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Fostering Ethnomathematics in Projective Geometry: A Hypnoteaching Framework for Effective Distance Learning

[1]Ja'faruddin & [2]Wen-Haw Chen
[1]*Universitas Negeri Makassar, Indonesia*
[2]*Tunghai University, Taiwan*
[1]*whchen@thu.edu.tw*

Abstract

This study evaluated the impact of integrating students' cultural backgrounds into online learning to improve understanding and participation. It employed "Simple House Theory" and projective geometry in designing traditional houses to make complex mathematical concepts relatable. The Ethnomathematics project and the Hypnoteaching model were two instructional strategies that successfully enhanced active student participation in distance learning. Data was collected from a joint course between Universitas Negeri Makassar (UNM Makassar), Indonesia, and Tunghai University, Taiwan. The study involved 36 students: 20 from UNM Makassar's international mathematics education program (Group I) and 16 from Tunghai University's applied mathematics department (Group II). Various tools like surveys, tests, and projects were employed for data collection. The survey had 23 Likert-scale questions, allowing a thorough evaluation of student feedback. Quantitative analysis of this data revealed that incorporating the Ethnomathematics projects and Hypnoteaching model into the curriculum significantly increased student engagement in remote learning. This was further evidenced by improved student performance in project work. The research underscores the benefits of culturally relevant teaching methods in enhancing engagement and understanding in online mathematics education. It highlights the effectiveness of embedding local cultural elements into online learning environments, creating more engaging and relatable experiences. The study suggests the potential of these approaches in other educational contexts and disciplines for future research.

Keywords: Hypnoteaching, Distance Learning, Projective Geometry, Simple House Theory, Projective Coordinates.

Introduction

As universities around the world grapple with the rapid transition to online learning due to the COVID-19 pandemic, a host of challenges has come to the forefront. One of the most significant issues is the difficulty in maintaining the quality and effectiveness of teaching and learning processes in this new format. Maintaining student motivation and engagement in a remote learning environment where social media and video games are easily accessible presents another challenge (Palloff & Pratt, 2000; Febrianti, Fransiskus, & Tjhin, 2017).

As an emerging field, online education research has been striving to adapt traditional educational models to this new environment. Prior studies have confirmed that the key factors for successful online education include the design and organization of the course, the interaction between instructors and students, and the students' level of self-motivation and discipline (Threlkeld & Brezoska, 1994).

To navigate these challenges, innovative and effective strategies that enhance student self-control and engagement are required. Within this context**,** the purpose of our research is to explore such strategies, specifically through the lens of culturally-grounded teaching and learning. It seeks to develop a model that utilizes students' cultural backgrounds in conjunction with an adapted hypnoteaching model to bolster comprehension and engagement in the online learning process.

The use of students' cultural backgrounds in teaching is not a new concept. Studies have shown that culturally responsive teaching, where the instruction is tailored to students' cultural backgrounds, can be highly effective in engaging students and improving their academic performance. This approach involves a shift from a traditional, teacher-centered model to a more student-centered one, where the cultural knowledge, prior experiences, and learning styles of diverse students are recognized, nurtured, and utilized to promote an optimal learning environment (Thomas & Thorne, 2010).

Building on this concept, our research team aims to design an Ethnomathematics project using a hypnoteaching model. Ethnomathematics is an approach that recognizes the diverse ways in which different cultures understand and use mathematical concepts. By linking these concepts to students' personal backgrounds, environments, and cultures, we hope to enhance their engagement and comprehension.

The hypnoteaching model is another innovative approach that this research will utilize. Hypnoteaching is a teaching method that combines conventional teaching techniques with elements of hypnosis. While it may sound unconventional, hypnoteaching techniques do not involve any form of mind control or manipulation. Instead, these techniques aim to stimulate students' subconscious minds to facilitate more effective learning. By using this model in conjunction with the Ethnomathematics project, we aim to create a learning environment that is both engaging and effective for online learning (Thomas & Thorne, 2010).

Given the backdrop of this approach, the goals of our research can be distilled into three primary research questions:

1. How does student engagement and supportive teaching impact distance learning outcomes in the context of online education?
2. What influence do Ethnomathematics projects and the Hypnoteaching model have on students' academic performance and critical thinking skills?
3. How do projects rooted in students' cultural backgrounds enhance their cultural awareness, self-identity, and overall distance learning experience?

Ethnomathematics

Ethnomathematics arose as a counterpoint to the supremacy of Western mathematics, a dominant force which, through the mechanism of colonization, often left indigenous mathematical systems in the shadows. This process led to a significant shift in which native modes of reasoning, behavioural norms, and methods of production were either sidelined or explicitly prohibited. They were supplanted by the colonizing Europeans' knowledge systems, resulting in the dominance of Eurocentric thought (Adam, 2011). This overarching historical context provides the backdrop for our detailed examination of ethnomathematics in a specific cultural milieu.

Our research sheds light on the persistent practice of indigenous mathematics, termed Ethnomathematics, in the context of culturally significant activities such as construction, area measurement, and different types of transactions. We probe into the unique mathematical abilities passed down through the generations, a testimony to the persistence of these practices. Our research aspires to add to the ongoing discussion about the role of Ethnomathematics in challenging the hegemony of Western mathematics, a dynamic imbued with politics, hegemonic stratification, ideology, and religion (D'Ambrosio, 2016).

Focusing on the application of ethnomathematics in our research, we scrutinize the ongoing debate about the nature of mathematics. This debate transcends philosophical discourse and navigates through cross-cultural, anthropological, and political perspectives while discussing the future of mathematics education in multicultural societies (Powell & Frankenstein, 1997).

In our study, we dive into the complex interplay between mathematics and culture as it manifests in the realm of Ethnomathematics (D'Ambrosio, 1999). Though the field of Ethnomathematics is defined by the context in which it is employed (Adam, 2011) and can be identified in common structures, tools, and art, our research prioritizes the particular mathematical practices and patterns inherent to the culture under study.

Our investigation delves into the role of Ethnomathematics among distinct cultural groups (Powell & Frankenstein, 1997), often related to "cultures without written expression" (D'Ambrosio, 1999). We provide a nuanced analysis of how these specific communities incorporate mathematics into everyday life and problem-solving. Furthermore, in the context of our study, we integrate research on the simple house theory, exploring how architectural practices within the community reflect their unique ethnomathematical principles.

