eighth-grade students for the 2023/2024 academic year. The study involved 50 students as participants.

2.2. Research Design.

This research uses a 4D development model which includes four stages as used Sutarto et al., (2022):

2.2.1. Defining.

At this stage, the researcher assesses the curriculum to align it with Core Competencies and Basic Competencies relevant to geometry content. Additionally, the researcher evaluates student characteristics, cognitive development, and motivation through classroom observations and interviews with teachers and students. The researcher then details and organizes the module content systematically. Relevant geometry concepts are selected, and tasks, questions, and exercises are prepared.

2.2.2. Designing.

In the design phase, this e-module is crafted to integrate geometry concepts directly linked to Bima's cultural heritage through various traditional objects, such as tembe nggoli woven cloth, sarau hats, wonca baskets, doku strainers, uma lengge traditional houses, and the mpa’a gopa game. This approach not only introduces students to theoretical geometry concepts but also places these concepts within a meaningful cultural context. The following are explanations of each traditional object and how they connect to geometric learning:

Tembe Nggoli, This traditional cloth features geometric patterns such as triangles, polygons, squares, and circles arranged symmetrically. Tembe nggoli offers an avenue to teach symmetry, pattern repetition, as well as ratio and proportion, which are crucial for understanding size and shape.

Sarau is a conical hat worn by the Bima people to protect themselves from the sun. In geometry learning, sarau exemplifies the cone shape, allowing students to explore concepts like height, radius, and slant height. It also serves as a practical example for calculating surface area and volume of cones.

Wonca is a circular basket with a square base, woven from bamboo. This unique form enables students to study two-dimensional shapes (circle and square) and transformations, helping them understand how shapes can adapt to functional needs.

Doku, used to sift rice, is circular in shape. It provides an accessible way to teach circular geometry concepts, including diameter, radius, and area, connecting everyday objects to geometric learning.

The uma lengge features a square base and a conical roof. This structure can introduce students to three-dimensional shapes, specifically cones and cubes, and the application of the Pythagorean theorem for measuring height and slant height.

Mpa’a gopa is played on a square, rectangular, or trapezoidal field. These shapes offer an opportunity to teach concepts of two-dimensional shapes, symmetry, and spatial relationships, while students practice estimation skills when throwing objects into designated sections.

This approach makes geometry concepts more accessible by relating them to familiar objects in the students’ daily lives, creating an engaging and meaningful learning experience.

2.2.3. Developing.

In this phase, the e-module undergoes expert validation and development testing. The validation process evaluates the feasibility of the e-module, lesson plans, and students' problem-solving ability tests by experts, including two mathematics education lecturers and two eighth-grade mathematics teachers from SMPN 1 Kota Bima. Based on expert feedback, revisions are made to the e-module, focusing on content, presentation, language, and design. The e-module is considered valid if the validation results are satisfactory. The practicality of the e-module is assessed using student response questionnaires and interviews. The e-module is deemed practical if at least 61% of student responses fall into the "attractive" category. Effectiveness is measured by comparing students' problem-solving abilities in geometry before and after using the e-module through pre-tests and post-tests, analyzed using paired T-tests.

2.2.4. Disseminating.

In the final stage, the e-module is distributed through links shared on WhatsApp Groups and YouTube to schools and educators.

2.3. Data Analysis Techniques.

2.3.1. E-Module Validity.

The validity of the e-module is assessed using an expert validation questionnaire. The validity criteria are as follows:

Table 1. Validity of E-Module

No.	Score Range	Validity Criteria
1	$3 \leq x \leq 4$	Highly Valid
2	$2 \leq x < 3$	Valid
3	$1 \leq x < 2$	Fairly Valid
4	$0 \leq x < 1$	Invalid

Calculation of Average Validity Score:

The average validity score is calculated using the formula:

$$\bar{\bar{X}} = \frac{\sum x}{n}$$

Where:

$\bar{\bar{X}}$= Average validity score

$\sum x$ = Total score given by the validators

n = Number of validators

2.4. Practicality.

The practicality of the e-module is assessed based on students' responses to the questionnaire. The e-module is considered practical if 60% or more of the students respond with "agree" or "strongly agree."

