The Effect of Application Kumon Learning Method in Learning Mathematics of Ability Troubleshooting Mathematics of Students

Usmadi[1*], Amelia Agita[2] , Ergusni[3]**

[1,2,3] Departement of Mathematics Education Muhammadiyah University West Sumatera
[*]**usmadidttumanggung@gmail.com**
[**]ergusni12@gmail.com

Abstract: This study aims to determine students 'problem solving abilities and to see the effect of applying Kumon learning methods to students' mathematical problem solving abilities in linear program material in class X SMK N 2 Padangpanjang. The hypothesis of this study is "There is an influence of the application of the Kumon learning method to the ability of students to solve mathematical problems in linear program material in class X SMK N 2 Padang Panjang". Based on the test results of the two mean differences for paired data obtained, that $t_{Count} = 11,42 > 1,699 = t_{(0,05;29)}$, H_0 rejected and H_1 accepted. This means that the Kumon learning method influences students' mathematical problem solving abilities in linear program material in class X SMKN 2 Padangpanjang. Conclusions of the results of the study that the application of the Kumon learning method affects the ability of students to solve mathematical problems on the subject of linear programming.

Keywords: Kumon Learning Method, Mathematical Problem Solving

1. Introduction

Research has shown that some very basic Mathematics skills are innate ([4], [20]). The more advanced skills, such as enumeration, correspondence construction, counting, Arithmetic, and understanding of arithmetical concepts, develop sequentially through instruction ([2], [4], [14]). These skills, and the sub-skills that comprise them, progress from acquisition to mastery. Once the skills are mastered, they can be used as a foundation for the acquisition of the next, more advanced skill in the hierarchy. Most of the skills in the Senior High school Mathematics curriculum are taught this way.

Mathematics learning is a teaching and learning process that was built by the teacher to develop students 'creative thinking that can improve students' thinking abilities, and can improve their ability to construct new knowledge in an effort to improve good mastery of mathematical material. In the process of learning mathematics, both teachers and students together become the perpetrators of the implementation of learning objectives. The learning objectives will achieve maximum results if learning runs effectively. Effective learning is learning that is able to actively involve all students.

This is in line with the opinion of [19] that the learning process is a series of activities, namely: first, individuals feel the needs and see the goals to be achieved. Second, individual readiness to meet needs and achieve goals. Third, understanding the situation, that is, everything in the individual environment fulfills needs and achieves their goals. Fourth, interpreting the situation that is how individuals see the relationship of various aspects contained in the situation. Fifth, individuals undertake activities to meet needs and achieve goals in accordance with what they have designed in the third and fourth stages. Sixth, individuals will get feedback on what they have done. There are two possibilities that occur in the learning process, namely success or failure.

The quality of learning can be in terms of process and outcome terms. First, in terms of the process, learning is said to be successful and quality if all or most students are actively involved, both physically, mentally, and socially in the learning process, in addition to showing a high enthusiasm for learning and self-confidence. Second, in terms of results, learning is said to be effective when there is a change in behavior in a positive direction, and the achievement of learning objectives that have been set. These changes occur from not knowing to knowing mathematical concepts, and being able to use

them in everyday life. A quality learning process, can only be done by effective teachers. Effective teachers are teachers who encourage students to take responsibility for themselves to learn, creating a comfortable atmosphere in learning so that students learn successfully [5], [1], [18], [26]. In order to improve the quality of our education, teachers need to introspect and change teaching paradigms, ways of thinking and practicing innovative learning models using the learning paradigm [6]. This means, the teacher as the spearhead of learning has been using the old method (conventional) for a long time. The teaching paradigm must be changed by increasing the activeness of students in learning, so students can achieve their competence through the mastery of teaching materials. One of the competencies expected is problem solving ability.

Overcoming obstacles in the learning process so far, it is necessary to work towards the application of mathematical learning models that provide opportunities for students to be more active in learning. One of the learning strategies or methods that can be applied is the Kumon method. According to [10] the kumon method is an individual learning method. The starting level for each Kumon student is determined individually. Students are given assignments ranging from the level that can be done easily without mistakes. The worksheet has been designed so that students can understand for themselves how to solve the problems. If students continue to learn with their own abilities, they will pursue learning material that is equivalent to their grade level and even go beyond it.