Our research also unveils how Ethnomathematical concepts within our study's context may deviate from Western norms. Such differences are often intertwined with factors such as environmental context, reasoning methodologies, cultural traditions, myths, codes, symbols, and religions. Our study, therefore, underscores the breadth of Ethnomathematics, going beyond the typical confines of mathematics, ethnicity, and multiculturalism to offer a comprehensive view that intertwines philosophy, linguistics, pedagogy, anthropology, and history (Rosa & Shirley, 2016).

Our study, based on D'Abrossio's (2001) definition, delves into the cultural intricacies of Ethnomathematics (Rosa & Shirley, 2016). It emphasizes the intersection of ethno (socio-cultural contexts such as language, codes of behaviour, myths, and symbols) and mathematics (activities of understanding, ciphering, measuring, classifying, ordering, inferring, and modelling).

Our study is positioned within a rich research tradition dating back to 1976, which has addressed almost every fundamental mathematical concept from counting, ordering, and sorting to measuring and weighing (D'Ambrosio, 2016; Rosa & Shirley, 2016; Syarif, 2018; Yanuarto, 2017; Zhang & Zhang, 2010). Yet, our research stands out by examining these concepts within a specific cultural context, offering a detailed understanding of their unique interpretation and application.

Our exploration of number theory reveals unique counting systems utilized in the community under study, juxtaposing them with those of ancient societies such as the Mayans, Africans, Papua New Guineans, and other "non-mainstream" societies.

We also delve into geometry, taking cues from Zhang & Zhang (2010) findings that African communities in the Sahara and Mozambican peasantry constructed traditional homes with circular or rectangular bases. Our study extends this exploration to our cultural context.

Our research contributes significantly to the understanding of symmetry in architectural practices (Sagdic, 2006), specifically focusing on how traditional Balinese homes and the Borobudur Temple in Central Java, Indonesia, apply principles of similarity, shift, and reflection (Suharta & Astawa, 2017; Yanuarto, 2017). Therefore, our work delivers a focused and thorough examination of Ethnomathematics within a particular cultural context, further enriching the field's literature.

Students' Engagement in Distance Learning

According to Bozkurt (2019), distance learning is the use of digital technology to facilitate formal, informal, and non-formal learning process, that involves the learners emotionally and physically to increase interaction among facilitator, learner, and learning materials. Bacich and Trevisani (2015) emphasize the definition of distance learning in its process. These resources are mediated by using technology. A technology-based method allows students to connect to knowledge, establishing a routine and pace that fits their study time. With Distance Learning, students can manage their study routine, which is mediated by learning management systems, to provide individualized learning (Bacich & Trevisani, 2015).

The most important factor in keeping students engaged in an online learning environment is to provide them with various options (Conrad & Donaldson, 2004). They are:

- Students are responsible for setting their learning objectives.
- Students collaborate in groups.
- Investigating relevant resources to find answers to essential questions.
- Tasks that are transdisciplinary and authentic and have real-world applications.
- Continuous and performance-based evaluation.
- Out-of-class products that are shared with a wider audience, enabling students to contribute outside of the classroom.

The principle of engagement in distance learning suits constructivism. According to Smith and Reagan (Smith & Ragan, 1999), the key to constructivism are:

- Experience is utilized to build knowledge.
- Learning is the consequence of an individual's interpretation of information. Learning is a dynamic process in which meaning is created via experience.
- Learning is a collaborative process in which many views are used to negotiate to mean.

According to Weigel (2002), content is the basis of knowledge creation; learning is shaped into something meaningful. The process of building knowledge is more viable, and coherent knowledge structures are closely tied to creativity, critical analysis, and skilled performance. There is significant evidence to suggest that learners learn best while developing their knowledge (Collison, et al., 2000). There is, however, a time to clearly advise learners or simply provide them with a critical piece of information to assist them in moving forward.

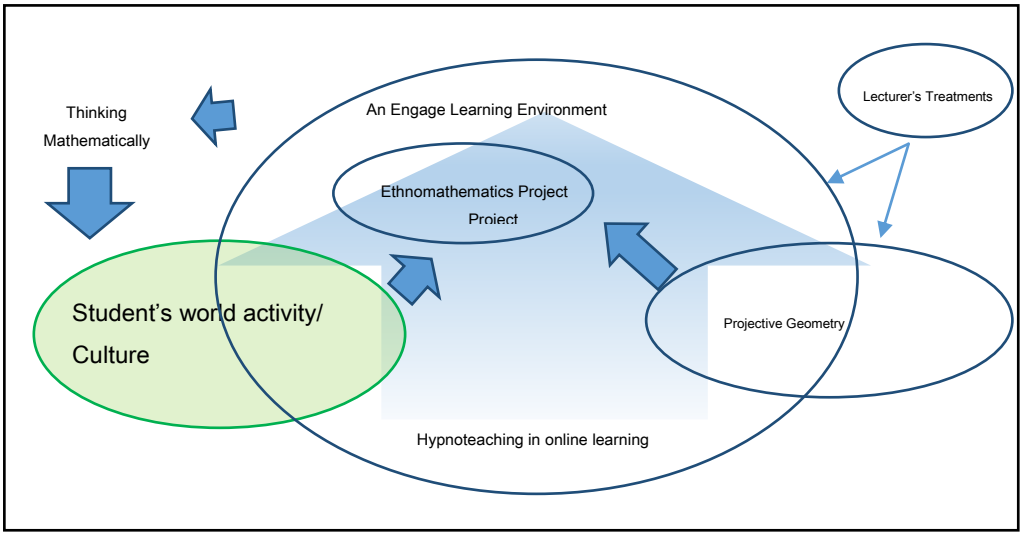

Figure 1. An Engaged Learning Framework.

Figure 1 shows the Engage Learning framework. Certain features of culture influence students' lives in one society. Their activities are affected by their parents and their community. This condition is a valuable resource for improving the teaching and learning process (Lerner & Callina, 2013; Fischer & Bidell, 2006; Rose & Fischer, 2013).

