Analysis Learning Strategies on Contemporary Advanced Mathematical Thinking

Ayu Aristika*

Universitas Islam An Nur Lampung, Lampung, Indonesia

*Corresponding Author: ayuaristika@students.unnes.ac.id

Abstract. The rapid development of the world of technology also has an impact on world development education so that new and innovative learning models are needed so that students can more quickly understand learning. To answer this situation, we created a learning model that equips students to think critically, creatively and independently through Advanced Mathematics courses using the Contemporary/constructivism model. Utilization of contemporary/constructivism learning models in classroom learning activities has various advantages or benefits. Strength is oriented towards optimal learning activities so that learning objectives can be achieved effectively through the support of lecturers and students in learning. Based on the research results, CTL, Mastery Learning, & Participatory learning strategies have the greatest influence when compared to other learning strategies.

Keyword: (*Contextual Teaching and Learning*) CTL; *Mastery Learning*; Participatory & Contemporary

INTRODUCTION

The development of the industrial world continues to move along with the increasingly sophisticated technology being developed. All of this certainly affects the world of education. The world of education must seriously consider the provisions given to students so that later when students complete their studies, they can adapt to conditions in society. It cannot be denied, the current condition is filled with high availability of technology in the form of data exchange automation, Internet of Things (IoT), Big Data, and Artificial Intelligence. Current technology has made the world change rapidly, full of turmoil and uncertainty (Mkrttchian et al., 2021). For this reason, a new learning model is needed that equips students to be able to think critically, creatively, and independently through Advanced Mathematics courses using contemporary learning models. (Sudibjo et al., 2019) states that incorporating learner-centered learning is the most suitable approach to dealing with Society 5.0. Lecturers must also continue to guide students through contemporary theoretical learning models whose learning is based on constructivism learning theory.

(Supendi, 2022) Contemporary learning according to Constructivist Von Glassersfeld is developing cognitive functions in constructing knowledge. Here learning functions to equip students with the ability to access information needed in learning in terms of obtaining information students have the ability to access a variety of information used for learning, so educators function to equip students' ability to select the information needed. Information does not contain the only truth, but information only has meaning in the context of time, place, problems and certain fields. (Aprilisa, 2020) states ten skills must be introduced to students. These skills are: (1) analytical thinking skills, (2) innovative thinking skills, (3) being active, (4) acquiring strategies in learning something independently and creatively, (5) critical thinking and analysis, (6) mastering technology and programming, (7) solving complex problems, (8) gaining leadership and social adaptability, (9) managing emotions, and (10) developing and analyzing problems.

In the world of education, mathematics material and mathematical thinking skills are two things that continue to develop, that is, mathematics material understood through students' mathematical thinking skills needs to be developed further through learning mathematics and mathematics material which continues to grow more broadly. Therefore, learning mathematics needs to be developed (A Aristika & Darhim, 2019). The National Council of Mathematics Teachers (NCTM) states that there are five standard processes for students in acquiring and using mathematical abilities, namely: problem solving, reasoning and proof, communication, connection, and representation. Therefore, lecturers are required to master the five process standards in teaching. (Isaoud Alhunaini, Kamisah Osman, 2020) Mathematical ability is the ability to deal with problems in mathematics or real life. Mathematical abilities consist of: mathematical reasoning, mathematical

communication, mathematical problem solving, conceptual understanding, mathematical understanding, creative thinking and critical thinking, but these abilities can develop into higher abilities if developed. One of them is Advanced Mathematical Thinking (AMT) ability (Hariadi, 2022).

