Macrothink Institute™

Journal of Educational Issues
ISSN 2377-2263
2022, Vol. 8, No. 2

Developing Grade 10 Student Learning Achievement of Relation Using Deductive Learning Management with Online Exercises

Minmanee Reangnok

Faculty of Education, Mahasarakham University, Thailand

E-mail: minmanee.028@gmail.com

Apantee Poonputta (Corresponding author)

Faculty of Education, Mahasarakham University, Thailand

E-mail: oomsin.putta@gmail.com

Received: June 6, 2022 Accepted: July 26, 2022 Published: August 3, 2022

doi:10.5296/jei.v8i2.20065 URL: https://doi.org/10.5296/jei.v8i2.20065

Abstract

The purposes of the study were 1) to investigate the effectiveness of deductive learning management with online exercises on grade 10 students learning achievement of mathematical relations; and 2) to investigate students' satisfaction with the learning management. The study was conducted in a one-group pretest-posttest design. The participants were 41 Thai grade 10 students learning mathematics. The cluster random sampling method was employed in the participant selection process. The instruments were a learning management plan designed in a deductive learning management, a learning achievement test, and a satisfaction questionnaire. The effectiveness of the deductive learning management on students' learning achievement of mathematical relation was assessed by considering the participant's performance while learning in the class and at the end of the class. The statistics used in the data analysis were percentages, mean scores, standard deviation, a paired t-test, and an effectiveness test (E_1/E_2) with the determining criteria of 75/75. The results of the study indicate that the deductive learning management plan with online exercises was capable of improving grade 10 students' learning achievement of mathematical relations. Moreover, it also brought about a satisfying experience learning the concept. The study contributed to the area of mathematics education as it provided an example to support the use of the deductive learning management on learners with limited

mathematic skills.

Keywords: Deductive teaching, Online exercises, Mathematics education

1. Introduction

The key characteristic of 21st-century learning is how it lets learners take control of their learning. Moreover, in a more complicated world, learners need to acquire skills and abilities which still make them competitive in a new era of the job market. According to the framework of 21st -century skills (P21 Partnership of the 21st-Century Skills, 2008), learners need to develop both core subject knowledge and 21st-century learning skills. It could be noted in the framework that mathematics is an important subject for students as a core subject and a knowledge that could contribute to skills such as thinking skills, technology skills, and innovation skills. Therefore, it could be implied that students who are proficient in mathematics have a better chance of succeeding in the 21st century.

However, learning mathematics is a complex process. Learners need to deconceptualize the mathematical components, employ them in equations, and use their mathematical skills to solve the problems (Atteh, 2020). These skills might not be simple for all learners as they need to both understand the math concepts and use them in practice. Rameli and Kosnin (2016) found that the challenges in mathematic teaching can be classified into 5 categories including self-factors (negative perception and low self-regulation), teachers (behaviors, practices, characteristics), parents (lack of cognitive, emotional, and financial support), friends (negative attitudes, behaviors, lack of support), and others factors (nature of math and assessment pressure). Consequently, the subject is perceived as one of the most difficult classes in high school (Simmer, 2011).

In Thailand, mathematics is one of the crucial problems in its education. The average score in mathematics of 12-grade students was 26.04 % of the full mark (National Institution of Education Testing Service, 2021). Moreover, the country was ranked 57th out of 78 on the PISA test regarding mathematics (The OECD Programme for International Student Assessment, 2018). In detail, the report also shows that the average score of Thai students taking Mathematics tests was 419 (S.D. = 88) which is considered at a level 1 out of 6 of the mathematics skills labeled by the test organization. Subsombat (2020) suggested that apart from the complexity of the subject, Thai math education also faces challenges in teaching, parent support, and student aspects. The incapability of improving mathematics education in the country results in a delay in technology and innovation development and obstructs national development as a whole.