The teaching and learning are designed to make students use their cultural background in the Ethnomathematics project. The projective geometry and knot theory materials have been delivered in distance learning. After understanding the topology projective geometry concepts, students think and propose their ideas about their Ethnomathematics project. Lecturer gave some criteria in question form about the Ethnomathematics project. Students then complete their task and present their Ethnomathematics Project. In this situation, students will think creatively about their projects. They will prepare for their presentation and try to analyze their ideas, which mean students form critical thinking that contributes highly to their achievement. The lecturers' behaviours toward students are essential.

According to Kuh and Hu (2001), engagement is "the quality of students' effort to educationally purposeful activities that contribute directly to desired outcomes." The present study is based on this concept, which defines engagement as interaction with relevant phenomena and help to their learning.

Student engagement is strongly associated with academic achievement. This is a measure of academic success in the teaching and learning process. Students' attention demonstrates positive behaviours and attitudes and serves as a deterrent to students engaging in negative behaviour. Giving students a difficult task, such as a project, will increase student engagement. They will be forced to overcome the obstacles with great interest and high respect. This will lead to the contribution of students' achievement in school. (Fredricks et al., 2004; Ali & Hassan, 2018; Morse, 2004; Coates, 2006).

According to Ali and Hassan (2018), there are three dimensions of engagement: behaviour, emotion, and cognition. The effect of engagements is also divided into positive engagement, indirect engagement, and negative engagement. Positive attention manifests itself in behaviours such as attending and participating in the online class, participating in-class activities, and ultimately achieving success. On the other hand, negative engagement happens

when students feel bored and skip classes. Lecturers or teachers expect positive engagement in online learning. Appropriate design activities associated with online learning assist students in avoiding unanticipated negative engagement.

Students evaluated their engagement in the online learning process to see the level of students' enjoyment of the learning process. The pleasure will lead students to prepare for the next class. This preparation will be held for presentations or tests. Sometimes, while engaging in the teaching and learning process, students will exert great effort to advance their performance. This is because their will show their respect and effort in preparing a presentation. Engagement also can be indicated as more challenging to learn than students expect. Students will qualify for the class and discussion.

Lecturers can encourage positive engagement in online learning. There are some aspects the facilitator needs to do to make students feel engaged in distancing learning. Lecturers should prepare a course meeting platform, explain the course concepts, give feedback, and impress students in an inclusive environment.

Students must develop intellectual and critical thinking skills in online learning and recognize the relationship between the course materials and culture. They can improve their understanding by communicating and sharing their knowledge through discussion and presentation. In addition, the students' intercultural knowledge and awareness can be enriched by collaborating with students from different cultural backgrounds, such as students from other countries.

Component of Distance Learning

The distance learning process was organized and inspired by the Hypnoteaching Model (Ja'faruddin, 2021; Ja'faruddin et al., 2020). The model has been modified for distance learning by using the Ethnomathematics project as the center of the model.

The most difficult online learning is distance learning control management, including students' motivation (Palloff & Pratt, 2000; Febrianti et al., 2017). When students are in front of their computer monitor or smartphone screen, distractions such as a game or social media will unconsciously affect their concentration on distance learning. The condition is a big challenge in the teaching and learning process. This situation needs treatments and methods to lead students in self-controlling during online and distance learning.

As such, the initial lesson for students in both online and in-person learning should revolve around self-regulation during digital education (Threlkeld & Brezoska, 1994). Hypnoteaching could be a viable solution to mitigate this issue. A significant advantage of the Hypnoteaching method lies in its capacity to assist learners in managing their thoughts during the instructional process through positive affirmations. This approach enables them to guide their thoughts by providing constructive affirmations. Such affirmations are offered to learners prior to and during the commencement of online learning (Ja'faruddin, 2014; Ja’faruddin et al., 2020).

The principles of Hypnoteaching endorse the application of cultural content in teaching. The cultural context can be employed to enhance students' comprehension. Learners can discern the correlation between their pre-existing knowledge, their environment, their cultural and personal backgrounds, and mathematics, and thereby reconfigure their understanding of

the material, ultimately bolstering their advanced cognitive abilities (Thomas & Thorne, 2010).

The process of remote learning, through the implementation of a modified Hypnoteaching model for online and distance education incorporates the following elements (Ja'faruddin, Upu, Chen, & Teng, 2020):

The first element pertains to rapport-building, which involves establishing a connection with the students. Hypnoteaching is linked with pacing and leading, both of which commence with the student's original idea in the context of Ethnomathematics. Subsequently, the teacher guides the student to establish a connection with mathematical concepts. The students express their cultural perspectives, and they are guided towards comprehending mathematical concepts through their cultural understanding. They are motivated to realize that mathematics pervades their daily lives and their culture.

The second element involves triggering a unique anchor, which is the most crucial and distinctive aspect of learning. This unique anchor is an emotional catalyst that facilitates learners in accessing their most productive emotional state by eliciting positive emotions. In remote education, the unique anchor is activated by the teacher's patient demeanour and other impressive, unique actions on the teacher's part.

The third element emphasizes the importance of properly structuring the online learning environment for group activities and for the teacher and students to adhere to the principles of questioning and answering during the online learning process. The teacher aids students in internalizing the material, which is structured to present their mathematical ideas in relation to their culture.

The fourth element involves the integration of the knowledge acquired through mind mapping (Buzan & Buzan, 1993) or note-taking (Pauk & Owens, 2005). At this stage, students map out their ideas to form a connection between mathematics and their notions about knot theory. This element is crucial in assisting students in establishing connections between their culture, real-life activities, and traditional mathematics.

The final element entails reflecting on the teaching and learning material. This element is well-suited for distance education since students can unwind in their homes or any other relaxed environment to participate in remote learning. This final step needs to conclude with a positive affirmation to reinforce the "learning" and the "genius anchor." Students document the most crucial takeaways from the lesson.

House Theory: Building Numbers and Projective Coordinates

Chen and Ja'faruddin's (2021) research developed a theory of housing based on traditional buildings and projective geometry. Traditional structures embody the culture, history, and identity of a nation, as underscored by Teng (2016). The researchers used the terminology associated with traditional dwellings to better identify historic buildings. Traditional houses, built following conventional methods, serve socio-cultural roles and are passed down through generations. Each traditional house is built around a particular concept that guides its design (Yudohusodo, 2007).

Chen and Ja'faruddin's (2021) study used projective geometry to divide simple dwellings into three categories. They determined building numbers and projective coordinates based on the structure of traditional Indonesian dwellings. From an Ethnomathematical perspective,

traditional dwellings are represented in house diagrams, which are then projected using vanishing points. This method was applied to the analysis of a traditional Indonesian house, resulting in a house diagram with one vanishing point.

