

3-Dimensional Modeling Training for Pre-Service Teachers Through The Tinkercad Platform

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ABSTRACT

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The ability to develop 3D modelling is very important for educators because of its potential for further development in augmented reality and virtual reality. This paper describes the training activities for making 3D modelling for preservice teachers. The training was centred on the use of the Tinkercad platform. Pre-service teachers were asked to create 3D models of *Mbaru Niang* and the Grand Mosque of West Sumatra. The evaluation was conducted to assess the extent to which preservice teachers utilised the features in Tinkercad. In making *Mbaru Niang*, pre-service teachers generally use different forms of objects (basic objects made from cones or paraboloids), but with the same features (group, hole, and alignment). In contrast, when creating the Great Mosque of West Sumatra, pre-service teachers use the same basic object (a pyramid), but with additional features, such as a mirror. The results of this community service indicate that each teacher employs a similar approach in one 3d model project and different approaches in other projects. This study can serve as a starting point for future research or community service, providing a foundation for a similar long-term project that develops a more complex 3D model.

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INTRODUCTION

The use of 3D models in various aspects has been widely implemented across multiple fields, including infrastructure (El Bedewy et al., 2022), engineering (Ali et al., 2022; Šafhalter et al., 2022), archaeology (Barrile et al., 2022; Simou et al., 2022), and education (Andić et al., 2022; Tejera et al., 2025). The use of 3D models in education is primarily focused on providing learning media, especially those that will later be integrated with augmented reality (AR) and virtual reality (VR) (Ghosh et al., 2022; H. Huang & Lee, 2022; Zhao et al., 2023),

in more complex cases, integrated into virtual laboratories or educational games (Marks & Thomas, 2022).

The widespread use of 3D models in education requires a significant amount of raw materials (in its use in VR and AR), especially those developed independently by teachers, so that they can be implemented according to student needs and school conditions later (Anđić et al., 2023). However, several studies have reported that this is a challenge in itself, as creating 3D models requires good spatial visual skills (Lane & Sorby, 2022; Šafhalter et al., 2022). This ability needs to be trained continuously to teach someone to see an object from a 3-dimensional perspective.

The use of 3D modeling (and 3D printing) in teacher education is still infrequent in Indonesia. A systematic literature review by Tejera et al. (2025) revealed that most of these studies were conducted in the United States, followed by Turkey and China. This result indicates a significant gap and also an opportunity to initiate 3D modeling learning for teacher education in Indonesia.

Many studies use the Tinkercad platform as an initial introduction to 3D models for users (Hosic et al., 2025; Karaismailoglu & Yildirim, 2024; Sun, 2023). This is because the Tinkercad interface is user-friendly and straightforward (Eryilmaz & Deniz, 2021). Several studies have even shown the use of Tinkercad among young users at the elementary education level, yielding promising results in improving their ability to develop 3D models (Bhaduri et al., 2021; Hosic et al., 2025; Takáč et al., 2023). Not only that, but other studies also show increased motivation in learning when using the Tinkercad platform (Arada, 2025; Chinwong et al., 2025; Pejcinovic & Holtzman, 2024; Vidal-Silva et al., 2024).

This study uses the Tinkercad platform as an initial activity in introducing 3D model creation. In bridging this problem and providing space for innovation, this community service is carried out by involving pre-service teachers. In the context of this service, a pre-service teacher refers to individuals who will become teachers, including students in the teacher profession program who have not yet taught, students from the faculty of education, and graduates of the faculty of education who have not yet taught in a classroom (Alnasib, 2023; Jita & Munje, 2022). The selection of these participants is based on considerations to provide insight to pre-service teachers about 3D model-based variations.

METHOD

Context and stages of community service

This community service is carried out based on Hosic et al. (Hosic et al., 2025) in four main stages: preparation, introduction to Tinkercad and its basic features, introduction to advanced features, and 3D modelling projects. All stages are completed in five meetings. The meetings are described in detail in Figure 1. Each meetings are designed for 120 minutes. The stages are carried out systematically by introducing Tinkercad features to participants. Additionally, the assignment focuses on measuring participants' spatial thinking as they create

complex designs using Tinkercad. The preparation stage involves preparing for this activity, which includes pre-implementation preparations. These preparations include an explanation of the community service activity and checking each participant's device to ensure access to Tinkercad is not constrained. This involves verifying the internet and laptop specifications of each participant. The introduction stage and basic features focus on explaining the platform, 3D perspective and objects. The introduction stage of advanced features includes an explanation of how to manipulate 3D objects using these advanced features.