Table 2. Practicality of e-Modules

No	Score	Validation Criteria
1	$R \geq 80\%$	Very Practical
2	$60\% \leq R < 80\%$	Practical
3	$40\% \leq R < 60\%$	Fairly Practical
4	$20\% \leq R < 40\%$	Impractical
5	$R \leq 20\%$	Very Impractical

2.5. Effectiveness of the E-Module.

In this study, data analysis was conducted using a quasi-experimental design featuring a pre-test and post-test approach with a control group. This method aimed to assess progress in students' problem-solving abilities in geometry by comparing pre-test and post-test results following the use of the e-module. Problem-solving tests were used to collect data on students' problem-solving skills in geometry, and these skills were evaluated based on the indicators listed in Table 3.

Table 3. Indicators of Geometry Problem-Solving Ability

Stages of Problem-Solving Process	Indicator
Observing the Problem	Initial activities performed to understand and analyze the geometry problem at hand.
Organizing Information	Activities involving the use of strategies to systematically organize information and facilitate the problem-solving process.
Finding and Predicting Patterns	Activities involving the identification of patterns or relationships in the geometry problem and predicting possible solutions.
Formulating Solutions	Activities of creating statements or solutions based on the analysis and understanding of the geometry problem.
Validating Solutions	Activities undertaken to verify that the proposed solution is correct and applicable to specific cases.
Generalizing Solutions	Activities related to applying the solution to various geometry cases to ensure that it works universally.
Justifying Generalizations	Activities conducted to convince others that the generated solution is effective for a range of geometry cases.

The impact of using e-Module on geometry problem-solving skills was assessed by analyzing student scores. The instruments used to evaluate this ability include pretest and posttest, which consist of one descriptive question. The effect of the e-Module on problem-solving skills was analyzed using a Paired Sample T-Test with SPSS 17.00 for Windows. For the Paired Sample T-Test, the data used must be normally distributed to ensure accurate analysis. This value determines the decisions made in the study.

Results and discussion

3.1. Defining Phase

In the planning phase, the researcher identifies the Core Competencies and Basic Competencies relevant to the geometry material to be developed. Initial analysis reveals that students' ability to solve geometry problems is still relatively low. Data collected through classroom observations and interviews with teachers indicate that students often struggle to apply geometric concepts to practical situations. For example, in the context of online ride-hailing applications, students are frequently faced with standard textbook problems that emphasize cognitive aspects alone, without considering critical thinking skills and practical applications in daily life.

Analysis of conventional teaching materials reveals that textbook problems tend to focus on theoretical problem-solving and do not provide enough practical context or connections to students' daily lives. This results in students having difficulty relating geometric concepts to real-world applications. Additionally, the teaching methods used still do not offer sufficient opportunities for students to practice critical thinking and more complex problem-solving skills.

In this context, the development of ethnomathematics-based e-modules is expected to address these shortcomings by integrating local cultural elements, such as weaving patterns and household tools, relevant to the students' context. Thus, this e-module is designed not only to meet the standards of Core Competencies and Basic Competencies but also to enhance students' critical thinking skills and practical application in solving geometry problems. This approach aims to bridge the gap between theory and practice and improve the relevance of learning for students.

3.2. Design Phase

In the design phase, the researcher carries out several design steps, including: 1) test preparation, 2) media selection, and 3) format selection. During the test preparation stage, the researcher develops tests in the form of spatial problem-solving questions, such as determining the pattern of the tembe nggoli weaving. The ethnomathematics-based e-module integrates Bima cultural elements, which include the tembe nggoli weaving motifs, household tools like sarau and doku, as well as traditional house structures such as uma lengge and traditional games like mpa'a gopa.

The integration of Bima culture aims to motivate students to learn mathematics, make learning more meaningful, and help students recognize the benefits of studying mathematics in their daily lives. By linking geometric concepts with local cultural elements, this e-module is designed to enhance student engagement and the relevance of learning, connecting geometric material with real-life contexts they encounter in their everyday lives.

3.3. Development Phase

In the development phase, the researcher conducts a series of validation tests and e-module trials. During this phase, the researcher develops an initial draft of the module, which is then revised based on feedback from experts and results from small-scale trials. The validation of the e-module is carried out by two mathematics education lecturers and two mathematics teachers from SMP Negeri 1 Kota Bima. This expert assessment involves evaluating the validity, quality, and alignment of the content with the learning objectives (see Table 4).

