Original Research Article

Designing a Learning Model with a Contextual Teaching Learning Approach Based on the Flipped Classroom to Improve Science Understanding

ABSTRACT

This research aims to describe a learning model design with a Contextual Teaching Learning (CTL) approach based on the Flipped Classroom to increase the understanding of science concepts. The research is categorized as qualitative research with descriptive analysis. Data were obtained from literature studies, documentation, and expert opinions related to the design of learning models. Several theories that support the design of learning models with a CTL approach based on the Flipped Classroom to improve understanding of science concepts were studied. The result of this research is a learning model design named Contextual Flipped Group Classroom (CFGC), which has the syntax of Networked Learning, Active Inquiry, Student Empowerment, Reflective Practice, and Authentic Assessment.

Keywords: *CTL, Flipped Classroom, CFGC*

INTRODUCTION

Education is very important to be studied and updated from time to time to meet the needs of human resources (HR) needed by the country in supporting development. The main problems of education in Indonesia are still in equity, access expansion, and quality. The government through the Ministry of Education and Culture, Research and Technology must continue to strive to improve the quality of education outcomes in Indonesia. The PISA test results in 2018 showed that Indonesia was in the bottom 10 out of 79 participating countries. The ability of Indonesian students is below the ability of students in ASEAN countries. This can be seen in the average reading, mathematics and science scores released by PISA in 2018 at Puspendik, namely the Philippines (339, 352, 357); Thailand (392, 418, 425); Indonesia (371, 379, 396); Malaysia (415, 440, 438); ASEAN (413, 431, 433) (Nur'aini et al., 2021).

Focusing on science skills, the 2018 PISA results can be seen to have decreased scores from 2015. Science is a natural science that studies natural phenomena. The low PISA score shows that the level of science skills of students in Indonesia has decreased, especially at the level of understanding of student concepts. This is in line with the results of research (Fuadi et al., 2020) found that one of the factors of low science literacy/ability is the selection of textbooks, misconceptions, non-contextual learning and students' reading ability.

Based on survey data on the results of previous researchers' research, the results of the average score of 94 PGSD students at Muhammadiyah Makassar University in the Basic Science Concepts Course in the last 4 (four) years are: 69.42 (2018); 80.07 (2019); 74.42 (2020); and 69.11 (2021). In line with this, data from interviews with PGSD Unismuh Makassar lecturers who teach science courses were also obtained, namely the following data: (1) In general, lecturers have used learning media, (2) Various learning models and strategies are applied by lecturers, (3) Some lecturers are constrained in delivering material online, (4) Students lack understanding of science material, students lack creativity and straightforward presentation. In addition, the dense lecture material sometimes the time given in lectures is not enough to conduct a deeper study of the material, so that the level of student understanding of the material is still lacking (Nasrah et al., 2023).

Research (Rawh et al., 2020) using the Four-tier Diagnostic Test obtained 28.4% of students had misconceptions and 28.2% did not understand the material of optical devices. Using the same test tool, research (Rahayu, 2021) shows that 28% of students experience misconceptions and 30% do not understand the concept on the Continuity Principle material, while research (Diella & Ardiansyah, 2020) suggests that there are 9.7% - 95.5% misconceptions in the questions given and 0%-35% do not understand the ecosystem material. The same research on science and biology study programme students was conducted by (Sutomo & Fathurrahman, 2019) found that 26.04% of students had misconceptions and 33.84% of students did not understand chemistry. Research (Tiro et al., 2020) also found that for the level of understanding of concepts in the basic science concepts course only

55% of students were in the sufficient category. From the various research results above, it can be seen that there are misconceptions for students and students about science concepts which cause a low level of understanding of science concepts.

Science literacy is closely related to the learning of Natural Sciences (IPA). Natural Science is a science that examines the symptoms of the surrounding nature which is built with a constructivism approach personally and society (Agriyana, 2019). Science learning is a scientific learning process related to the community environment (Dewi et al., 2021). According to Trianto in (Aningsih & Zahrani, 2019) Science is a combination of systematic theories, about natural phenomena created and developed through scientific methods such as observation, experimentation and sophisticated scientific attitudes such as curiosity, open-mindedness, honesty, and others. Thus it can be concluded that science is a science that studies natural phenomena through the scientific method. Science is very influential on the educational process and technological development from era to era so that it requires a learning process that runs effectively.