Building on the definition of projective transformations, Chen and Ja'faruddin (2021) posited that the combination of a triangle and trapezoid is projectively congruent to a rectangular triangle. This definition was then used to develop building numbers. Simple houses were categorized based on basic geometrical figures, such as rectangles, triangles, and combinations of rectangular triangle shapes, rectangular shapes, rectangular-triangular trapezoid shapes, rectangular trapezoid shapes, and shapes with curved edges.

Seven categories of simple houses were identified, each with distinctive shapes and representative examples from different cultures:

Simple House I (Cubic Simple House): These houses have a cubic form, like a mud house in a local village in Pakistan.

Simple House II (Triangular Simple House): These houses are triangular, like the Uma Lengge, a traditional house in Bima District, West Nusa Tenggara, Sumbawa Island, Indonesia.

Simple House III: These houses have a triangular-trapezoidal shape, like the Batak Toba traditional houses in Indonesia.

Simple House IV: These houses combine a triangle and a rectangle, like some houses in the Bone District, South Sulawesi Province, Indonesia.

Simple House V: These houses combine a triangle, a trapezoid, and a rectangle, like the Sao Mario House and Batak Toba House in Indonesia.

Simple House VI: These houses combine two trapezoids and one rectangle, like the Joglo House and Tongkonan House in Central Java, Indonesia.

Simple House VII (Paraboloid Simple House): These houses are parabolic, like Hanoi houses in Papua Province, Indonesia.

The researchers also introduced the concept of building numbers and projective coordinates to identify traditional house models. The building numbers of a house diagram take the form $\hat{\boldsymbol{n}}_{\alpha,\beta}$, where α is the index of a building of the same type, β is the number of vanishing points, and n is a natural number. Projective coordinates, denoted as (a, b, c), include building numbers from one, two, and three vanishing points respectively.

Chen and Ja'faruddin (2021) concluded that traditional dwellings can be classified using a coding system that utilizes building numbers and projective coordinates. This system could help organize traditional dwellings from Indonesia and other nations in the future.

Methods

Investigative Site and Participants

This research was conducted under the "MERDEKA BELAJAR KAMPUS MERDEKA (Independent Campus, Freedom to Learn)" initiative, supported by the Ministry of Education. The course, a joint venture between UNM and Tunghai University, offered a chance to observe student engagement in a remote learning setting. Active video feeds kept by students during the online sessions were a primary source of real-time data. Additional data came from student interaction patterns, recorded through text responses on Google Jamboard and verbal

communication during the online sessions. The study group consisted of 36 students, including 20 from UNM Makassar's international mathematics education program (Group I) and 16 from the applied mathematics department at Tunghai University (Group II).

The Instruments

The research tools included surveys, tests, and projects. The survey contained 23 questions with fixed responses on a 4-point Likert scale. The survey was divided into three sections; the first part consisted of five questions assessing students' engagement and involvement in distance learning. The second segment included eight questions related to clarity and encouragement, while the third section comprised ten questions evaluating learning outcomes. The achievement of students was evaluated using Ethnomathematics project rubrics and tests.

Data Collection

The data for this study was systematically collected through a series of procedures. To begin with, Professors conducted their presentations via Zoom, Meet, and Teams. In response, students actively engaged by recording their feedback and responses on Google Jamboard and Pear Deck. Following the instructional phase, students proceeded to assemble their projects and presented via Zoom. Subsequently, students participated in a survey to provide feedback regarding their group interactions, with the average completion time for the survey being approximately 20 minutes. Once the surveys and open-ended questions in Google Forms were completed, the data was subjected to analysis.

Data Analysis

Data was processed using quantitative techniques. Data points 1 to 22 were analyzed quantitatively using Excel sheets and represented in bar charts. The data was sorted into three categories: engagement and involvement of students in distance learning, clarity and encouragement, and learning outcomes.

Results and Discussion

Results

Understanding the level of student engagement in remote learning environments requires a careful examination of the nature and quantity of interactions between the students and their instructor during online sessions. Both the depth and frequency of these interactions provide a measure of engagement. In this study, we adopted a comprehensive approach to assess the dynamics of this interaction and evaluated its influence on learning outcomes.

The research particularly focused on the application of Ethnomathematics within a Hypnoteaching Framework in the course titled Projective Geometry. This innovative pedagogical approach was observed across three distinct stages of the remote learning process, offering a broad overview of its implementation and effects. These stages included the lecture sessions led by the instructors, the group discussions among the students, and the individual presentations delivered by the students. Observing these different interactions provided a holistic view of how the pedagogical strategy was used and how students responded to it.

One of the first steps in the application of the Hypnoteaching model within the Ethnomathematics project was the establishment of rapport. This began in the initial meeting, where the lecturer aimed to foster a connection with the students by understanding their original ideas about the course content. From this starting point, the instructor could gradually guide students towards the relevant mathematical concepts. This approach not only allowed for an introduction to the academic content but also provided a platform for students to express their cultural perspectives. The goal was to use this cultural framework as a pathway to understand the mathematical ideas. This method emphasized that mathematics is not an isolated academic field but rather one that interlinks with culture and daily life experiences.

As the online sessions progressed, the lecturer continued to maintain a positive learning atmosphere by providing constructive suggestions related to the students' cultural backgrounds. This was a particularly important aspect of the Hypnoteaching approach, serving as a unique anchor to maintain the emotional state of students during the learning process. These suggestions were tailored to both Indonesian and Taiwanese students, thereby promoting inclusivity and cultural relevance in the course content.

The design of the online learning environment was carefully curated to promote engagement. The layout and structure of the course were arranged to encourage group activities and uphold the principles of the questioning and answering process during learning. This strategic course design, in combination with the instructor's efforts, helped students assimilate the material effectively. The content was strategically planned to enable students to align their mathematical ideas with their cultural contexts, promoting a comprehensive understanding of the course concepts.

In a subsequent stage of the course, students were tasked with integrating the knowledge they acquired through the process of mind mapping. This activity involved students outlining their ideas, forming a connection between mathematics and their notions about knot theory, a key topic in the course. This crucial step aided students in establishing links between their cultural perspectives, daily life activities, and traditional mathematical concepts. By doing so, the course facilitated a deeper understanding of the course material by relating it to familiar concepts and experiences.