In math, a relation is a link between two different sets of information. Learners can figure out the relation between two sets of data (or more) if there is a link between the things in two or more collections that are not empty (Bruskiewich, 2015). Taking into account two sets will allow them to discover the relationship between the data if there is a connection between the non-empty components of two or more collections. The concept could be beneficial in learning other concepts of maths (*e.g.*, function) and applicable in real life. For example, we can see patterns and links that describe relationships, such as father-son, brother-sister, etc. In

arithmetic, we encounter various number relations, such as x y, l m, etc. Relation let us notice the link of domains and codomain (Bruskiewich, 2015).

Therefore, teaching the concept of relation needs a clear explanation of how two sets (or more) can relate to each other and examples that would help learners make a connection between the concept and the demonstration. In this case, teaching mathematics could be in both deductive and inductive approaches. Deductive teaching refers to the instructional method that begins with a general statement or hypothesis and then investigates the various possibilities to arrive at a particular logical conclusion (Baki, 2008). Meanwhile, inductive teaching, known as discovery learning, provides specific examples and how they could be applied in the real context and then explains regulations to explain the phenomena. According to Miyazaki (2000), the method would be more effective when students have prior knowledge regarding the class concept. Considering the problems found in the Thai context, the deductive method could be a solution for Thai students learning the concepts of relation as it would enable them to comprehend the rules, establish a connection between examples and rules, and increase their knowledge. Each process of a learning management plan designed deductive method can be exemplified below.

(1) Preparing Stage

Students are asked to review their prior knowledge. Teachers ask questions to help students make a connection between the prior knowledge and the class concept. The adaptation of the class concept in real life could also be given to stimulate students' interest.

(2) Teaching Stage

Explanation in solving mathematical problems in the concept of relation is provided. Background theory, elements of the sets, and how to figure out the relation between sets are taught with techniques and teaching materials. The examples of relation of sets can also be given.

(3) Conclusion Stage

Teachers and students collaboratively summarize the class understanding of the class concept. Students help each other to explain how the relation in mathematics works while teachers provide feedback if necessary.

(3) Application Stage

The knowledge is applied in exercises. Teachers assigned classwork to let students practice using their knowledge in mathematical problem-solving.

Therefore, students learning in a deductive learning environment would experience knowledge receiving and constructing. They are also allowed to test their understanding of the concept via exercises that could ensure their development of skills and abilities. The benefits of the deductive method in teaching mathematics could be seen in several studies (*e.g.*, Atta et al., 2015; Ayalon & Even, 2008; Rahmah, 2017; Singh, 2017; Sriplaeg, 2022; Siswono et al., 2020).

In addition, the covid-19 pandemic affects education settings around the globe. The class cannot be handled in a typical setting and the influence of online technology becomes a new normal in class management. In Thailand, the whole 2021 academic year is instructed by the government to be held with the caution of disease prevention. Therefore, all class activities were performed online. In this case, online exercises were beneficial in assisting teachers to manage their classes despite the absence of students in the face-to-face setting. In terms of managing deductive learning management, online exercise plays a great part in the application stage. Learners can access the learning materials and are still on their path to skill development.

Considering the potential of the deductive method in mathematics education and the benefits of online exercise in teaching during the pandemic, we employed the teaching approach with the integration of the online exercises in a design of learning management and use it to teach grade-10 students the concept of mathematical relations. The purposes of the study were 1) to investigate the effectiveness of deductive learning management with online exercises on grade 10 students learning achievement of mathematical relations; and 2) to investigate students' satisfaction with the learning management.

2. Methodology

2.1 Research Design

The study was conducted in a one-group pretest-posttest design. The effectiveness of the deductive learning management on students' learning achievement of mathematical relation was assessed by considering the participant's performance while learning in the class and at the end of the class. The participants' satisfaction with the learning management is also assessed to investigate how the method affects the learning environment in class.