(Tulbure, 2012) suggests that effective learning requires flexibility, creativity, and responsibility to provide a learning environment that can meet the individual needs of students. Indicators of effective learning include (1) the quality of teaching is related to the presentation of information or the ability of learners to help students learn the subject matter easily, (2) the appropriate level of teaching is related to the teacher's ability. Ensuring the appropriateness of the subject matter to students' abilities, (3) incentives are related to the teacher's ability to ensure students' motivation in learning, and (4) learning time is related to providing sufficient time for students to learn the subject matter taught. In learning, students should be given the opportunity to develop their abilities by referring to the indicators of effective learning (Slavin, 2017). An effective learning process can ensure student learning motivation that leads to increased student understanding.

Understanding is the level of ability where students are expected to be able to understand the meaning of concepts, situations and facts that they are familiar with. Understanding occupies a very important and strategic position in learning activities because it is a reconstruction of meaning relationships, not just a process of assimilating previously held knowledge. For this reason, the learning package must focus on activities that support the understanding of the content of the learning material and its relation to the student's environmental life (Mauke et al., 2013). In addition, the factors that cause low understanding of student concepts are the ability to understand questions that are still low, different academic abilities, the complexity of the material, the willingness to study deeper material that is still low, and the learning process that is still low (Adhani & Rupa, 2020).

According to Anderson and Krathwol in (Trianggono, 2017), understanding is the ability to construct meaning from learning messages either orally, in writing, or graphically. Students can understand information well if they can construct old knowledge into new knowledge. As for the revised Bloom's taxonomy, seven indicators of concept understanding are given, including Interpreting, Exemplifying, Classifying, Summarising, Inferring, Comparing, Explaining.

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Based on research findings (Fuadi et al., 2020), namely one of the factors for low science abilities in terms of understanding science concepts is learning that is not contextualised. From the results of observations, lecturers who teach courses have generally used various learning models, but these conventional models have not been able to improve the understanding of science concepts of PGSD students at Muhammadiyah Makassar University. To improve understanding of science concepts, a learning model with a Contextual teaching and Learning (CTL) approach is one solution. This is in accordance with research (Mauke et al., 2013), namely the CTL approach has a significant effect on students' understanding of science concepts. In addition, the CLT approach received a positive response from students according to the results of research (Merawan et al., 2021).

The Contextual Teaching and Learning (CTL) approach is a learning method that helps teachers connect the material they teach with students' real-life situations and encourages students to make connections between their knowledge and its application in their daily lives by including the seven

main components of effective learning (Agriyana, 2019). In contextual learning, five forms of learning are possible, namely linking, experiencing, applying, collaborating, and transferring knowledge (Helmiati, 2012). The application of CTL is linked to 21st-century learning, which expects learning to be student-centered, collaborative, contextual, and integrated into society. The knowledge gained by students through CTL tends to be permanent but may require a longer time and learning process (Muliawan, 2016). Consistent with the findings of (Bujuri & Baiti, 2019), one drawback of integrative science teaching materials that employ a contextual approach is the time-consuming nature of their implementation, which poses the risk of lagging behind other subjects.

The CTL learning approach involves the utilization of learning principles to enable teachers to establish links between the subject matter they teach and the real-life experiences of students. This approach also aims to foster students' ability to connect their knowledge with its practical application in their everyday lives. It encompasses the incorporation of the seven key components of effective learning (Agriyana, 2019). Contextual learning encompasses five distinct modes of learning: linking, experiencing, applying, cooperating, and transferring information (Helmiati, 2012). The utilization of CTL in the learning process reveals a correlation with 21st century learning, which emphasizes student-centeredness, collaboration, contextualization, and integration into society. The implementation of CTL ensures that the knowledge acquired by students has a tendency to be enduring, while it does not circumvent the limitations that necessitate a lengthier period and learning process (Muliawan, 2016).