One method or learning strategy that can be applied is the Kumon learning strategy. Kumon is a learning system that provides individual learning programs according to the abilities of each student. The Kumon Method of Learning has seven components: individualized learning, independent learning, comfortable starting point, curriculum, repeated practice, mastery, and advanced level of study [12]. Both Kumon programmes (Reading and Mathematics) were created based on this Method. And then, The Kumon Strategy enables students to explore their potential and develop their abilities to the fullest by doing exercises in the modules given by the teacher continuously [9]. Similarly, based on research results, It was reported that the Kumon method, effectively improving children's mathematical abilities at school, emphasizes activities on each student's abilities, so students can explore their potential and develop their abilities to the fullest.Kumon method learning not only teaches how to count but can improve students' ability to focus more in doing something and confident [8]. Since Kumon seems to be a promising intervention (based on a review of the available literature and anecdotal evidence) and its' use is so ubiquitous, the current study will begin to add to the current literature by investigating the effectiveness of Kumon as a remedial and enrichment Mathematics programme.

The Kumon learning syntax in this study are: Stage 1: Placement Test; First, students will take a placement test. The teacher then analyzes the results of the test carefully and determines the initial level of students. Keep in mind, the Kumon program consists of a series of worksheets consisting of several levels, and students can advance to the next level with their own abilities. Determining the right starting level is the key to independent learning from the early stages of Kumon. Stage 2: Attending Classes; Kumon has its own programs and classes. For this reason, students are encouraged to come to the Kumon class 2 times a week. Because Kumon emphasizes the importance of independent learning, no special teaching is given in Kumon classes. Students are encouraged to study worksheets independently without having to be specifically taught. The Kumon worksheet is designed so that students can solve problems on their own; Stage 3: Supporting Independent Learning; before the day of learning in class begins, the teacher prepares the right worksheet for each student. In class, the teacher observes students carefully, to ensure each student learns at the right level for him; Stage 4: Work independently; after completing the lesson that day, students submit the worksheets that have been done to the teacher. Worksheets are then graded and returned to students. If there are mistakes, students correct them themselves. By completing the worksheets independently, students will deepen understanding of the material and develop good study habits; Stage 5: Homework; after students finish their lessons in Kumon class, the teacher gives the right worksheet to do at home. This makes parental support at home very important. Homework that has been done is then collected to the teacher at the beginning of the next meeting when students come to class. Homework that has been collected is then assessed by the supervisor and if necessary, students correct the worksheets independently until all the answers are correct.

Meanwhile, to solve problem solving problems in this study, based on Polya's opinion in [22] namely: (a) understanding the problem; concerning what is known and what was asked, (b) formulate a solution for the settlement, which can be realized by writing down the mathematical

sentence, (c) carrying out the solution; after students collect existing data then students implement appropriate strategies to get results, and (d) check back on all the steps that have been done.

2. Methodology

This type of research is quasi-experimental research with the research design is One Group Pretest-Posttest Design as in Table 1 below.

Table 1. Research Design

Class	Pretest	Treatment	Posttest
Experiment	X_1	T	X_2

Source: modified from [13]

The population in this study was normal and homogeneous in distribution, namely class X SMK N 2 Padangpanjang registered in the 2018/2019 school year. While the sample was taken by random sampling and selected class X TKJ 2 as a sample with a sample size of 30 people. The research variables of students' mathematics learning outcomes before and after treatment, namely: students' mathematical problem solving ability before being given the treatment of the application of the Kumon method of learning methods, and = ability of students' mathematical problem solving after being given the treatment of the application of learning with the Kumon method.

All research instruments and instruments are first validated by experts. As for the test questions made, guided by the curriculum and syllabus. Based on the results of the analysis of test trials, obtained valid questions, significant and has a distinction index of moderate questions, and have medium reliability. The hypothesis in this study is that the application of the Kumon learning method affects the ability of students to solve mathematical problems in linear program material in class X SMKN 2 Padangpanjang, the hypothesis is tested using a statistical test of the two difference average t-tests for paired data.

3. Results and Discussion

3.1. Research Results

Data Description: Results of Students' Mathematical Problem-Solving Abilities with the Kumon Learning Method.