In this research AMT advanced mathematics learning will be developed with a contemporary learning model. (Kadir, 2017) The essence of learning mathematics is a process that is deliberately designed with the aim of creating an environment that allows a student to carry out mathematics learning. A good mathematics teaching and learning process is that a lecturer must be able to apply an atmosphere that can make students enthusiastic about problems that have never existed so that they are able to try to solve these problems. Therefore, in the learning strategies are needed. (Hutajulu & Minarti, 2017) Errors in using strategies can hinder the achievement of the desired mathematical goals, one of the indications is to improve the abilities that students already have for the better. Thus the importance of developing students' mathematical abilities, one of which is AMT ability. So it is deemed necessary to study the effectiveness of mathematics learning strategies. One method that can be used is to do a meta-analysis using the Contemporary model.

METHODS

This research is a qualitative case study that occurs in Advanced Mathematical Thinking (AMT) learning at the An-Nur Lampung Islamic Institute 2022. The research data is in the form of statements and arguments derived from observations and field notes. The main research instrument is the researcher himself, as data collector, processor, and interpreter, assisted by additional instruments in the form of field notes, observation sheets of teacher activities, student activities, and learning transcripts. This research was conducted in accordance with the 2013 curriculum which develops competence in a combination of knowledge, skills, values and attitudes that are reflected in the habits of thinking and acting. The competencies that students need to master need to be developed also by involving IT in learning so they can think creatively and innovatively (Ayu Aristika et al., 2021).

Data is obtained through observation of learning, by recording all learning activities from the beginning to the end. After the data is collected, it is followed by the data validation process through triangulation. Triangulation is done by looking at the suitability of the data from each research instrument. The collected data will be reviewed for its consistency. Data that is consistent/relatively the same is valid data, and can be continued with the data analysis process. Data analysis was carried out using Contextual Learning (CTL), Mastery Learning, & Participatory Learning techniques.

RESULT AND DISCUSSION

Contemporary learning/constructivism criticizes the concept of learning that has existed so far, teaching and learning in the sense that it tends to be centered on educators on the other hand tends to be centered on learning subjects (Pasandaran & Kartika, 2019). Because constructivism adheres to the view of the activeness of students in constructing knowledge based on their interactions in the learning experiences obtained. The learning form of student center learning strategies is carried out through active learning, independent learning, cooperative learning and collaborative generative learning and problem based learning (Suryana, 2019).

Contemporary learning currently uses a scientific approach, the CTL learning model and direct learning are more suitable for andragogy (adult education) not for school children's education (pedagogy). This is very suitable for advanced mathematics learning among students (Supriyadi, 2022). This is because the culture of the teacher itself is difficult not to dominate in the classroom. In addition, administration also triggers a teacher to be more inclined to deliver material regardless of the level of understanding of students. Combining IT learning can also greatly affect a student's creative thinking in understanding AMT (Wahyuni, 2020).

a) Implications of Contemporary Learning in Advanced Mathematical Thingking (Fitriani & Nurfauziah, 2020).

1) Knowledge is built by the students themselves.
2) Knowledge cannot be transferred by the teacher to the students without the activeness of the students.
3) Students actively construct continuously so that there are always changes in scientific concepts.
4) The teacher is just a facilitator so that the construction process runs smoothly.

5) Dealing with problems that are relevant to students.
6) Learning structure around the main concept of the importance of a question.
7) Seeking and assessing students' opinions.
8) Adjusting the curriculum to respond to student perceptions.

b) Contemporary Learning Model

1) Contextual Learning (Contextual Teaching And Learning)

CTL is a learning concept that emphasizes the linkage between learning material and the real world of students' lives, so that students are able to connect and apply the competencies of learning outcomes in everyday life. The role of the teacher in contextual learning is to provide easy learning for students, by providing various means and adequate learning resources. In short, CTL has characteristics, namely, meaningful, class relationships with the real world, higher order thinking, critical and creative, inquiry and questioning, communication and collaboration, authentic assessment, reflection, models and the community learns. In contextual learning the learning process takes place naturally in the form of student work and understanding activities. Learning will be more meaningful for students because they are the ones looking for learning resources, information and analyzing the information obtained, either individually or discussing it in groups.