With the development of technology, students can quickly access lecture materials, making the application of the flipped classroom a solution to this problem. The flipped classroom is a popular learning method among academics because it is believed to encourage active learning. In the practice of flipped classroom, students have readings or exposure before the lesson begins so that learners will have prior knowledge before the lesson takes place (Tazijan et al., 2016).

According to (Fatimah Abd Rahman et al., 2019), flipped classroom is a strategic approach for educators in a technology-based learning environment. The implementation of flipped classroom has the concept of balance between education and technological advances. This is in line with research (Fatimah Abd Rahman et al., 2019) that flipped classroom can increase motivation and learning attitudes. Besides, flipped classroom has a positive effect on cognitive, affective, and soft skills of students and college students (Birgili et al., 2021). Flipped classroom takes a step forward into a new era by using innovative strategies and technologies to facilitate learning outcomes (Hwang et al., 2019).

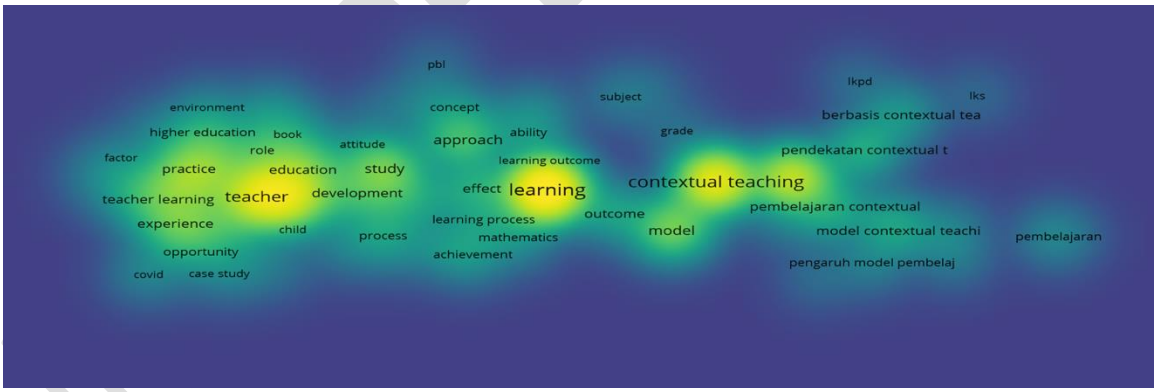

Figure 1. Bibliometric Analysis of Previous Research

The following are the results of bibliometric analysis using the VOSviewer application of research that examines CTL learning from 2013-2023. From various studies, the results of the research support this research, namely about the development of learning models with approaches. In this study, shortcomings were found, namely the application requires more time. This is in accordance with research (Aningsih & Zahrani, 2019; Slavin, 2017; Tulbure, 2012), which also indicate that the application of CTL allows the knowledge gained by students to tend to be permanent but does not escape the shortcomings that require time and a longer learning process. As a result, researchers are interested in developing a learning model with a CTL approach based on Flipped Classroom to improve understanding of science concepts.

METHOD

This research is categorized as qualitative research with descriptive analysis. Data will be obtained from literature studies, documentation, and expert opinions related to the design of learning models.

The literature review will be improved by citing related papers in machine learning. The research will be conducted in three phases: (1) adaptation and application of the CFGC learning model to enhance concept understanding in subjects beyond science, (2) identification of key factors influencing the successful implementation of the CFGC learning model in educational institutions, and (3) exploration of the implications of the CFGC learning model for teacher professional development and instructional practices in classrooms beyond science.
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RESEARCH RESULT

This model is named CFGC Learning Model. It is developed based on the CTL approach and Flipped Classroom strategy, which is adjusted to the concept understanding indicators adopted from Bloom, Tighe, and Gulo. The following is the relationship matrix of CTL approach, Flipped Classroom, CFGC Model, and concept understanding indicators:

Table 1. Relationship Matrix of CTL Approach, Flipped Classroom, CFGC Model and Concept Understanding Indicators