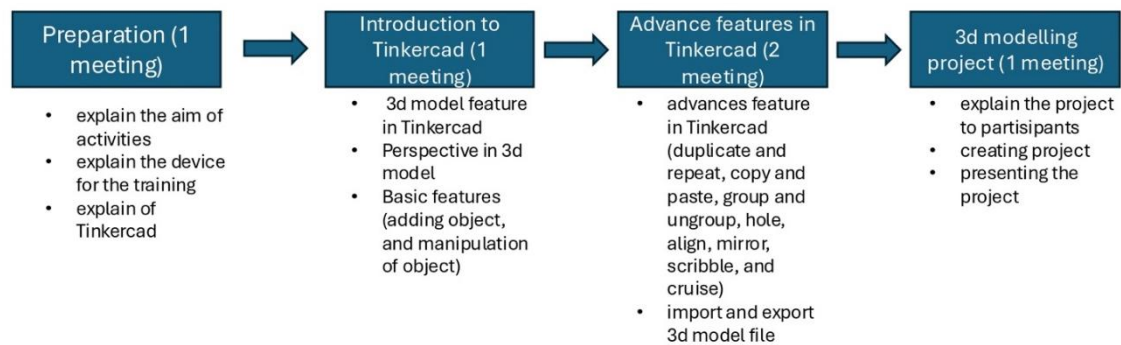


Figure 1 : Stages of the 3D modelling project.

Participants

Participants involved in this community service are pre-service teachers, comprising students in the Faculty of Education and Teacher Training, as well as students in the Teacher Professional Program at Universitas Borneo Tarakan. The community service is designed on a small scale with a total of 7 participants. The selection of this small-scale design is based on the consideration that the training process can be supervised directly and personally, allowing participants to use Tinkercad optimally.

Introduction to Tinkercad and its features

In the introduction stage, the training focuses on introducing Tinkercad and its basic and advanced features. The introduction to Tinkercad and its basic features focuses on describing the Tinkercad platform. As a note, Tinkercad not only features tools for creating 3D models, but also for designing circuits and coding blocks. In the introduction, we discuss the features of the 3D model. Furthermore, the description of the basic features is more directed at how to recognise 3D perspectives and also add objects to Tinkercad. For example, this is evident in Figure 2, which displays the Tinkercad platform.

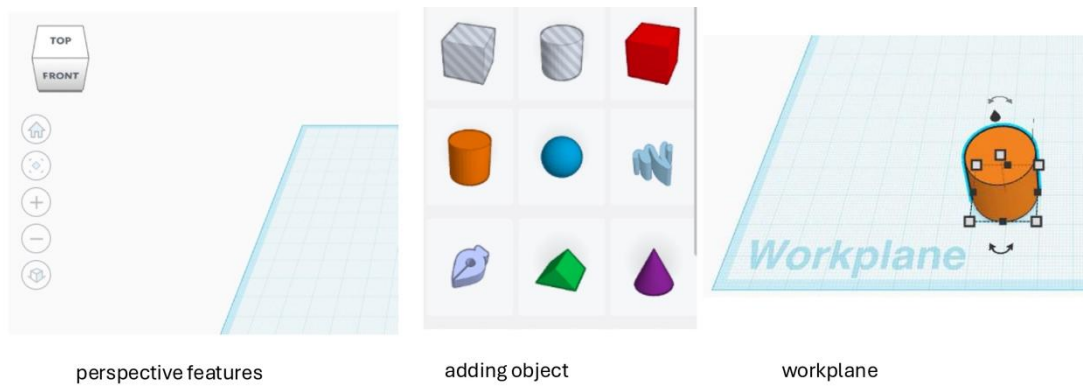


Figure 2 : Basic features in Tinkercad

The introduction of advanced features in Tinkercad focuses on features for object manipulation, including object colour, object size, duplicate and repeat, copy and paste, group and ungroup, hole, align, mirror, scribble, and cruise. Figure 3 shows the appearance of each of these features, which focuses on creating complex objects.