2) Completed Learning (Mastery Learning)

assumes that under the right conditions all students are able to learn by studying well and obtaining maximum results for all the material studied. Complete learning is a learning pattern that uses the principle of individual completeness. In terms of granting learning freedom, as well as to reduce student failure in learning, the complete learning strategy adheres to an individual approach, in the sense that even though learning activities are aimed at a group of students (classical), it recognizes and serves the individual differences of students in such a way, so that the application of thorough learning allows for optimal development of the potential of each student (Tanudjaya & Doorman, 2020).

1) Participatory

Learning This learning is learning that emphasizes student participation. Namely involvement, responsibility and feedback from students. Encouraging student participation can be done in various ways, including asking questions and responding positively to student responses, using structured experiences, using several instruments and using a variety of methods that involve more students.

The results of research conducted by researchers show the following results: (a) There is an influence of the Contextual Teaching and Learning (CTL) learning model on the mathematical problem solving abilities of students of An-Nur Lampung (b) It is quite influential in the application of the Contextual Teaching and Learning model (CTL) on the mathematical problem solving abilities of An-Nur Lampung students.

a. Analysis of Initial Test and Final Test Data

Table 1. Results of CTL and Conventional implementations

VALUE	EXPERIMENTAL CLASS		CONTROL CLASS	
	PRETEST	POSTTEST	PRETEST	POSTTEST
AVERAGE VALUE	29	34	30	28
TOP VALUE	40	40	40	40
LOWEST VALUE	13	23	10	10

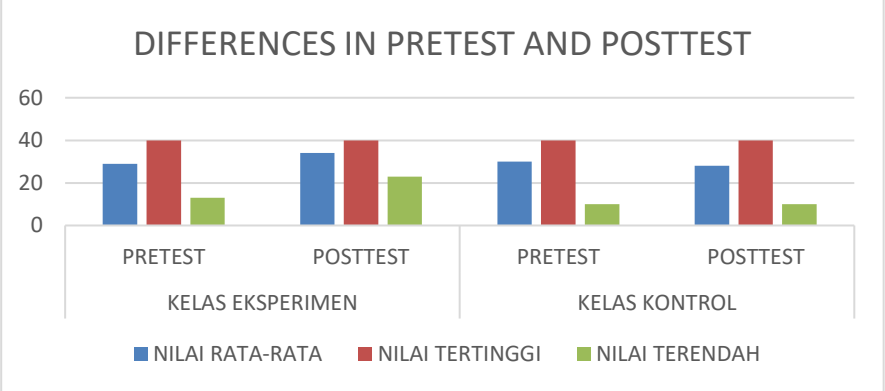

Figure 1. Results of the difference between pretest and posttest

Pretest the experimental class average which was initially 29% increased to 34%, while in the control class the initial average value was 30% decreased to 28%, this shows that students' mathematical problem solving abilities in the experimental class increased after learning using the Contextual Teaching learning model and Learning (CTL).

b. Discussion

This research was conducted on two classes, namely class 3A and class 3B, by applying the CTL model learning in mathematics lessons with fractional material in the experimental class (class 3B) and applying conventional learning methods in lesson mathematics with fraction material in the control class (3A). The research was conducted in the experimental group for six meetings, one pretest and one posttest. In the control group for six meetings, one pretest and one posttest. That is, the two study groups received the same treatment frequency.

Figure 2. Results of Conventional implementation on control classes.