Components of CTL Approach	***Flipped Classroom***	**CFGC Model**	**Concept Understanding**
self -regulating	*Before Content Active Content Attainment (Engage, Explore, Explain)*	Phase 1 : *Networked Learning* Stimulus and self-directed learning	Description;
relating*, *experiencing*, *cooperating		Phase 2 : *Active Inquiry,* (Problem identification, guiding group work and inquiry)	Interpretation; Comparing
applying	*During Class Concept Application (Elaboration & Evaluation)*	Phase 3 : *Student Empowerment* (Sharing of ideas, presentation and conclusion)	Conclusion
authentic assessment		Phase 4: *Reflective Practice*	Perspective; Extrapolation.
		Phase 5: *Authentic Assessment*	Application

The paragraph contains several grammatical and clarity issues. Here's a revised version: The CFGC model, developed by (Joyce et al., 2015), consists of syntax, social system, reaction principles, support system, instructional impact, and accompanying impact. This development is supported by the quality criteria of educational product development (Nieveen & Folmer, 2013), namely aspects of validity, practicality, and effectiveness.

CFGC Model Syntax

Syntax refers to the learning steps starting from the beginning to the end. In the CFGC model, there are five phases, namely (1) Networked Learning; (2) Active Inquiry; (3) Student Empowerment; (4) Reflection Practice; and (5) Authentic Assessment. These phases describe the activities of lecturers and students, as shown in the following table:

Table 2. Steps of Contextual Flipped Group Classroom (CFGC) Learning Model

PHASE	LECTURER ACTIVITIES	STUDENT ACTIVITIES
Phase 1 : *Networked Learning* Stimulus and self-directed learning	Lecturers provide material in groups before face-to-face lectures on the Learning management system (LMS). Lecturers use digital resources, such as videos, interactive learning materials, or relevant online references. Encourage students to participate in the existing learning network, both with fellow students and with their peers.	Students form groups before determining the group leader who is responsible for learning activities outside of face-to-face meetings with lecturers. Each group studies the material determined by the lecturer guided by the group leader..
Phase 2 : *Active Inquiry,* (Problem identification, guiding group work and inquiry)	Lecturer provides a problem statement/identification on the LMS before the face-to-face meeting. The lecturer prepares a space on the LMS for questions and answers between the group and the lecturer without other groups.	Students in groups complete the problem statement/identification task. Students in groups conduct discussions and questions and answers on the LMS.
Phase 3 : *Student Empowerment* (Sharing of ideas, presentation and conclusion)	Lecturer Provide opportunities for students to share their ideas, thoughts, and views on the lecture material. Lecturers encourage students to develop creativity, critical thinking skills, and innovative solutions in the application of the concept. Lecturers clarify or strengthen the findings of each group. Lecturers facilitate each group to conclude their findings after being clarified or reinforced.	Students in groups share their ideas, thoughts and views on the lecture material. Students in groups take turns presenting their findings. The head of the group appoints one of its members to conclude the findings after being clarified or given reinforcement from the lecturer. Students record the results of the lecturer's clarification
Phase 4: *Reflective Practice*	Lecturers give assignments to students to write personal journals about lecture reflections	Students listen to the reinforcement of the material given by the lecturer. Students fill out a self-reflection journal as a form of students measuring their own abilities in terms of strengths and weaknesses in the lecture material studied.
Phase 5: *Authentic Assessment*	Lecturers give evaluation tasks to students Lecturers facilitate students in problem-based projects or assignments	Students do the evaluation task Students work on project or problem-based assignments.

Social System

The social system of the developed learning model is a description of all roles in learning, both as students and teachers. This interaction is expected to be a system that functions properly to achieve learning objectives. In the CFGC model, the social system of this model development is as follows:

a. Students play an important role in the implementation of this model. They work individually and in groups, with group leaders randomly selected by group members who are considered capable of managing the implementation of learning outside the classroom before learning takes place in the classroom. They collaboratively work on tasks given by the lecturer.

b. The lecturer plays an active role as a facilitator who assists students in learning. They prepare materials or problems that students will examine with their groups outside the classroom. In the classroom, they act as a facilitator, guide, and mediator in learning, but more importantly, as a motivator of students to be more eager to learn.
c. A conducive atmosphere is one of the important things that require the ability of teachers in classroom management. A conducive atmosphere makes students comfortable and at home in learning.

