ETHNO-FLIPPED CLASSROOM MODEL: FLEXIBILITY MEETS CULTURALLY-CONTEXTUALIZED MEANINGFUL LEARNING

by Rahmi Ramadhani

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Abstract

The success of mathematics is largely based on the learning model, which has been proven in terms of syntax and field application. However, the learning model has not adjusted to the environment around students, including cultural and traditional contexts, and it is inapplicable and ineffective to enhance students' mathematical skills. This can be seen from the lack of implementation of learning that brings students closer to meaningful experiences. The meaningfulness obtained from mathematics learning and the results of the application of activity-centered learning have not provided optimal results. Subsequently, the contradiction between learning theories and the application results should be analyzed. Therefore, this study aimed to provide recommendations for developing new models and theories to optimize the application of flexible and meaningful learning. The results provided recommendations for developing a model that integrates the flipped classroom model and the ethnomathematics approach. Meanwhile, a new theory was also proposed due to the development of the Cognitive-Social-Cultural Constructivist Theory of Learning (CSCCTL). Further studies on the development of theories from the ethnic-flipped classroom model should be conducted.

Keywords: Cognitive Learning Theory, Constructivism, Ethnomathematics, Flipped-Classroom

Introduction

Mathematics is a subject that provides experience for students to use their ability to think logically, critically, practically, and thoughtfully in solving contextual problems. It also plays a role in training students to be positive, creative, critical reasoning, and responsible in every decision made after solving a problem. The existence is crucial the advancement of science and technology as well as the intellectual growth of children. It allows teachers to investigate the subject in various contextual and non-contextual situations. Mathematics learning is growing along with the times, and technology integration, specifically after the Covid-19 pandemic.

Technology in mathematics education serves as an aid and integral element of comprehension. The integration of technology promotes teachers to be more flexible in providing differentiated learning experiences to students (Kafyulilo et al., 2015; Liburd & Jen, 2021) Teachers are no longer constrained by limited space, and various types of technology also facilitate their creativity to implement more optimal mathematics learning.

The flexibility offered in technology integration also has a negative impact on learning. Unpreparedness to use technology is one of the variables that contribute to suboptimal mathematics learning. Boca (2021), Bringula et al. (2021), and Keržič et al. (2021) agreed that personal factors and the personal behavior of each person cause the unpreparedness of students and teachers in using technology. Technology integration can provide new math learning experiences for students. Meanwhile, meaningful and student-centered learning is a new paradigm in mathematics learning (Polman et al., 2021). Meaningful learning is also one of the Sustainable Development Goals (SDGs), which focus on achieving quality education for all. Education for Sustainable Development (ESD) involves strengthening local culture in developing the quality of education. Hill et al. (2020) and Zidny et al. (2020) agreed that the combination of knowledge gained from local culture and science could be continued at various scales and education sectors.

Teachers have long implemented meaningful and student-centered learning by applying learning models based on constructivism (Mercer et al., 1994), Vygotsky (Vygotsky, 1978), and Ausubel's learning theory (Vallori, 2014). Student-centered cooperative (Kurjum et al., 2020; Turgut & Turgut, 2018) and project-based learning (Almulla, 2020; Jacques, 2017) emphasized group activities and project-based investigations (Bamiro, 2015). Furthermore, the model focuses on the discovery and problem-based learning model activities (Argaw et al., 2017; Ramadhani, Huda, et al., 2019). Meaningful learning in mathematics (Revina & Leung, 2019; Yuanita et al., 2018) focuses on students' activities using real-world situations and experiences.

The field shows that mathematics teachers have implemented student-centered learning. However, the learning model has not been well validated regarding the suitability of the syntax and its application. Furthermore, it has not adjusted to the environment around students, including cultural contexts and traditions. The learning model is not practical and effective in helping students improve their abilities. This can be seen from the lack of implementation that brings students closer to meaningful learning experiences. TIMSS survey in 2019 (Mullis & Martin, 2017) showed that environmental factors, the quality of learning practices, and socioeconomic background are closely related to the achievement of learning outcomes.

Based on the results, personal factors and behavior are obstacles to optimizing student-centered learning. Another aspect that does not include environmental, social, traditional, and cultural factors is the suboptimal application of meaningful learning. This causes students to struggle to comprehend, reason, and solve contextual problems outside their cultural backgrounds.