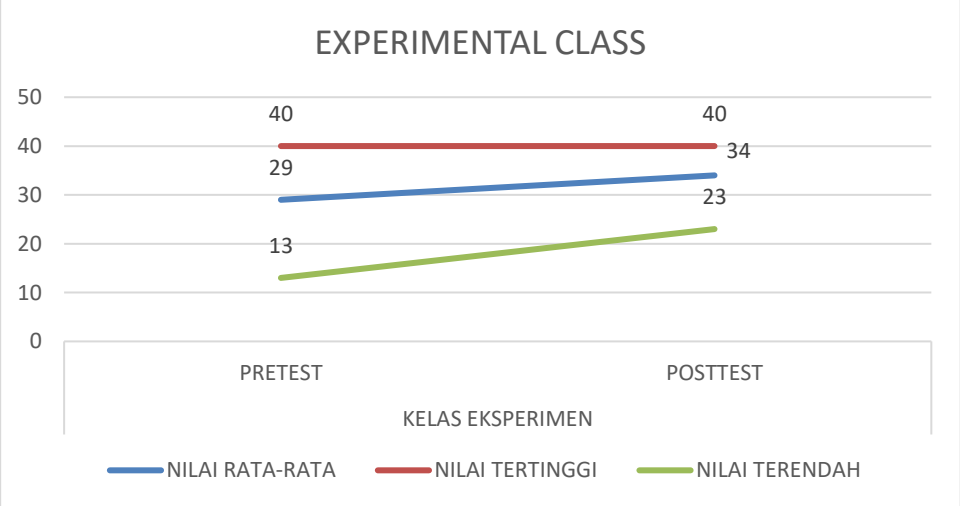

Figure 3. Results of CTL Implementation in experimental class

Based on the problem solving indicators contained in the assessment instrument that students must have, namely students are able to understand the problem, plan the problem, complete the settlement plan and finally, check again. While re-checking is still considered low.

In line with research (Purba & Surya, 2020) and research (Muslihah & Suryaningrat, 2021), by using the CTL model students become more active in learning. Students can develop their thinking, students can learn on their own and discover their own knowledge and skills, can develop their curious nature through questions, and students can discover new things from the results of their learning.

Overall, it turns out that appropriate learning strategies can improve AMT abilities for students. These results are consistent with the

findings in a meta-analysis of the effectiveness of learning strategies, that learning strategies can improve learning outcomes. Based on the results of the research above, CTL, Mastery Learning, & Participatory learning strategies have the greatest influence when compared to other learning strategies. Inseparably with the Kinsley, Metacognitive, APOS, PACE, and Hybrid learning methods, of course the AMT learning method also plays an important role in understanding students in the Contemporary environment.

(Yuliyani, 2021) The use of contemporary/constructivism learning models in classroom learning activities has various advantages or benefits. Strength is oriented towards optimal learning activities so that learning objectives can be achieved effectively through the support of lecturers and students in learning. In addition, the selection of learning strategies used by lecturers is greatly influenced by the nature of the subjects to be taught and also influenced by the level of AMT abilities that already exist in students.

CONCLUSION

Based on the results of this meta-analysis, it is recommended for lecturers to optimize the use of constructivist learning strategies (CTL, Mastery Learning, & Participatory learning) by incorporating technological information to improve AMT abilities for students and trigger students to think critically, innovatively and creatively. Furthermore, considering the benefits obtained through meta-analysis research, it is necessary to carry out similar research for other fields and use more experimental research samples. Because there is still a lack of research on the use of strategies to improve AMT abilities in students and students.

REFERENCES

Aprilisa, E. (2020). Realizing Society 5.0 to Face the Industrial Revolution 4.0 and Teacher Education Curriculum Readiness in Indonesia. *Proceeding International Conference on Science and Engineering*, *3*(April), 543–548. https://doi.org/10.14421/icse.v3.559

Aristika, A, & Darhim, A. (2019). *Meta-analysis the effect of learning strategies on ability advanced mathematical thinking students*. *4*, 110–115.

Aristika, Ayu, Darhim, Juandi, D., & Kusnandi. (2021). *The Effect Of Hybrid Learning And Enjoyment Learning In Increasing Advance Mathematical Thinking*. *10*(3), 1860–1875.

Fitriani, N., & Nurfauziah, P. (2020). *Meningkatkan kemampuan advanced mathematical thinking dengan menggunakan model pembelajaran matematika knisley pada mata kuliah trigonometri*. *3*(1). https://doi.org/10.22460/jpmi.v3i1.p69-80

Hariadi, M. J. D. S. & B. (2022). *C-Chil: A New Learning Model For Advanced Mathematics Course In The Society 5.0 Era*. *11*(3), 1789–1804.