In developing a learning model, it is important to pay attention to the social system and ensure that the interactions, norms, and environment support the creation of effective learning. Actively involving students, creating an inclusive environment, and considering contextual factors will help in developing a learning model that suits the needs of students and the learning context.

Reaction Principle

The reaction principle describes the relationship between students and teachers. The CFGC model has special characteristics of flipped classroom by emphasizing the cultivation of leadership skills, independent and group learning, and flipped classroom. This model demands students' technological proficiency in both collecting references and learning because online and offline learning are combined into one. The reaction principles of this learning model are as follows: (1) the teacher prepares a digital module in the learning management system (LMS) such as Google Classroom, (2) the teacher prepares a contextual problem that will be sought for solutions in groups, (3) facilitate online/offline learning well so that learning objectives are achieved. In general, the reaction principle of this model is one-way, two-way, and multi-directional.

The reaction principle in learning model development is important to create a responsive, supportive, and motivating learning environment for students. Through informative feedback, acknowledgement, appropriate responses, and flexible adjustments, students can feel supported in the learning process and actively involved in the development of their abilities.

Support System

The support system in the CFGC learning model is a condition to support the implementation of learning. The supporting system in this model includes the CFGC Model Book, Learning Tools consisting of (1) Semester Lecture Plan (RPS, which describes lecture activities with the CFGC model); (2) Semester Learning Plan (RPS) CFGC model; (3) Student Book, a one-semester lecture guide containing materials designed based on the learning model (CFGC); (4) Student Worksheets (LKM) which contain problems that are done in groups or individually, the availability of a Learning Management System (LMS), LCD, Visio Viewer application, Microsoft Office applications, and Basic Science practicum tools.

Learning Impact

The CFGC learning model is developed with the aim of making learning more effective. The impact of the CFGC model is divided into two, namely:

a. Instructional impact of the CFGC model, which is the understanding of concepts in the basic science concepts course.
b. Accompanying impact, which includes curiosity, critical thinking skills, problem-solving skills, leadership, independence, responsibility, thoroughness, and objectivity.

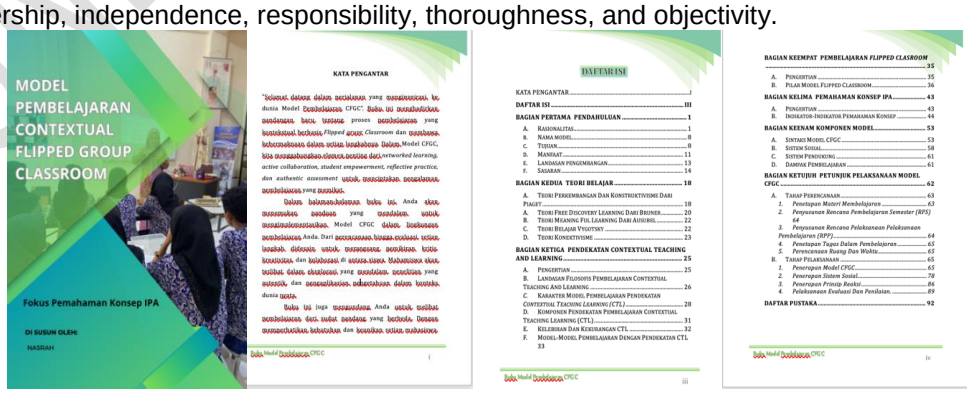

Figure 2: CFGC Learning Model Book Design

The expected outcomes of this research are (1) an adapted and applied CFGC learning model to enhance concept understanding in subjects beyond science, (2) identification of key factors

influencing the successful implementation of the CFGC learning model in educational institutions, and (3) exploration of the implications of the CFGC learning model for teacher professional development and instructional practices in classrooms beyond science.
In conclusion, this research aims to investigate the adaptability and applicability of the CFGC learning model to enhance concept understanding in subjects beyond science. The research will be conducted in three phases, and the expected outcomes are an adapted and applied CFGC learning model, identification of key factors influencing the successful implementation of the CFGC learning model, and exploration of the implications of the CFGC learning model for teacher professional development and instructional practices.