Many findings showed that meaningful and student-centered learning can improve students' mathematical abilities (Khadka et al., 2022; Lin et al., 2020; Maam et al., 2022) Based on this, it is considered necessary to conduct further studies regarding proposed solutions. Investigation and analytical studies are needed to develop a new learning model. Furthermore, an analytical study is also needed to determine contradictions in learning theories as the basis of meaningful and student-centered learning. Therefore, this analytical study focuses more on the role of social environment, tradition, and culture in optimizing the process of meaningful and student-centered mathematics learning.

Method

This study is qualitative research using an integrative literature review approach to build a theoretical working construction related to recommendations for alternative learning models used in technology-based distance schemes. In this study, an integrative literature review provides the basis for building a new model or conceptual theory by reviewing, critiquing, and synthesizing the literature that presents a particular topic so that new theoretical frameworks and perspectives can be built (Torraco, 2005). In addition, integrative literature review studies also have a potential unique contribution to the conceptualization of topics that do not exist, which can then be used to develop new frameworks and perspectives by providing an overview or description of research trends and their effects (Prahmana, 2022).

The study results from the integrative literature review process will obtain findings from various previous studies, which are then analyzed to obtain what underlies the emergence of these findings. The results of the analytical study obtained are then criticized for presenting the construct of a new theoretical study framework, namely the recommended mathematics learning model in the implementation of learning in the New Normal period. The focus of the findings and analytical studies resulting from the integrative literature review process is then used as the main characteristics of the new mathematics learning model. The learning model recommendations presented through the integrative literature review approach are also based on syntax studies on learning models related to researchers' focus and analysis studies. In this study, the flipped classroom model and ethnomathematics approach are used as the basis for syntax and characteristics that will be integrated into recommendations for a new model while still presenting meaningful learning that is close to the traditions and culture of students and flexible to be applied using technology-based learning. This research is conducted in four steps: designing the review, leading the review of the results, analyzing the results, and writing the report (Snyder, 2019; Torraco, 2005).

Discussion

Flipped-Classroom Model

Flexibility in the Flipped Classroom Model

Blended learning, such as flipped classroom model, has advantages in learning flexibility by integrating technology as a connecting space during the process. The model is carried out in two stages, namely out-class and in-class learning (Ramadhani, 2020; Ramadhani, Umam, et al., 2019; Ramadhani & Fitri, 2020). Furthermore, the implementation of the flipped classroom model provides space for interaction (Attard & Holmes, 2020; Fernández-Martín et al., 2020). Students can explore the material presented by teachers while still collaborating with others to increase confidence, interest, motivation, and adaptation to using technology in learning (Abeysekera & Dawson, 2015). The implementation of the flipped classroom model provides flexibility in time and place for students to collaborate and explore the material.

However, the application is not actualized effectively and optimally in learning, and this is supported by previous study, where Davies et al. (2013) compared the effectiveness of general classes, flipped classroom, and simulation in college lectures. The results showed that general class and flipped classrooms are more efficient than simulation, but there is no significant difference between them. Kim et al. (2014) also obtained findings where the application of the flipped classroom model gave significant results on the self-efficacy of Korean University students.

The Contradiction of Supporting Learning Theory with the Implementation of Flipped Classroom Model

Contradiction occurs in the advantages offered by the flipped classroom model. It is also seen in the less-than-optimal support of learning theories that underlie the model in the application of learning. Self-determination theory also supports the flipped classroom model and presents three aspects, namely competency, autonomy, and relatedness. Competency is related to the need to feel capable and master the learning process. Autonomy is associated with the need to participate in tasks independently. Relatedness concerns the need to engage in tasks that allow students to interact and communicate with their peers (Khayat et al., 2021). This is also supported by the Self-Regulated Theory, which enables students to obtain constructive learning experiences. Students can also monitor, regulate, and control their cognition, motivation, and behavior under the learning objectives and contextual features (van Alten et al., 2020; Wolters et al., 2005). Students who follow the flipped classroom model can take advantage of the flexible environment through independent learning and collaboration. Personal factors and behaviors that support this theory are considered before implementing the model (Ng & Lo, 2022).