To measure the practicality and effectiveness of the e-module, the researcher conducts trials with student groups. During these trials, students are asked to complete questionnaires and participate in interviews to provide feedback on their experience using the e-module. Data collected from these questionnaires offer insights into how the e-module is received by students and the extent to which it facilitates their understanding of geometry material. The results from this process are used to assess whether the e-module meets the expected standards and its effectiveness in enhancing students' geometry problem-solving skills.

3.4. Validity of the E-Module

Table 4. Validity of the E-Module

No	Validator	Score	Validity Criteria	Remarks
1	X-1	3.45	Very Valid	No revision needed
2	X-2	3.50	Very Valid	No revision needed
3	X-3	3.52	Very Valid	No revision needed
4	X-4	3.48	Very Valid	No revision needed
Average		3.49	Very Valid	No revision needed

Table 4 shows that the average validity score of the e-module is 3.49, which means the e-module falls into the "Very Valid" category (average score of $3 \leq x \leq 4$). This assessment indicates that the developed e-module meets the validity criteria established by the validators and does not require further revisions.

3.5. Practicality of the E-Module

According to the interview and questionnaire results, the e-module is categorized as highly practical, with a score of 88.25% (the percentage of students who strongly agree and agree). Table 3 presents the analysis results of the questionnaire regarding the use of the e-module

Table 5. Indicators of the E-Module Usage Questionnaire

No	Aspect	Indicator	Percentage of Student Responses in Each Category (%)
			Strongly Agree
1	**Content Aspect**: Evaluates how well the e-module content aligns with learning objectives, ease of following learning steps, and relevance of activities to students' daily lives.	Content presented aligns with learning objectives	74.00
2		Learning steps in the e-module are easy to follow	68.00
3		Activities in the module are enjoyable because they relate to students' daily lives	72.00
4	**Language Aspect**: Assesses the clarity of the text in the e-module, ease of understanding the material, and the communicativeness of the language used in the e-module.	E-Module is clearly readable	70.00
5		The material presented is easy to understand	62.00
6		The language used is communicative	58.00
7		Instructions, learning objectives, and learning activities in the E-Module are sufficiently clear	64.00
8	**Benefit Aspect**: Evaluates the ease of using the e-module, its impact on learning motivation, and the effectiveness of images in supporting practical student activities	E-Module is easy to use	65.00
9		E-Module motivates me to study harder	60.00
10		Availability of images in the module facilitates practical activities	62.00
11	**Technology Aspect**: Assesses the ease of accessing the e-module on various devices, the performance of e-module features, and technical stability during use	E-Module can be easily accessed on various devices	68.00
12		Features in the e-module work well	64.00
13		E-Module does not experience technical issues during use	60.00
Average			65.23

Based on Table 5, students' responses to the e-module are generally positive. Students find the e-module content easy to understand and relevant to their daily lives. The module's final competencies effectively assess students' ability to solve geometry problems. Activities within the e-module are consistently connected to the local Bima culture, such as the tembe nggoli weaving patterns, traditional household tools, and Bima traditional games.

3.6. Effectiveness of the E-Module

The effectiveness of the e-module was assessed using an Independent Sample T-Test. The study involved two groups: the experimental group and the control group. The experimental group used the ethnomathematics-based e-module, while the control group used traditional printed modules. Before further analysis, a normality test was conducted to ensure that the data were normally distributed. The total number of participants in this study was 30 students. Based on the analysis results, the pretest scores of both groups, experimental and control, showed no significant differences, as presented in Table 4 and Table 5. This indicates that before the intervention, the initial abilities of the students in both groups were at a relatively similar level.

Tabel 6. The results of pretest data analysis

Group	N	Mean	Std. Deviation	Std. Error Mean
Experiment Class	25	1.6120	0.75530	0.15106
Control Class	25	1.5230	0.67280	0.13456

Based on Table 6, the average score of students in the experimental class is 1.6120 with a standard deviation of 0.75530, while the average score of students in the control class is 1.5230 with a standard deviation of 0.67280. This indicates that before the treatment, both groups had relatively similar initial abilities in solving geometry problems. The relatively small standard deviation in both classes suggests that the students' scores in these groups are consistent, making it likely that the difference in treatment (the use of the ethnomathematics-based e-module) can reveal a significant impact on improving students' problem-solving skills.