The final step in this pedagogical approach was a phase of presentation and reflection. This involved students reviewing their learning materials and reflecting on their understanding of the concepts. Given the remote nature of the learning, this phase allowed students to engage in this reflective practice from the comfort of their homes or other chosen environments. This step was crucial in reinforcing the learned material and evaluating individual understanding.

In addition to these pedagogical strategies, we further evaluated the quality of interaction between students using an observation sheet. The analysis involved a thorough review of the video recordings of the online learning sessions by two independent observers. We used the results of the students' self-assessments to optimize their interaction during the online learning sessions. Examination of the Zoom recordings revealed that students were actively involved in both asynchronous and synchronous learning sessions, indicating a high level of engagement and interaction throughout the course.

Student Engagement and Involvement in Distance Learning

The study's findings on student engagement and participation in distance learning with a focus on projective geometry are visualized in Figure 2. The feedback was overwhelmingly positive across all groups, with Group I, in particular, demonstrating a considerably higher level of engagement than Group II.

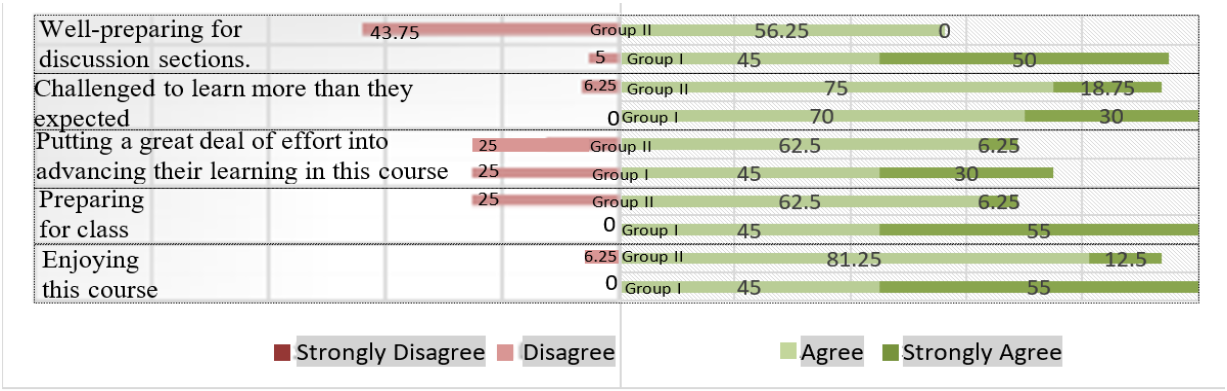

Figure 2. Student engagement and involvement

On an individual level, every student in Group I reported a positive learning experience. They enjoyed the course, made adequate preparation for class, and found the learning process more intellectually stimulating than they initially predicted. However, a small segment of students in Group II had a different perspective, with 6.25% reporting a lack of enjoyment in online learning, 25% admitting to insufficient preparation for class, and 6.25% finding the learning process less challenging than expected.

In terms of personal investment in the learning process, the majority of students from both groups, a figure exceeding 65%, claimed they put considerable effort into optimizing their experience in the online learning environment. Conversely, a quarter of students in both groups acknowledged a lack of effort. It is worth noting that 6.25% of the total students chose not to respond to this question.

When considering preparation for group discussions, an intriguing difference became apparent between the two groups. About half of the students from Group II confessed they hadn't adequately prepared for the discussions, a stark contrast to Group I, where only 5% admitted to a lack of preparation.

This evaluation underscores the differences in engagement and preparation levels among students and underlines the importance of individual and collective accountability in remote learning environments. It provides valuable insights for educators seeking to optimize student participation and engagement in distance learning scenarios. Further studies could probe these dynamics more deeply to understand the specific factors influencing student motivation and commitment in online learning.

Table 1.
Summary of Descriptive Analysis and Hypothesis Testing of Student Engagement and Involvement in Distance Learning

Category	Group I	Group II
Subject	20	16
Very low	0.00%	6.25%
Low	0.00%	18.75%
High	55.00%	68.75%
Very high	45.00%	6.25%
Mean	3.28	2.7875
Category of mean	Very high	High

Table 1 provides a descriptive analysis and hypothesis testing results concerning students' engagement and involvement in distance learning focusing on projective geometry. The table is divided into two major sections, Group I and Group II, reflecting two separate student cohorts participating in the study.

The "subject" row presents the total number of students in each group, with 20 students in Group I and 16 students in Group II. The subsequent rows categorize the level of student engagement and involvement in distance learning into four categories: very low, low, high, and very high.

The results are remarkably positive for Group I, with 0% of students falling into the 'very low' or 'low' categories. Instead, 55% of students demonstrated 'high' engagement and involvement, and an impressive 45% of students showed a 'very high' level of engagement and involvement.

However, the results for Group II were more varied. The 'very low' category contained 6.25% of Group II students, and 18.75% fell into the 'low' category. The 'high' category was the most populated, with 68.75% of the students, but only 6.25% of the students in Group II reached the 'very high' category.

The 'Mean' row in the table displays the average levels of engagement and involvement for each group, with Group I having a mean score of 3.28 and Group II a mean score of 2.7875. The category of mean engagement and involvement is indicated as 'very high' for Group I and 'high' for Group II, further reinforcing the superior performance of Group I.

This table underscores the differences in engagement levels between the two student groups, indicating that Group I students demonstrated a significantly higher level of engagement and involvement in distance learning compared to Group II.

The findings offer a nuanced picture of student engagement across different groups and present critical insights for educators aiming to enhance student engagement in distance learning environments. Further examination could delve deeper into these dynamics, exploring the specific factors influencing these engagement levels and identifying strategies to boost motivation and commitment among students in distance learning scenarios.

The Clarity and Encouragement by the Instructor in Distance Learning

Figure 3 presents a detailed visual breakdown of how students assessed eight different aspects related to the clarity and encouragement offered by the instructor during distance learning. On the whole, both groups provided full marks to the instructor on six out of eight criteria, demonstrating a high level of satisfaction with the instructor's clarity and motivation in most areas.