The application of self-determination and self-regulated theory does not occur in the flipped classroom model. The results obtained by Kim et al. (2014) contradicted the self-determination theory underlying the flipped classroom, where students would be motivated in the learning process when given the application of the model. Baloran (2020) also obtained results related to personal factors and behavior, where about 59.25% of students in the Philippines experienced anxiety during the learning process. This anxiety is influenced by a lack of confidence in following math learning independently. Furthermore, students need full support from teachers in helping to understand the material provided.

Cognitive Load Theory supports the flipped classroom model, allowing students to manage their cognitive load. This should be closely aligned with self-determination and self-regulated theory (Akkaraju, 2016; Mattis, 2014). However, the three theories have not been able to provide full support for implementing the flipped classroom. Personal factors and behavior are two main points that need to be ensured in maximizing the ground theory of the flipped classroom. The support of individual behavioral theory will optimize the application of the flipped classroom model in learning, specifically mathematics learning. Furthermore, the socio-cultural and constructivism theory is also a space to complement the successful implementation of the flipped classroom.

The Role of Personal Factors and Behavior in the Implementation of Flipped Classroom Model

The flipped classroom model offers flexibility with the support of technology integration that acts as a virtual classroom during out-class learning. Technology readiness and adaptation are important points that should be considered before implementing the flipped classroom model, specifically in mathematics learning. Technology adaptation is one part of the competencies that teachers should possess. Additionally, the competence is called Technological Pedagogical and Content Knowledge (TPACK), which is the ability to master technology, content, or material with the teaching process (Munyengabe et al., 2017). TPACK is a theoretical framework that connects technology, content, pedagogy, and its usage in the classroom (Schmidt et al., 2009).

The facts contradicted the expectations offered in the flipped classroom model. Most students and teachers have not been able to adapt to the technology used in the implementation. Mailizar & Fan (2019), Malizar et al. (2020), Cevikbas & Kaiser (2020), and Christopoulus & Sprangers (2021) had similar findings where teachers experience difficulties in using technology. There is no flexible time to develop ICT competencies in implementing the flipped classroom model. Technology adaptability also affects students' learning motivation and decreases confidence and self-efficacy (Al Salman et al., 2021). The technological adaptation from TPACK competence is part of the teachers' behavior.

Personal factors also influence the behavior of teachers and students related to technology adaptation. These include self-efficacy (Bandura, 1986; Zimmerman & Schunk, 2008), emotional (Koob et al., 2021), componential, experimental, and contextual intelligence (Sternberg, 1986). Positive self-concept, realistic self-assessment, preference for long-term goals, leadership experience, community involvement, and knowledge are designed to the preferred learning style of individual students (Sedlacek, 2004). (Dehghani et al., 2011). Furthermore, these factors are an important part that needs to be considered in the implementation of the flipped classroom model. The results are contrary to the important role in optimizing flexibility-based learning, namely the flipped classroom model.

Ethnomathematics Approach

Ethnomathematics as Part of the Design of Culturally Contextualized Learning Environments for Meaningful Learning

Previous studies showed a mismatch between the factors that play an important role in optimizing flexibility-based learning. Personal factors and behavior play roles in implementing the flipped classroom and other learning models. However, both factors play an important role in the implementation of the flipped classroom model by intersecting with the technology used. The learning environment is one of the many personal factors of special consideration for teachers before designing flexibility-based learning (flipped classroom model). Previous studies in mathematics learning widely used contextual problems (Reinke, 2019; Suarsana et al., 2019; Widjaja, 2013) that are not based on students' cultural experiences.

The design of a learning environment under the cultural context of students is one solution for optimizing flipped classroom. Supporting a learning environment under the cultural context can provide meaningful experiences. Meanwhile, sStudents will feel that contextual problems close to cultural experiences intersect with mathematical concepts. The learning environment in the application of the flipped classroom model requires several conditions and further development to be designed and implemented successfully. The program development is to integrate the cultural context into the learning design of the model. This can optimize the implementation of flexible but meaningful mathematics learning.