Hutajulu, M., & Minarti, E. D. (2017). *Meningkatkan Kemampuan Advanced Mathematical Thinking Dan Habits Of Mind Mahasiswa Melalui Pendekatan*. *3*(2), 177–194.

Isaoud Alhunaini, Kamisah Osman, & N. A. (2020). *The Development and Validation of Assessment Practices of Mathematical Thinking (APMT) Instrument*. *45*(2), 79–91.

Kadir. (2017). *Meta-Analysis of Learning Intervention Toward Mathematical Thingking on Reasearch and Publication of Students*. *4*(2), 13.

Mkrttchian, V., Gamidullaeva, L., Finogeev, A., Chernyshenko, S., Chernyshenko, V., Amirov, D., & Potapova, I. (2021). Big data and internet of things (IoT) technologies' influence on higher education: Current state and future prospects. *International Journal of Web-Based Learning and Teaching Technologies*, *16*(5), 137–157. https://doi.org/10.4018/IJWLTT.20210901.oa8

Muslihah, N. N., & Suryaningrat, E. F. (2021). Model Pembelajaran Contextual Teaching and Learning terhadap Kemampuan Pemecahan Masalah Matematis. *Plusminus: Jurnal Pendidikan Matematika*, *1*(3), 553–564. https://doi.org/10.31980/plusminus.v1i3.1445

Pasandaran, R. F., & Kartika, D. M. R. (2019). Higher order thinking skill (HOTS) : pembelajaran matematika kontemporer. *Pedagogy : Jurnal Pendidikan Matematika*, *4*(1), 53–62. http://www.journal.uncp.ac.id/index.php/Pedagogy/article/view/1429/1242%0Ahttp://www.journal.uncp.ac.id/index.php/Pedagogy/article/view/1429

Purba, G. I. D., & Surya, E. (2020). The Improving

of Mathematical Understanding Ability and Positive Attitudes of Unimed FMIPA Students by Using the Contextual Teaching Learning (CTL)Approach. *Journal of Physics: Conference Series*, *1462*(1). https://doi.org/10.1088/1742-6596/1462/1/012019

Sudibjo, N., Idawati, L., & Harsanti, H. R. (2019). Characteristics of Learning in the Era of Industry 4.0 and Society 5.0. *International Conference on Education Technology*, *372*(ICoET), 276–279. http://staffnew.uny.ac.id/upload/130682770/penelitian/ba-32kur-masa-depansemnas-untirta16-2-

Supendi, A. (2022). *Kontemporer Terhadap Peningkatan Keterampilan Berpikir Tingkat Tinggi (Hots) Siswa*.

Supriyadi, E. (2022). *A Bibliometrics Analysis On Mathematical Thinking In Indonesia From Scopus Online Database With Affiliation From Indonesia*. *4*(1), 82–98. https://doi.org/10.35316/alifmatika.2022.v4i1.82-98

Suryana, A. (2019). *Advanced Mathematical Thinking dalam Pembelajaran Matematika Tingkat Lanjut*. *2682*, 15–28.

Tanudjaya, C. P., & Doorman, M. (2020). Examining Higher Order Thinking in Indonesian Lower. *Journal on Mathematics Education*, *11*(2), 277–300.

Wahyuni, S. (2020). *Missouri Mathematics Project (MMP) Model : Encouraging the Enhancement of Reasoning Ability and the Advanced Mathematical Thinking (AMT)*. *27*(3).

Yuliyani, M. (2021). Studi Literatur-Aktualisasi Pembelajaran Kooperatif Learning Pada Matematika Kontemporer. *ProSANDIKA UNIKAL (Prosiding Seminar …*, 175–182. https://www.proceeding.unikal.ac.id/index.php/sandika/article/view/557