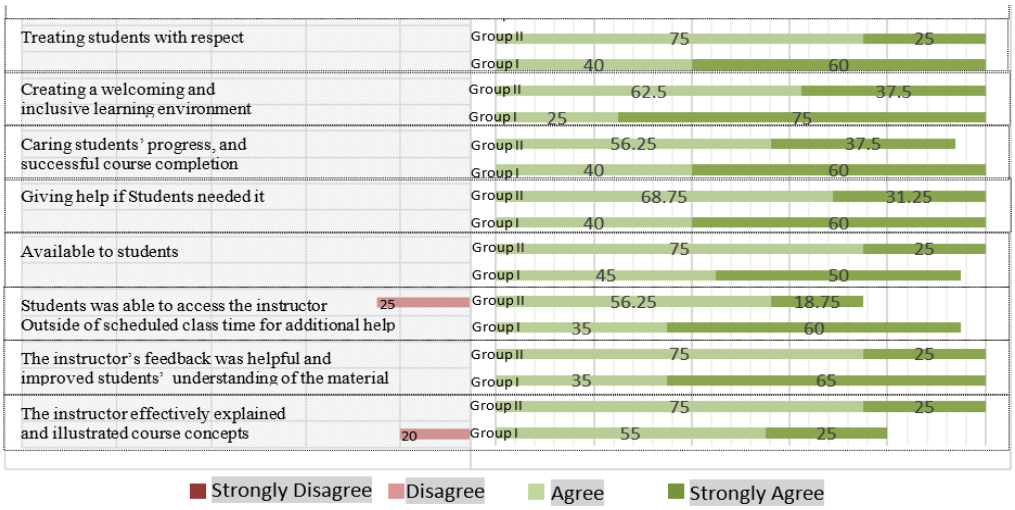

Figure 1. Clarity and Encouragement (in percentage)

In more granular terms, all students acknowledged that the instructors treated them respectfully, fostered a welcoming and inclusive learning environment, exhibited genuine care for student progress, were consistently available for assistance, and provided effective feedback. These findings highlight the integral role played by the instructor's approach and conduct in shaping a positive and productive distance learning experience.

However, the remaining two criteria saw varying responses from both groups. Notably, a quarter of students from Group II reported they were unable to access the instructor outside of the scheduled class time for additional assistance, a contrast to all students from Group I who expressed no such difficulties. Similarly, a fifth of Group I students felt the instructor was not effectively explaining and illustrating the course concepts, while all students in Group II expressed satisfaction with the instructor's explanation and illustration of the course material.

Table 2.
Summary of Descriptive Analysis and Hypothesis Testing of Clarity and Encouragement

Category	Group I	Group II
Subject	20	16
Very low	0.00%	0.00%
Low	0.00%	0.00%
High	40.00%	68.75%
Very high	60.00%	31.25%
Mean	3.60625	3.234375
Category of mean	Very high	High

Table 2 provides a summarized descriptive analysis and hypothesis testing on the clarity and encouragement aspect of the learning process. Generally, students from both groups

assessed the instructor's clarity and encouragement at 'high' to 'very high' levels. In Group II, over 60% of students categorized the instructor's clarity and encouragement as 'high', while the remainder assessed it as 'very high'. Conversely, in Group I, 60% of students evaluated the instructor's clarity and encouragement as 'very high', with the remaining students categorizing it as 'high'.

Student Self-Assessment

Figure 4 provides a comparison of student self-assessment results, spanning across ten criteria related to their academic achievements. These criteria include the development of critical thinking skills, ability to evaluate arguments, problem-solving capabilities, knowledge acquisition, confidence in communicating their understanding, recognition and analysis of the relationship between mathematics and culture, intercultural learning, cultural awareness, and the use of literature for their projects.

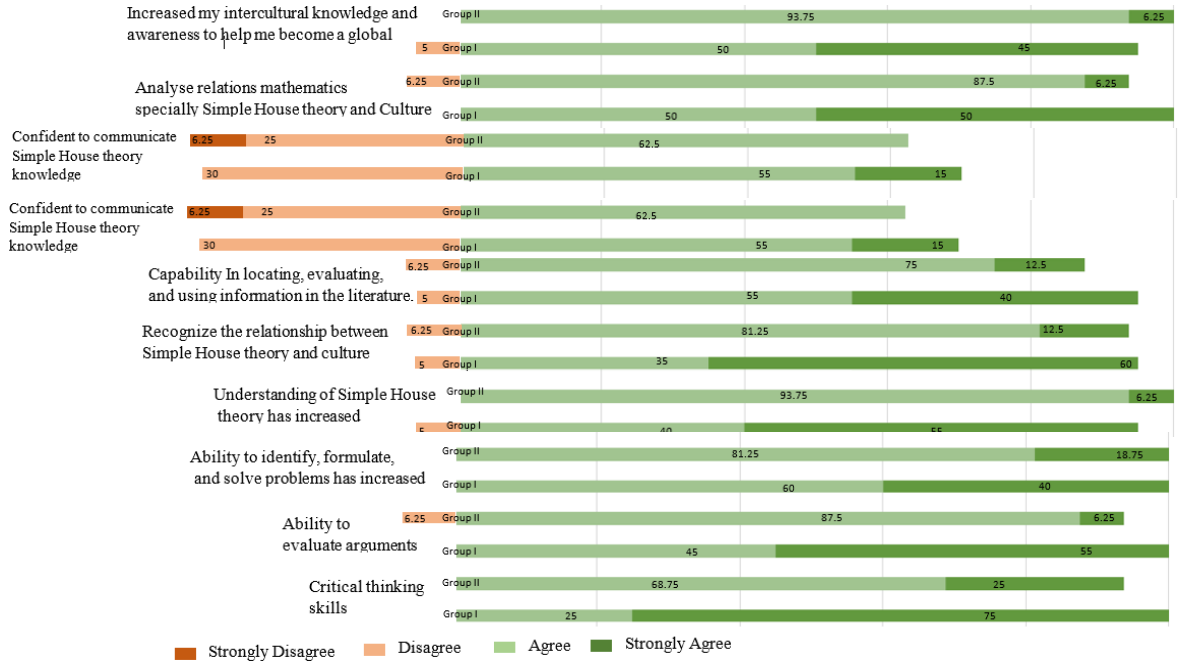

Figure 4. Student Self-Assessment

Collectively, all students from both groups acknowledged that distance learning has bolstered their intellectual and critical thinking skills, enhancing their ability to identify, formulate, and solve problems. However, a disparity was observed in the confidence levels in communicating their understanding of the Simple House Theory. Specifically, a quarter of Group II students expressed a lack of confidence in communicating their knowledge, compared to a smaller proportion, just 5% in Group I. When it comes to knowledge sharing, about 31% of students from both groups did not feel confident in communicating their understanding of the Simple House Theory. Despite these differences, an overwhelming majority, more than 90% of students from both groups, affirmed that the course aided them in achieving the other criteria.