Implementing a learning environment close to the cultural context can be conducted by integrating the dimensions contained in the ethnomathematics approach. The approach recognizes that different cultures develop different ways of conducting mathematics. Ethnomathematics represents the way various cultural groups create their mathematical reality through ideas, ways, techniques, and practices used in daily life (Risdiyanti & Prahmana, 2020). The concepts are related to the motives by which a particular culture (ethno) in history developed steps for calculating, inferring, comparing, and classifying techniques and ideas (D'Ambrosio, 2018; Rosa & Orey, 2016). Madusise (2015) believed that mathematics is part of local wisdom. Similarly, Marsigit et al. (2018) stated that mathematics is a cultural product. Judging from the above statement, cultural education and mathematics can be connected based on the ethnomathematics approach. According to Rosa & Orey (2016), the concept has cognitive, conceptual, educational, epistemological, historical, and political dimensions, which are closely related to each other, and used to analyze the socio-cultural roots of mathematical knowledge.

Several studies successfully applied the ethnomathematics approach to mathematics learning. (Nurjanah et al., 2021; Risdiyanti & Prahmana, 2021; Rosa & Orey, 2017; Santos et al., 2020; Utami et al., 2019). However, the application of cultural context is limited to cultural artifacts. This can be seen from some of the study results using Nias cultural context. It appears that the studies conducted are limited to exploring the cultural artifacts of the Nias tribe. Sarumaha & Gee (2021) applied the cultural artifacts of the Nias community, namely Hombo Batu, as a geometry learning media. Hombo Batu is a legacy from the ancestors in South Nias Regency and used in traditional sacred events. Zebua (2016) also used cultural artifacts of the Nias community, namely the Omo Sebua traditional house in the North Nias Regency area, as an ethnomathematics study on several materials, such as numbers, measurement, and geometry.

The findings clearly showed that the design of learning environments with cultural contexts is at the level of artifact exploration. Furthermore, the integration of mentifacts that contain cultural character values has not been developed in meaningful mathematics learning. This finding became a further analytical study to develop a learning program that offers flexibility and meaningfulness and contains cultural character values obtained from the integration of mentifacts in the learning design.

Cognitive Load Theory vs Constructivism Theory

The learning theories underlying the flipped classroom model do not fully support the successful application. Various factors cause the contradiction between the learning theories supporting the facts and findings of the implementation. Personal behavior and factors are two points of concern for teachers who will implement flexibility-based and meaningful mathematics learning. However, an analytical study that supports the flipped classroom model and ethnomathematics approach also need further attention. Based on the explanation, the learning theories under the flipped classroom include constructivistic, Vygotsky, and ethnomathematics learning programs (Mercer et al., 1994). Some of the learning theories are Vygotsky (Vygotsky, 1978), Ausubel (Vallori, 2014), self-determination (Muir, 2021), self-regulated (Zimmerman & Schunk, 2008), cognitive load (Akkaraju, 2016; Mattis, 2014), and ecological theory (Bronfenbrenner, 1986). These are also the theoretical basis for the ethnomathematics approach.

The contradiction supporting the flipped classroom model and the ethnomathematics approach occurs in cognitive load and constructivism theory. According to cognitive load theory, providing instructional guidance significantly impacts efficient and effective learning implementation (Sweller, 1988). On the other hand, the constructivism theory emphasizes the importance of deep learning-contextual understanding of materials (Loyens & Gijbels, 2008). The essence is that the learning environment is student-centered, and the knowledge is acquired through social interaction. A different view emerges from cognitive load theory, which builds on the idea of different types of learning. Furthermore, independent learning assists students in managing their cognitive load during the process (Seery & Donnelly, 2012; Turan & Goktas, 2016). Akkaraju (2016) also explained that managing students' perceived cognitive load is related to the availability of instructional guidance, which is a contention between cognitive load and constructivism theory.

The learning theories highlight the importance of acquiring strategies or methods. However, the knowledge acquisition process has conflicting viewpoints between these two theories. Krischener et al. pointed out that constructivism theory ignores the findings of the cognitive architecture literature that suggest working memory has a limited capacity (Sweller, 1988). It tends to provide students with information that exceeds their capacity, and teachers fail to guide the acquisition of knowledge efficiently. Constructivism theory also states that although providing initial guidance is necessary, promoting students to develop the learning process actively will further enhance the ability to acquire and apply conceptual knowledge. Furthermore, the cognitive load theory supports students in exploring more structured learning. This can assist the cognitive load experienced by students during the learning process.