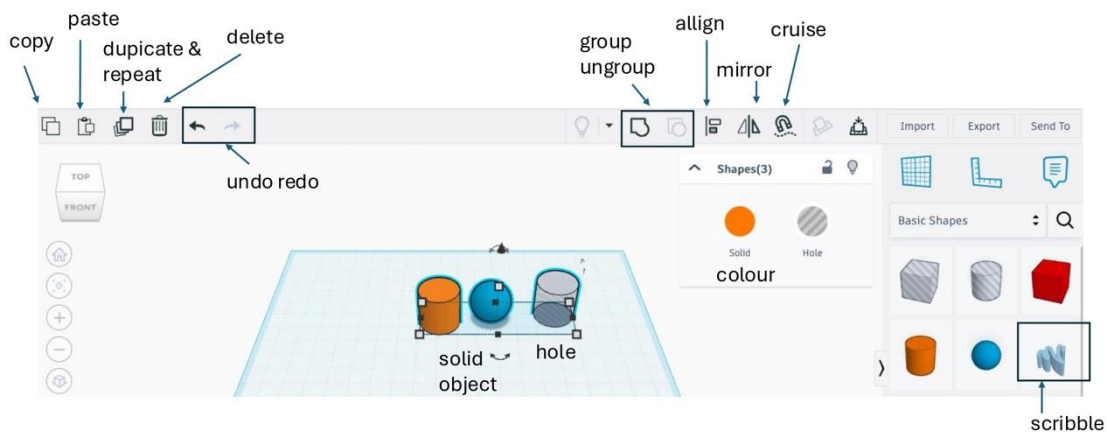


Figure 3 : Advance features in Tinkercad

Modeling project

After the introduction process of Tinkercad and its features, participants were given a project to create a simple shape based on examples of several buildings in Indonesia. Participants were asked to create examples of the *Mbaru Niang* traditional house and also the *Masjid Raya Sumatera Barat* (Grand Mosque of West Sumatera). Both forms of objects have unique geometric shapes, which from this point of view are very suitable as example objects to assess the participants' 3D modelling abilities. After participants were able to create the two examples, they were given the freedom to design a 3D model project based on a topic of their choice. In detail, the results of this project are further discussed in the Results and Discussion section.

Evaluation of activities

In this community service activity, evaluation is adapted Husic et al. (2025) approach, that conducted by assessing the complexity of participants' use of Tinkercad's objects and features. In final part of the project, participants are asked to describe how to create a 3D model and explain the objects and features used in its development.

FINDING AND DISCUSSION

During the evaluation process, a traceback approach was employed to identify the features used by the participants. Additionally, the description of the participants during the dissemination was also part of the evaluation of the features used in creating the 3-dimensional model. Tables 1 and 2 describe the features in Tinkercad used by participants in making the 3-dimensional models of *Mbaru Niang* and the Grand Mosque of West Sumatera. The number in brackets indicates the number of objects used, while the checklist indicates the features utilised. The image of the dissemination process is presented in Figure 4. Meanwhile, for some examples of 3-dimensional models, they can be seen in Figure 5a, showing an example of a 3-dimensional model of *Mbaru Niang* and Figure 5b, showing several examples of 3-dimensional models of the Grand Mosque of West Sumatera.

Table 1. Objects and Features Used by Preservice Teachers in Creating a 3D Model of *Mbaru Niang*

Pre-service teacher	Object	Group	Hole	Allign	Mirror	Scribble
A	Cone (2)	V	V	V		
B	Cone (2), Cylinder (1)	V	V	V		
C	Cone (2)	V	V	V		
D	Paraboloid (1), Half sphere (1)	V	V	V		
E	Cone (2), Cylinder (1)	V	V	V		
F	Cone (2), Cylinder (2)	V	V	V		
G	Cone (2), Cylinder (1), Round roof (2)	V	V	V		

From the results collected, most of the features used by preservice teachers in making *Mbaru Niang* and the Grand Mosque of West Sumatera are almost the same. In making *Mbaru Niang*, the mirror and scribble features were not used. Meanwhile, when creating the model of the Grand Mosque of West Sumatra, the scribble feature was not used. There was one participant who did not use two features, namely the mirror and the scribble.