Table 3.
Summary of Descriptive Analysis and Hypothesis Testing of Self-Assessment

Category	Group I	Group II
Subject	20	16
Very Low	0.00%	0.00%
Low	0.00%	0.00%
High	50.00%	81.25%
Very High	50.00%	18.75%
Mean	3.32	2.99375
Category of mean	Very High	High

Table 3 presents a summarized descriptive analysis and hypothesis testing of learning outcomes. It shows that all participants from both groups yielded good results, falling into the 'high' and 'very high' categories. Group I showed an even distribution, with 50% of the students in each category. In contrast, Group II had more than 80% of its students categorized as 'high', while around 20% fell into the 'very high' category.

These findings underline the impact of the course on enhancing students' critical thinking skills, problem-solving abilities, and knowledge of the subject matter. The results also highlight areas where additional support could be beneficial, such as building confidence in communicating their understanding. Future courses could therefore incorporate more opportunities for students to practice and refine their communication skills, thereby increasing their confidence and ultimately their ability to articulate their understanding of complex concepts.

Students Achievements

In addition to student feedback concerning their engagement, involvement, and perceptions of the instructor's clarity and encouragement, data was also collected on student learning achievement scores. This data served to evaluate the effectiveness of the Hypnoteaching model and the incorporation of Ethnomathematics projects into the online learning process.

Table 4.
Summary of Student Achievement in Mathematics Learning

Statistics	**Result**	
	Grup I	Group II
Number of Participants	20	16
Ideal Score	4	4
Highest Score	3.68	3.54
Lowest Score	3.36	3.40
Score Range	0.32	0.14
Average Score	3.56	3.52
Standard Deviation	0.086	0.098

Table 4 presents the mathematics learning achievement outcomes for both groups after the implementation of Ethnomathematics projects in projective geometry. It is evident that student performance in both groups is generally high. For Group I, the average score is 3.56, with the highest and lowest scores being 3.68 and 3.36 respectively. Group II students show

similar achievement levels, with an average score of 3.52, and the highest and lowest scores recorded at 3.54 and 3.40, respectively.

The lower score range and standard deviation in Group II suggests a more consistent level of achievement within this group, indicating that their scores are more clustered around the mean compared to Group I. Nonetheless, both groups demonstrate significant achievement, signifying the impact of the integrated Ethnomathematics projects and Hypnoteaching model.

Table 5.
Mathematics Learning Achievement Level

Category	Frequency	
	Grup 1	Grup 2
Very Low	0	0
Low	0	0
High	20%	31,25%
Very High	80%	68,75

Table 5 provides a breakdown of achievement levels for both groups. In Group I, a majority of the students (80%) achieved a very high level, while the remaining 20% are within the high achievement level. In Group II, the percentage of students in the very high level of achievement is slightly lower at 68.75%, while 31.25% are at a high level of achievement. Despite these slight variations, the results underscore the success of incorporating Ethnomathematics projects within the Hypnoteaching model in boosting student achievement in both groups.

Discussion

Student Engagement and Involvement in Distance Learning

Student engagement is an essential factor in successful education, particularly in distance learning environments (Coates, 2006). Our study underscores this, showing that students in the given sample were keen to participate in distance learning, exhibiting strong self-regulation and engagement in the process. These sentiments were echoed in their overwhelmingly positive response to the motivation survey.

Enjoyment was found to be a significant predictor of engagement. When students enjoy their courses, they are more likely to prepare for online classes and discussions, making the learning process more appealing. Notably, when students perceive the learning process as challenging, their engagement increases, inspiring them to put in the extra effort to enhance their remote learning experience.

The Hypnoteaching model played a pivotal role in boosting student engagement and involvement in distance learning (Ja'faruddin et al., 2020). This model emphasizes the importance of a well-structured online learning environment, conducive to group activities, and following the principles of questioning and answering, thus aiding students in assimilating the material and connecting mathematical concepts to their cultural context.

This study focused on students from UNM Makassar dan Tunghai University, who exhibited increased motivation and effort in the online course, notably due to the course's emphasis on Indonesian culture. A quantitatif analysis confirmed that the intersection of mathematics and culture plays a significant role in enhancing student engagement.

Figure 2 and Table 1 provide a comprehensive view of student engagement and involvement in distance learning, especially focusing on projective geometry. Across all groups, the majority of students reported positive engagement and participation. However, students in Group I exhibited notably higher levels of engagement and participation compared to those in Group II.

Examining the individual feedback, all students in Group I reported finding the course enjoyable, being well-prepared for the class, and finding the learning process more challenging than they had initially anticipated. Some students in Group II, however, presented a differing viewpoint. A small percentage (6.25%) of these students reported a lack of enjoyment in the online learning experience, and a quarter admitted to not being well-prepared for the class. About 6.25% of the students found the online learning process less challenging than they had initially anticipated.

While the majority of students from both groups claimed to put considerable effort into optimizing their online learning experience, a quarter of students from both groups admitted to not putting forth as much effort as they could have. In terms of preparing for group discussions, half the students from Group II confessed to not preparing adequately, in stark contrast to Group I, where only 5% admitted to a lack of preparation.

The study's findings underscore the differences in engagement and preparation levels among students. It emphasizes the need for individual and collective responsibility in distance learning environments, providing essential insights for educators striving to optimize student participation and engagement in distance learning scenarios.

The Clarity and Encouragement by the Instructor in Distance Learning

In the realm of distance learning, especially in the context of Ethnomathematics projects, the role of instructors extends beyond simply delivering content. Their ability to communicate clearly and provide encouraging facilitation is of paramount importance in shaping the student learning experience. Respectful and engaging interactions between the instructor and students can greatly enhance the comfort and inclusivity of the learning environment, fostering more productive and motivated learning dynamics.