2.2 Participants

The participants were 41 Thai grade 10 students learning mathematics. The cluster random sampling method was employed in the participant selection process. In detail, the participants passed through the mathematical learning path destinated by the Thai core curriculum (Ministry of Education, 2008). The concept of mathematical relation was assigned in the fourth level of learning. Students' prior knowledge was average considering their GPAs in math courses. The participants were treated with the caution of ethical issues.

2.3 Instruments

The instruments were a learning management plan designed in a deductive learning management, a learning achievement test, and a satisfaction questionnaire. In detail,

(1) The learning management plan was designed with the principle of a deductive learning management. Online exercises were assigned in the application stage of teaching. 10 lesson plans on mathematical relations were included in the learning management plan. The learning management plan evaluation employing 3 experts in the education management indicates a very high level of appropriation (Mean = 4.97).

(2) The learning achievement test was assigned as a pre-post-test. There were 30 multiple-choice question items. The validity of the test was testified by the index of item objective congruence (IOC) of 0.50-1.0.

(3) The questionnaire consisted of 10 positive statements regarding learning with the deductive learning management and the use of online exercises. The validity of the items was testified by the index of item objective congruence (IOC) of 1.0.

2.4 Data Collection and Data Analysis

The participants took a pre-learning achievement test before the implementation of the learning management plans. The plan took 10 class hours lasting for a semester. The data collection took place in the 2021 academic year when classes across the country were online due to the covid-19 prevention regulations. Students took a post-test and fill the questionnaire after the process of learning management ended. The participant's scores for pre-test, exercises, and post-test were taken into consideration. The participant's answers to the questionnaire were analyzed along with 5 Linkert scale interpretations. The statistics used in the data analysis were percentages, mean scores, standard deviation, a paired t-test, and an effectiveness test (E_1/E_2) with the determining criteria of 75/75.

3. Results

The results of the study reveal that participants' average score while learning the concept of relation with deductive learning management and online exercises was 389.05 out of the maximum point of 434 (E_1 = 89.64). In addition, participants' average score in the post-test was 22.56 out of the maximum point of 30 (E_2 = 75.20). Therefore, the effectiveness of the learning management plan designed using the deductive learning management with online exercises on students' learning achievement of mathematical relations was 89.64/75.20 (E_1/E_2) (Table 1). It could be interpreted that the learning management plan was effective in developing learners' knowledge of mathematical relations in both on-process and end-product aspects.

Table 1. The effectiveness of the deductive learning management with online exercises on students' learning achievement of mathematical relations

Participants' performances	Full mark	Mean	S.D.	Percentages
Effectiveness of Process (E_1)	434	389.05	42.57	89.64
Effectiveness of Product (E_2)	30	22.56	2.78	75.20
Effectiveness (E_1/E_2) 89.64/75.20				

Findings also indicate that the deductive learning management with online exercises could improve participants' learning achievement of relations. A paired t-test shows that participants' average score on post-test (Mean = 22.56, S.D. = 14.49) was significantly higher

than the pre-test (Mean = 8.07, S.D. = 5.48), t = 17.33, p = 0.00. (Table 2).

Consequently, it could be interpreted that the participants developed their knowledge of mathematical relations after learning with a learning management plan designed using the deductive learning management with online exercises.

Table 2. The comparison between participants' pre-test and post-test

Score	Pretest		Posttest		Paired Differences		t-test	p
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
30	8.07	5.48	22.56	2.81	14.49	5.35	17.33	0.00*

Note. * p > .05.

The results of the study indicate that students agreed with positive statements regarding the deductive method and online exercises. Participants' answers to the questionnaire can be interpreted that they were satisfied with the learning environment at a high level (Mean = 4.12, S.D. = 0.95). In detail, the deductive method with online exercises was perceived as a beneficial learning environment in terms of knowledge improvement, confidence booster, learning motivation, and profitable discussion. Moreover, students felt that learning activities and online exercises contributed to fair and accessible evaluation. Therefore, it could be claimed that students were satisfied with learning with the deductive method and online exercises (Table 3).