Table 2. Objects and Features Used by Preservice Teachers in Creating a 3D Model of *Masjid Raya Sumatera Barat*

Pre-service teacher	Object	Group	Hole	Allign	Mirror	scribble
A	Pyramid (1), Sphere(4), box (1)	V	V	V	V	
B	Pyramid (1), Sphere(4), box (1)	V	V	V	V	
C	Pyramid (1), Sphere(4), box (1)	V	V	V	V	
D	Pyramid (1), Sphere(4), box (1)	V	V	V	V	
E	Pyramid (1), Sphere(4), box (1)	V	V	V	V	
F	Pyramid (1), Cylinder(2)	V	V	V		
G	Pyramid (1), Sphere(4), box (1)	V	V	V	V	

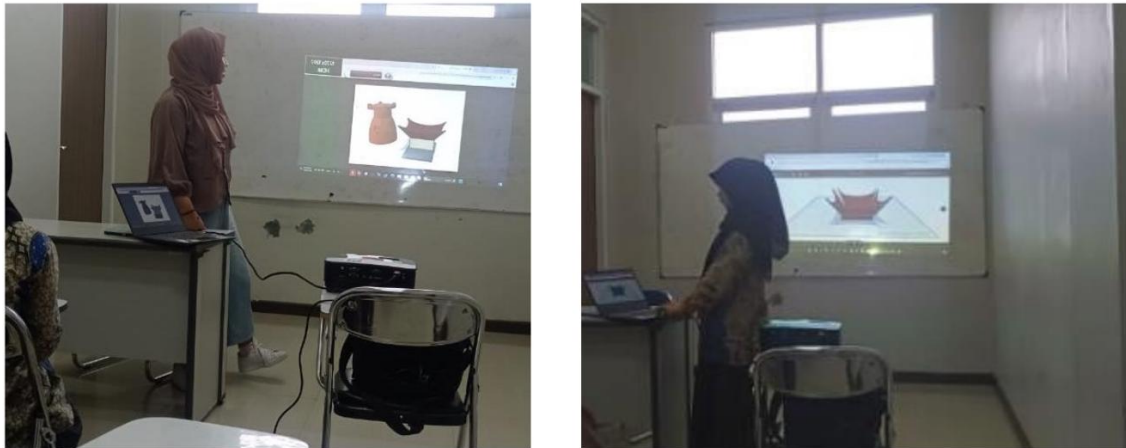


Figure 4. Dissemination/Presentation process

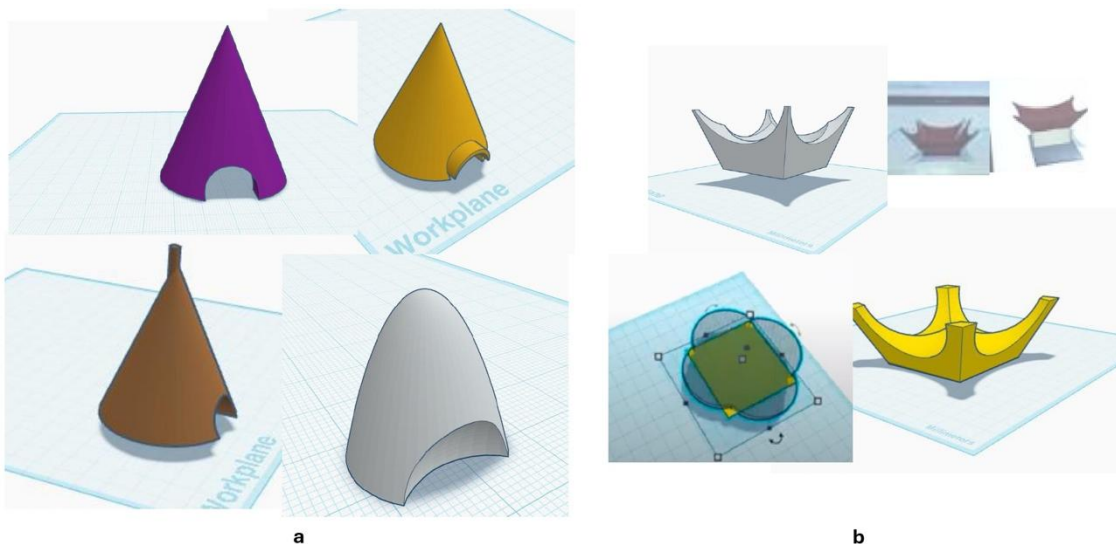


Figure 5. Example of Project : a) 3d-modelling *Mbaru Niang*; b) 3d-modelling *Masjid Raya Sumatera Barat*

Meanwhile, when viewed in terms of the variation in objects used to make the *Mbaru Niang* model, the variation is more noticeable between one participant and another. Meanwhile, when creating a 3D model of the Grand Mosque of

West Sumatra, almost everything remains the same. Some uniqueness can be seen from the basic shape used. For example, in making *Mbaru Niang*, most use a Cone as the basic shape, but some use a Paraboloid as the basic shape. For creating a 3D model of the Grand Mosque of West Sumatra, which appears different when a hole is made at the top of the mosque, most participants use a sphere (see Figure 5). However, some participants use a cylinder in creating the roof model of the Grand Mosque of West Sumatera.