Table 7. The comparison of pretest score using independent sample T-Test

F	Sig.	t	df	Sig. (2tailed)	Mean Difference	Std. Error Diference	95% Confdence Interval of the Difference	
							Lower	Upper
0.924	0.341	0.221	28	0.825	0.02847	0.19583	-0.35635	0.42201
		0.221	26.345	0.824	0.02847	0.19435	-0.37491	0.43185

Table 7 shows that the pretest data analysis results from both groups do not indicate a significant difference. The Independent Sample T-Test was conducted with the result [t (26.345) = 0.223, p > 0.05], which indicates that there is no significant difference between the average scores of the experimental group and the control group. The significance value (Sig.) of 0.824 suggests that the students' abilities in both groups were at an equivalent level before the treatment was administered. Additionally, the Levene's test for equality of variances shows an F value of 0.924 with a Sig. = 0.341, meaning that the assumption of equal variances was not met, leading to the analysis being continued under the assumption of equal variances not assumed.

The data also indicate that the mean difference between the two groups is only 0.02847 with a standard error of 0.19435. The 95% confidence interval for the mean difference ranges from -0.37491 to 0.43185, which includes zero, further confirming that there is no significant difference between the initial abilities of students in the experimental and control groups before the intervention was applied.

Tabel 8. The results of post-test data analysis

Group	N	Mean	Std. Deviation	Std. Error Mean
Experiment Class	25	4.0223	1.25488	0.32388
Control Class	25	2.9784	1.18472	0.30600

Based on Table 6, the average post-test score for students in the experimental class is 4.0223 (standard deviation: 1.25488, standard error mean: 0.32388), while for the control class, it is 2.9784 (standard deviation: 1.18472, standard error mean: 0.30600). The results indicate that students in the experimental class scored significantly higher than those in the control class after using the ethnomathematics-based e-module. This suggests that integrating local cultural elements into the e-module enhances students' geometry problem-solving skills more effectively than traditional printed modules. Additionally, the lower standard deviation in the control class indicates more consistent results among its students. This confirms the e-module's effectiveness in improving geometry understanding and skills through a contextual and relevant approach.

Table 9. The comparison of posttest score using independent sample T-Test

F	Sig.	t	df	Sig. (2tailed)	Mean Difference	Std. Error Diference	95% Confdence Interval of the Difference	
							Lower	Upper
1.256	0.272	4.191	28	0.000	1.0439	0.24963	0.5087	1.5791
		4.276	24.21	0.000	1.0439	0.24468	0.5396	1.5481

The analysis of the post-test results between the experimental and control classes shows that the t-value for the independent t-test with assumed equal variances is 4.012 with $p < 0.05$, and with not assumed equal variances is 4.067 with $p < 0.05$. These results indicate a significant difference between the two groups. In other words, the difference in post-test scores between the experimental class using the ethnomathematics-based e-module and the control class using traditional printed modules demonstrates a significant effect.

The use of the ethnomathematics-based e-module shows a significant improvement in students' geometry problem-solving abilities. Based on interviews with teachers and students, there are positive responses to this e-module. The use of the e-module proves to be consistent with students' learning habits familiar with digital technology. This e-module offers a better alternative compared to conventional textbooks, which often lack motivation for students due to their focus solely on theoretical information and lack of relevance to daily life (Minh, 2024; Osman & Lee, 2014).

Information and communication technology (ICT) in this e-module enhances students' engagement, motivation, and curiosity in learning mathematics, and helps them overcome various learning challenges z(Yulianti & Handican, 2023). This e-module is designed to facilitate the geometry problem-solving process through several stages, including: 1) observing cases, 2) organizing information, 3) detecting patterns, 4) formulating solutions, 5) validating solutions, and 6) generalizing patterns.

Students are given cases related to patterns in the local Bima culture, such as tembe nggoli, sarau, uma lengge, and mpa’a gopa. For example, in the initial stage, students are asked to observe patterns in tembe nggoli. They are then asked to find and predict the next pattern and to develop the pattern. The goal of this stage is to reinforce students' reasoning skills so they can actively formulate solutions or generalizations of patterns and engage directly in discovering and solving problems.