Table 3. Participants' satisfaction with the deductive method and online exercises

No.	Statements	Mean	S.D.
1	Learning activities helped me understand class content.	4.26	0.87
2	Learning activities helped me become enthusiastic about learning.	4.26	0.87
3	Learning activities supported class discussion.	3.95	1.08
4	Online exercises helped me understand class content.	4.05	1.18
5	Online exercises improved my mathematical skills.	4.11	0.99
6	I felt confident in doing activities and classwork.	4.26	0.93
7	I participated in class activities to my full potential.	4.16	0.83
8	Learning activities boosted confidence in learning.	4.11	0.81
9	Online exercises showed immediate results.	4.16	0.83
10	Activity and exercise scores were given with a fair procedure.	3.89	1.15
Average		4.12	0.95

4. Discussion

The results of the study could be summarized that the deductive method and online exercises were effective in developing students' learning achievement of mathematic relations. The results of the study confirm the benefits of the deductive learning management in math education as found in the previous studies (*e.g.*, Atta et al., 2015; Ayalon & Even, 2008; Rahmah, 2017; Singh, 2017; Sriplaeg, 2022; Siswono et al., 2020). At this point, apart from developing students' knowledge of the area (Singh, 2017), mathematical problem-solving (Rahmah, 2017), and solving intermediate proof tasks (Siswono et al., 2020), the deductive learning management was also capable of improving students' knowledge of mathematical relation. It seems that providing knowledge of rules before giving examples and exercises could be an effective method in math education. Due to the complicated nature of mathematics, learners need to understand equations, formulas, substitution, rules, etc. Only when students acquire the knowledge of concepts taught in the class, examples can be comprehensible (Baki, 2008). Therefore, it results in the improvement of the students' skills in the current study.

Moreover, it should be noted that the deductive learning management is debatably considered a teacher-center instructional method. The nature of the class in the deductive setting starts with teachers lecturing about the content of the class. However, the method was proved to be effective in the current study in both on-process and end-product aspects. Considering the participants' mathematics competency, it could be implied that the deductive learning management is suitable for learners with limited knowledge. Therefore, teachers should prioritize students' needs in choosing an appropriate teaching method. In addition, it could be

noted that the online exercises supported the learning process of deductive teaching in the current study. This confirms the influence of information technology in learning during the pandemic era (Starkey et al., 2021).

It could also be noted that the students were satisfied with the deductive learning management and online exercises. Even though teachers play an important role in the teaching method, students were allowed to collaboratively summarize the understanding of class concepts before doing exercises. Therefore, class participation and discussion play a great role in students' attitudes toward the class environment. The result of the study is related to Echiverri et al. (2020) who also found the relationship between the two components in contributing to a learnable class environment.

5. Conclusion

The study was conducted to study the effectiveness of the deductive learning method as the main principle in the design of a learning management plan along with the use of online exercises on students' knowledge of the mathematical relation concept. The results of the quasi-experimental study indicate that the deductive learning management plan with online exercises was capable of improving grade 10 students' learning achievement of mathematical relations. Moreover, it also brought about a satisfying experience learning the concept. The results of the study could be implicated in pedagogical settings as teachers should be aware that the deductive learning method is suitable for learners with limited mathematics knowledge. Knowledge can be constructed by the understanding of principles of mathematics relations. Therefore, teachers should prioritize the explanation of class content to improve the effects of deductive teaching. The findings could also be implicated in future research as the method could be tested with learners of different mathematical competencies to illustrate its effects.

For the limitations of the study, the one-group pretest-posttest design could be improved with the control or comparative group. Moreover, students' satisfaction with the method could be investigated in more detail with the use of qualitative instruments such as interviews and observation.

Acknowledgements

The project is financially supported by Mahasarakham University, Thailand.