Discussion

The selection of objects and features in Tinkercad in the project creation process reflects the teacher's spatial skills. The findings reveal that the pre-service teacher employed a different object approach in creating *Mbaru Niang*, using either a cone or a paraboloid, along with several additional objects. Meanwhile, at the Grand Mosque of West Sumatra, teachers tended to use a basic form that employed a pyramid, then provided *holes* through boxes and spheres as objects. While the features used by teachers at Mbaru Niang were all the same, those at the Grand Mosque of West Sumatera were more complex, with some pre-service teachers using *mirror* features. The various methods participants use to create 3D models are influenced by several factors. In several previous studies, it has been influenced by thinking in three dimensions, different strategies/methods, and spatial reasoning.

The first factor is 3D thinking (three-dimensional thinking). Three-dimensional thinking is significantly different from thinking in two-dimensional conditions. 3D thinking requires broader reasoning because it is related to volume, depth, rotation, and perspective (İbili et al., 2020; Knochel, 2018). Therefore, it is necessary to become accustomed to new skills so that 3D modelling becomes more efficient. Participants certainly have different tempos and speeds in learning these new skills, which is what causes differences, especially in the use of object variations in Tinkercad.

The second factor is related to different strategies. Because 3D thinking differs among participants, their strategies also differ. Some may prefer a straightforward method for creating a 3D model. For example, in making *Mbaru Niang*, participant A used only two cone objects, whereas participant G employed a more complex method, utilising many objects to create *Mbaru Niang*. This has also been mentioned in previous research that individuals have different strategies when creating 3D models (Hosic et al., 2025; T.-C. Huang et al., 2019).

The third factor is spatial reasoning (Bates et al., 2023; Fowler et al., 2022; Harris, 2023; Harris et al., 2021; Mercan & Kandır, 2024). Not everyone has the same innate ability to imagine and visualise 3D objects. This makes the way of thinking and even the strategies used different. In previous studies, this was the primary factor that determined how quickly individuals could adapt to creating 3D models. It may also happen to the participants involved in this training.

In brief, the 3D modelling training for pre-service teachers was deemed successful based on the evaluation results, where pre-service teachers were able to develop examples of 3D models of several buildings in Indonesia. This training could be an idea for teacher training (not only pre-service but also in-service), where teachers should be trained in visual-spatial skills through 3D modeling from an early stage of their career. The training not only fosters creativity but can also improve teachers' problem-solving skills, especially those related to spatial abilities. This training could also serve as a reference for incorporating 3D modeling as part of the practical implementation of the *Kurikulum Merdeka* in Indonesia. Three-dimensional modeling activities can also be enforced for students, leading to increased creativity and improved student learning outcomes. Further community service or research is recommended to enhance this training, for example, by conducting training specifically focused on young learners to develop 3D spatial skills from an early age. Longer-term training could further deepen teachers' creativity and problem-solving skills in addressing diverse spatial problems involving the thousands of complex geometric shapes of buildings in Indonesia.

CONCLUSION

In conclusion, this community service highlights the training of pre-service teachers in 3D modelling using Tinkercad. The evaluation in this training highlights how pre-service teachers create two building models, namely *Mbaru Niang* and the Grand Mosque of West Sumatra. The components evaluated are the features used by teachers in Tinkercad when creating 3D models of the two buildings. From the results obtained, it was found that there were many variations in the methods used by pre-service teachers in creating *Mbaru Niang*. In contrast, the Grand Mosque of West Sumatra generally tended to be similar in its creation.

This training still has limitations, as it is currently limited to a small number of pre-service teachers. In the future, the number may be increased to reach wider training benefits. Additionally, long-term training can also be recommended in the future by introducing more complex 3D examples.

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