Conclusion

Based on this study, the ethnomathematics-based e-module integrating Bima local wisdom has been shown to positively impact students' geometry problem-solving abilities at SMP Negeri 1 Kota Bima. The analysis results indicate that using the e-module, which incorporates local cultural elements such as tembe nggoli, sarau, uma lengge, and mpa’a gopa, can significantly improve students' post-test scores compared to traditional printed modules. While there is a clear improvement in students' abilities, the results also suggest that this e-module is a valuable step in connecting geometry concepts with local cultural contexts. The use of an e-module aligned with students' digital habits positively contributes to their learning process, though the results remain within a realistic context and require further evaluation for broader implementation.

Recommendation: Based on the results of this study, it is recommended that schools at SMP Negeri 1 Kota Bima consider using ethnomathematics-based e-modules in geometry teaching to enhance relevance and effectiveness in learning. Integrating local cultural elements such as tembe nggoli and uma lengge can make the material more engaging and meaningful for students. Furthermore, further development of the e-module to cover various aspects of geometry and periodic evaluations are necessary to ensure the sustainability and improvement of the quality of learning.

Acknowledgment: We express our deepest appreciation and gratitude to BPPT Kemendikbudristek and LPDP for their support and funding of this research.

WORKS CITED

Cardona, M. A., Rodríguez, R. J., & Ishmael, K. (2023). Artificial Intelligence and the Future of Teaching and Learning. In Miguel A. Cardona Roberto J. Rodríguez Kristina Ishmael (Issue 1). https://www2.ed.gov/documents/ai-report/ai-report.pdf

Dwirahayu, G., Handayani, I. D., Suhyanto, O., Musyrifah, E., & Sobiruddin, D. (2022). Development of mathematics teaching-learning material with metaphors approach. Journal of Physics: Conference Series, 2157(1). https://doi.org/10.1088/1742-6596/2157/1/012045

Indriani, E., Fauzan, A., Syarif, A., Zainil, M., & Gistituati, N. (2024). Development of Ethnomathematics-Based Module to Improve Students' Critical Thinking Skills. AL-ISHLAH: Jurnal Pendidikan, 16(1), 371-386. https://doi.org/10.35445/alishlah.v16i1.4835

Minh, L. N. B. (2024). Strategic Integration of Technology to Foster Students' Learning Outcomes and Motivation in Legal English Lessons. Studies in English Language and Education, 11(2), 957-975. https://doi.org/10.24815/siele.v11i2.34885

Oco, R., Jade, S., Sabasaje, N., & Oco, R. M. (2023). Students' Mathematical Skills and Performance. International Journal of Multidisciplinary Research and Publications (IJMRAP), 6(2), 328-332. https://www.researchgate.net/publication/373110709

Osman, K., & Lee, T. T. (2014). Impact of Interactive Multimedia Module With Pedagogical Agents on Students' Understanding and Motivation in the Learning of Electrochemistry. International Journal of Science and Mathematics Education, 12(2), 395-421. https://doi.org/10.1007/s10763-013-9407-y

Putri, M., & Junaedi, I. (2022). Development of Etnomathematics-Based E-Module Using the Inquiry Learning Model to Improve Mathematical Problem Solving Ability. Unnes Journal of Mathematics Education, 11(2), 174-182. https://doi.org/10.15294/ujme.v11i2.59938

Semenov, A. L., Abylkassymova, A. E., & Polikarpov, S. A. (2023). Foundations of Mathematical Education in the Digital Age. Doklady Mathematics, 107(August 2023), S1-S9. https://doi.org/10.1134/S1064562423700564

Sutarto, I. D. H., Sukarma, I. K., & Untu, Z. (2022). Ethnomathematics-based E-Module Development for Improving Conjecturing Ability in Object Configuration Materials. Journal of Positive Psychology ..., 6(1), 2813-2823. https://www.journalppw.com/index.php/jppw/article/view/4505

Weng, T.-S. (2017). The Importance of Mathematics and Science Education in the Context of Digital Technology on Industrial Innovation. Research Journal of Applied Sciences, Engineering and Technology, 14(11), 418-426. https://doi.org/10.19026/rjaset.14.5142

Yulianti, P., & Handican, R. (2023). Information and Communication Technology (ICT) Skills: Are They Important For Prospective Mathematics Teachers? JDIME : Journal of Development and Innovation in Mathematics Education, 1(1), 11-22. https://doi.org/10.32939/jdime.v1i1.2341