References

Atta, M. A., Ayaz, M., & Nawaz, Q. (2015). Comparative study of inductive & deductive methods of teaching mathematics at elementary level. *Gomal University Journal of Research, 31*(1), 20-28. Retrieved from http://www.gujr.com.pk/index.php/GUJR/article/view/321/192

Atteh, E. (2020). The nature of mathematics education: The issue of learning theories and classroom practice. *Asian Journal of Education and Social Studies, 10*(2), 42-49. https://doi.org/10.9734/ajess/2020/v10i230265

Ayalon, M., & Even, R. (2008). Deductive reasoning: in the eye of the beholder. *Educational*

Studies in Mathematics, 69(3), 235-247. https://doi.org/10.1007/s10649-008-9136-2

Baki, A. (2008). *Mathematics education from theory to practice*. Ankara: Harf Educational Publications.

Bruskiewich, P. (2015). *An Introduction to Relations, Expressions and Functions*. Pythagoras Publishing.

Echiverri, L. L., Haoyu, S., & Keer, X. (2020). Class Discussion and Class Participation: Determination of Their Relationship. *Journal of Higher Education Theory and Practice, 20*(11). https://doi.org/10.33423/jhetp.v20i11.3761

Miyazaki, M. (2000). Levels of proof in lower secondary school mathematics. *Educational Studies in Mathematics, 41*(1), 47-68. https://doi.org/10.1023/A:1003956532587

National Institution of Education Testing Service. (2021). *2020 Ordinary National Educational Test (O-Net) results*. Retrieved September 1, 2021, from http://www.niets.or.th/th

P21 Partnership for 21st Century Skills. (2009). *Framework for 21st century learning*. Retrieved December 21, 2021, from https://www.teacherrambo.com/file.php/1/21st_century_skills.pdf

Rahmah, M. A. (2017). Inductive-Deductive approach to improve mathematical problem solving for junior high school. *Journal of Physics: Conference Series, 812*, 012089. https://doi.org/10.1088/1742-6596/812/1/012089

Rameli, M. R. M., & Kosnin, A. M. (2016). *Challenges in mathematics learning: A study from school students' perspective*. Retrieved from https://www.researchgate.net/publication/321873178_Challenges_in_Mathematics_Learning_A_Study_from_School_Student's_Perspective

Simmer, M. J. (2011). It's not the math they hate. *Proceedings of International Conferences on Mathematics and Engineering* (pp. 1-48). Hawaii.

Singh, N., & Yadav, A. K. (2017). Inductive and Deductive Methods in Mathematics Teaching. *International Journal of Engineering Research and Applications, 7*(11), 19-22. Retrieved from https://www.coursehero.com/file/69261052/Inductive-and-Deductive-Methods-in-Mathematics-Teachingpdf

Siswono, T. Y. E., Hartono, S., & Kohar, A. W. (2020). Deductive or Inductive? Prospective Teachers' Preference of Proof Method on an Intermediate Proof Task. *Journal on Mathematics Education, 11*(3), 417-438. http://doi.org/10.22342/jme.11.3.11846.417-438

Sriplaeg, C. (2022). Effects of deductive learning method in mobile learning environment on English learning achievement and learning motivation of 4th grade students with different learning abilities. *Journal of Education Studies, 47*(3), 98-117.

Starkey, L., Shonfeld, M., Prestridge, S., & Cervera, M. G. (2021). Special issue: COVID-19 and the role of technology and pedagogy on school education during a pandemic. *Technology, Pedagogy and Education, 30*(1), 1-5. https://doi.org/10.1080/1475939X.2021.1866838

Subsombut, V. (2020). *2019 Ordinary National Educational Test (O-Net) results*. Retrieved September 1, 2021, from http://www.niets.or.th/th

The OECD Programme for International Student Assessment. (2018). *PISA 2018 insights and interpretations*. Retrieved 1 September 2021, from https://www.oecd.org/pisa/PISA%202018%20Insights%20and%20Interpretations%20FINAL%20PDF.pdf

Copyright Disclaimer