The study results, as depicted in Figure 3 and summarized in Table 2, indicate that students highly appreciate instructors who are interested in their progress and provide valuable feedback on engagement, homework, and overall achievements. These factors directly contribute to creating a welcoming and inclusive learning environment that bolsters student motivation.

Moreover, the Hypnoteaching model, which was integrated into the learning process, further underscores the significance of clarity and encouragement by the instructor (Ja'faruddin et al., 2020). The model facilitates the connection of mathematical concepts to cultural and real-life activities, thereby engaging students more deeply and personally in the learning process. It underscores the value of mind mapping, note-taking, and reflective practices in facilitating the understanding and integration of teaching and learning materials.

In the context of distance learning, the instructor's qualities, including patience, availability, clarity, respect, and enthusiasm, play a significant role in enhancing the course's

appeal to students. Such a student-centered approach not only elevates the learning experience but also necessitates a high level of commitment and preparation from instructors.

Delving into the finer details of the results, a few disparities emerge between Group I and Group II. Notably, a quarter of students from Group II expressed difficulties in accessing the instructor outside the scheduled class times, a hurdle that was not reported by Group I students. Additionally, while all students from Group II were content with the clarity of course concepts, a fifth of Group I students reported dissatisfaction in this area.

In essence, these findings underline the critical role of the instructor in facilitating a conducive distance learning experience. Further exploration could delve deeper into the specific strategies that can enhance the clarity and encouragement offered by instructors in distance learning environments.

The Students' Achievement

An essential aspect of the Ethnomathematics projects is the ability to cultivate critical thinking skills by inviting students to delve deeper into the relationship between mathematics and their cultural heritage. Students are motivated to identify and evaluate the links between mathematical principles, cultural traditions, structural designs, and the creation of traditional tools.

The Hypnoteaching model has proven instrumental in fostering this exploration and enhancing student achievement (Ja'faruddin et al., 2020). It enables students to map their ideas, discern connections between mathematics and their understanding of projective Geometry, and foster critical reflection on the teaching and learning materials.

Students participating in the project demonstrate a heightened recognition and analysis of the relationship between mathematics and culture. In completing their projects, they enhance their understanding of intercultural knowledge, leading to increased cultural awareness as part of their identity (Kinasevych, 2010).

In essence, the task of project assignment based on students' cultural backgrounds is significant. It invokes deep engagement and motivates them to draw resources from within their community to ensure the project's success. This strategy, nestled at the intersection of culture, mathematics, and real-world context, enriches the learning experience and facilitates higher levels of learning.

Figure 4 and Table 3 offer a more detailed look at how students perceive their own learning achievements across a range of criteria. They suggest a robust self-assessment of improved intellectual and critical thinking skills, heightened abilities to identify, formulate, and solve problems, and a noticeable confidence in communicating their understanding of the Simple House Theory.

However, the results also shed light on a disparity between the confidence levels of students in Groups I and II, with students in Group II expressing a lack of confidence in communicating their knowledge compared to Group I. Despite these differences, the vast majority of students from both groups affirm the course's effectiveness in achieving other outlined criteria.

The achievement data, summarized in Tables 4 and 5, underscores the effectiveness of the integrated Hypnoteaching model and Ethnomathematics projects. Students' scores indicate

high achievement levels, with a notable consistency within Group II, as suggested by their lower score range and standard deviation.

These findings highlight the impactful role of culturally integrated teaching models in enhancing critical thinking, boosting students' confidence, and fostering higher levels of achievement. Future directions may involve creating more opportunities for students to refine their communication skills, further bolstering their confidence and ability to articulate complex concepts.

Conclusion

The study underlines the effectiveness of student-centered and culturally relevant teaching strategies, such as Ethnomathematics and Hypnoteaching, in enhancing critical thinking, academic performance, and the overall quality of distance learning experiences.

Firstly, the study highlighted the significant impact of student engagement and supportive teaching on distance learning outcomes. It established a strong correlation between high student engagement and better learning results. This engagement was largely attributed to a teaching environment that was both supportive and respectful, creating an inclusive atmosphere for online learning. The study found that effective teaching strategies, including constructive feedback and readily available support, played a crucial role in the success of distance learning outcomes.

Secondly, the influence of Ethnomathematics and Hypnoteaching on students' academic performance and critical thinking was evident. The Ethnomathematics projects allowed students to connect mathematical concepts with their cultural backgrounds, leading to a deeper understanding and enhanced critical thinking. The Hypnoteaching model aided in organizing their thoughts and establishing meaningful links between mathematical concepts and cultural contexts, which in turn improved academic performance.

Finally, the study revealed that projects grounded in students' cultural backgrounds significantly boosted their cultural awareness, self-identity, and the overall distance learning experience. These culturally oriented projects made the learning content more relevant and engaging, enriching the distance learning experience. By involving students in projects that were rooted in their own cultural backgrounds, they were encouraged to explore resources within their communities. This approach provided a culturally rich and relevant learning context, not only enriching their educational experience but also promoting higher levels of learning.

The research offers several recommendations for future studies and explorations to deepen our understanding and improve the student experience in distance learning.

Firstly, it suggests expanding the research to include a wider range of student demographics. By involving diverse student populations from varying cultural, socioeconomic, and educational backgrounds, researchers can gain a broader perspective on the effectiveness of the Ethnomathematics and Hypnoteaching models.

Secondly, there is a recommendation for longitudinal studies. By tracking student performance, engagement, and involvement over an extended period, these studies could provide valuable insights into the long-term effects of these teaching models.

Thirdly, the research proposes investigating the application of these models across different academic disciplines. This would help in assessing their versatility and effectiveness beyond the field of mathematics.

Another area of recommendation is lecturer training. Exploring the impact of specific teacher training programs on the implementation of these learning models could help in refining their effectiveness in distance learning environments.

The study also highlights the potential of integrating advanced educational technologies, such as artificial intelligence or virtual reality, with these models. This could potentially enhance student engagement and achievement.

Additionally, there is a call for developing more sophisticated methods to measure student engagement in distance learning. Methods like qualitative interviews or focus groups could provide deeper insights into student involvement.

Lastly, the research recommends tracking and assessing ongoing global initiatives that are implementing and studying the Ethnomathematics and Hypnoteaching models. These initiatives, along with efforts to understand culturally responsive teaching in online learning environments, could offer valuable data for future research.

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