DISCUSSION

The design of the learning model is based on the need assessment. The learning model is designed in the form of an early hypothetical model, which is described in the form of a diagram. The hypothetical model becomes the reference for the development of the CFGC learning model. The design of the hypothetical model is based on the results of the need assessment, which includes analysis of lecturer interviews, analysis of student responses, curriculum analysis, and analysis of indicators of understanding of science concepts.
The learning model is a teaching design plan that shows learning patterns consisting of syntaxes that are systematically arranged in the role of teachers and students in learning (Wayan, 2018). The CFGC learning model consists of several syntaxes, namely:
Learning in the network (Networked Learning): This learning step is supported by the Flipped Classroom strategy, which can be seen in learning using the Unismuh Makassar SPADA LSM.

a. Inquiry activity (Active Inquiry).
b. Student Empowerment.
c. Reflection Practice.
d. Authentic assessment.

In depth, the CFGC Model is a learning model developed from learning models with a CTL approach, a model developed based on the advantages of each of these learning models, namely the STAD and PBL Learning models. In the STAD learning model, peer tutors are adopted, while in the PBL learning model, the main characteristic of this model is the solving of real-life problems. As we know from the explanation of the background and literature review, the shortcomings of learning models with the CTL approach are that it takes a long time, so the author is interested in combining it with the Flipped Classroom method, namely inverted learning, which requires students to study the material first before. The flipped classroom design adopted is the group-based flipped classroom.
The characteristics of the CFGC learning model are learning that trains students to become leaders and members in groups, active and collaborative learning, learning that applies peer tutors, learning that can measure in detail the personal abilities of students and groups, authentic learning. The existence of problem-solving in learning that trains students' critical thinking skills and creativity as a review of student concept understanding. The purpose of CFGC learning is to train students to solve problems with a deeper understanding of concepts in groups without ignoring students' personal abilities in depth by utilizing time efficiently and training students how to become good leaders and group members. So that later in the world of work, they can solve work problems with innovative and creative solutions and are expected to be good and wise leaders or subordinates.
This model is compiled into a learning model book, semester learning plan (RPS), teaching materials, and other instruments, which are the novelty of this research. The design of the model book is designed with the first part of the introduction consisting of points of rationality, model name, objectives, benefits of development foundations, and objectives. The second section contains learning theories that support the learning model, namely developmental theory and constructivism, free discovery learning theory, meaningful learning theory, Vygotsky learning theory, and connectivism theory. Section three consists of an explanation of the Contextual Teaching and Learning (CTL) approach. The fourth section is about the theory of Flipped Classroom. The fifth section is about the theory of concept understanding, the sixth section consists of model components. The seventh section consists of instructions for implementing the CFGC model. The model book is arranged as interesting as possible so that it can be used practically and effectively.
The teaching materials are designed as interesting as possible based on contextualisation so that users can understand the teaching materials well. The module consists of systematically arranged materials accompanied by learning simulations that are leaked and equipped with evaluation questions. The images presented are interesting and contextualised. Contextualised teaching materials create more meaningful and understandable learning. This is in line with the opinion (Bujuri & Baiti, 2019) that contextual-based science teaching materials make learning more active, effective,

and meaningful and can improve the achievement of learning outcomes both from cognitive, affective, and psychomotor aspects.

The Semester Learning Plan (RPS) is presented with the Flipped Classroom system. Online learning but can also be used offline. Flipped Classroom is one of the learning strategies that can activate and streamline learning, where students are required to study at home both in groups and individually before learning in class sessions (Sukmana & Suartama, 2019). The flipped classroom strategy can be applied anytime, under any conditions, wherever there is a learning process and using digital technology/information technology that is developing in the current era (Suhartono et al., 2021); (Eppard & Rochdi, 2017).

CONCLUSION

The Contextual Flipped Group Classroom (CFGC) learning model is designed based on supporting theories to maximise the results of science concept understanding ability of PGSD students at Muhammadiyah University Makassar. The CFGC model has a syntax of Networked Learning, Active Inquiry, Student Empowerment, Reflective Practice, Authentic Assessment. This syntax is expected to improve students' understanding of science concepts. Lectures in the network using LMS SPADA Unismuh Makassar. The design of the CFGC learning model will be carried out next research to see the validity, practicality and effectiveness of the learning model.

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