Based on the explanation, there appears to be a gap theory between cognitive load and constructivism, which provides an opportunity to develop a new theory. The basis of this development can be adjusted to improve a learning model based on an analytical study of the flipped classroom and the ethnomathematics approach.

Ethno-Flipped Classroom Model: Flexibility Meets Culturally Contextualized Meaningful Learning

The flipped classroom model and ethnomathematics approach have advantages and disadvantages supporting each other. The flexibility offered in the flipped classroom provides comfort for teachers and students in learning activities and preparing cognitive loads according to their level of competence. Furthermore, the existence of technology integration that becomes a virtual space for out-class also supports the implementation of learning anywhere and any time. Exploration and development of teachers' TPACK competence will be further honed when integrated with technology. The ethnomathematics approach can complement the learning environment and cultural context factors neglected in the flipped classroom model. It offers ease of learning by integrating cultural contexts, activities, phenomena, values, and characters reflected in the socio-culture that has become part of students' life experiences (Prahmana et al., 2021). This can positively impact students, where learning activities and contextual problem-solving are no longer far from life experiences.

The Ethno-Flipped Classroom model begins by ensuring learning readiness in terms of adaptation to the technology used and the environment. Learning activities in this model are student-centered and provide opportunities to explore the material according to their ability level. Exploration of problems close to cultural characteristics, phenomena, and activities helps students identify, reduce, visualize, analyze, and predict the presented data. Meanwhile, investigation and collaboration schemes are very important and are carried out in stages by utilizing the cultural characteristics possessed by students to gain character and moral values. Tiered collaboration is conducted by grouping students according to their ability level. This scheme is designed in the Ethno-Flipped Classroom model to maximize and solve the problem. The tiered collaboration scheme also helps students improve their self-regulated learning and provides a space to enhance social interaction during the learning process. Furthermore, the Ethno-Flipped Classroom model also allows students to apply their socio-cultural character values to solve problems in the given context. Elaboration can also be conducted by linking the problem-solving obtained with existing theories and concepts. Students are invited to further validate and confirm with the teacher to strengthen their understanding of concepts and problem-solving procedures. The Ethno-Flipped Classroom model also allows students to evaluate and reflect after participating in a series of flexible and meaningful learning activities.

This study recommended the development of a learning model that provides flexibility and meaningfulness of learning through a cultural context applied in mathematics. The ethnic-flipped classroom is a recommended learning model to optimize flexible, technology-integrated, meaningful, and culturally based mathematics. Furthermore, it maintains student-centered, collaborative, creative, and innovative learning and trains students to develop positive social interaction skills. The development of the flipped classroom model reconciles cognitive load and constructivism theory. The Cognitive-Social-Cultural Constructivist Theory of Learning (CSCCTL) was formed from the development of the flipped classroom model. Further analyses related to developing theories from the ethnic-flipped classroom model can be conducted in the analytical study.

Conclusion

The Ethno-Flipped Classroom model was developed by combining the flipped classroom and the ethnomathematics approach. It was developed by analyzing the theoretical studies, and the results found that learning theories overlap the two approaches. However, the supporting learning theories do not play an optimal role in the implementation. The theoretical review also found the existence of theory and study gaps. Personal Factors and Behavior are related to the less-than-optimal role of learning theories that support the flipped classroom model. An environment that does not offer flexibility and meaningful learning is also an obstacle based on the ethnomathematics approach. Meanwhile, cultural exploration is at the level of cultural artifacts, and the culture's character and moral values are not well actualized.

This study also concluded that there is a contradiction between learning theories supporting the flipped classroom model and the ethnomathematics approach. Cognitive load and Constructivism theory need further analysis to assist students in managing their ability level. The results offered an Ethnic-Flipped Classroom model to maximize flexible and meaningful learning and manage the knowledge acquired through cultural context and traditions. Some limitations need to be considered in interpreting the results of this study, which is limited to the exploration of theoretical analysis and has not been based on the results of direct implementation. It focuses on the analytical study to develop a new learning model that provides flexibility and meaningfulness in a learning process. Finally, further study is needed to develop emerging theories on the Ethno-Flipped Classroom model.

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