Ability to Identify Problems

Based on the analysis carried out on the student's pretest answer sheet and posttest score, the results of the development of students' mathematical problem solving abilities are described in identifying the problem. The results of these developments can be seen in Figure 1.
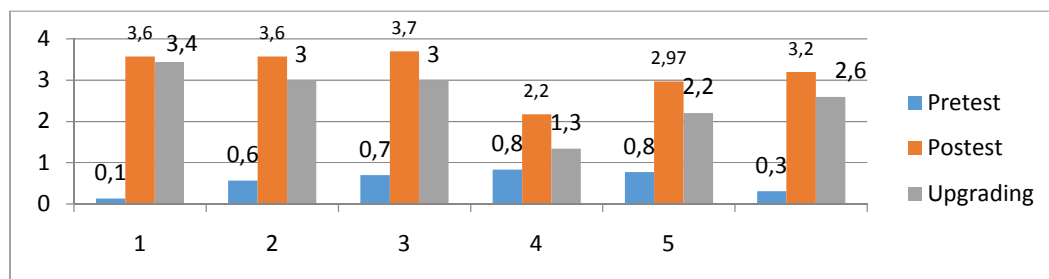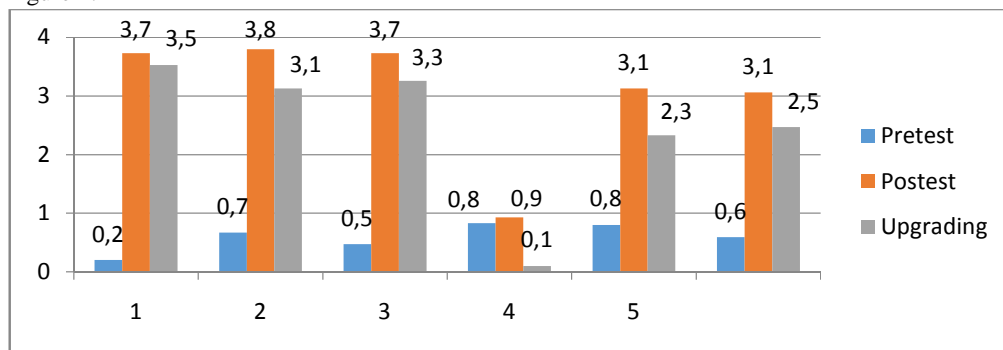

Figure 1. Graphic Development of Students' Ability in Identifying Mathematical Problems

Based on Figure 1, it appears that the ability of students to identify mathematical problems has significantly improved analyzed from the results of the pretest and posttest.

Ability to Plan Problem Resolutions

Based on the analysis conducted on the students 'pretest and posttest answer sheets, the results of the development of students' mathematical problem solving ability in describing the

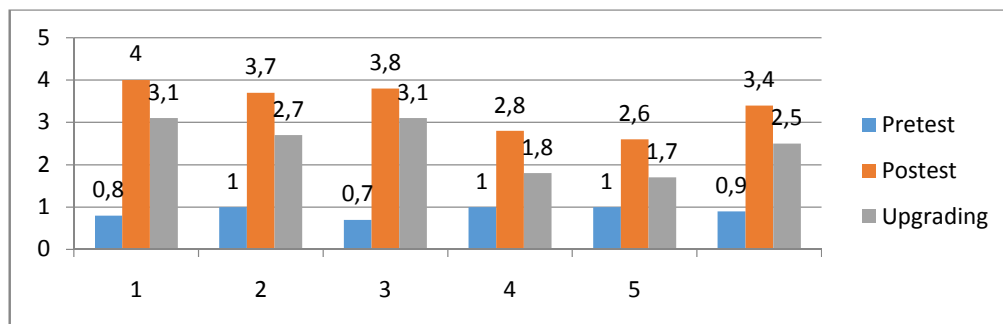mathematical problem solving plan are described. The results of these developments can be seen in Figure 2.

Figure 2. Graphic Development of Students' Ability in Planning Mathematical Problem Solving

Based on Figure 2, it can be seen that students' ability to plan mathematical problem solving has increased. In questions number 1 to 4 the average ability of students in planning problem solving in the pretest has increased in the posttest.

Ability to Resolve Problems

Based on the analysis conducted on the students 'pretest and posttest answer sheets, the results of the development of students' mathematical problem solving abilities in describing the problem are described. The results of these developments can be seen in Figure 3.
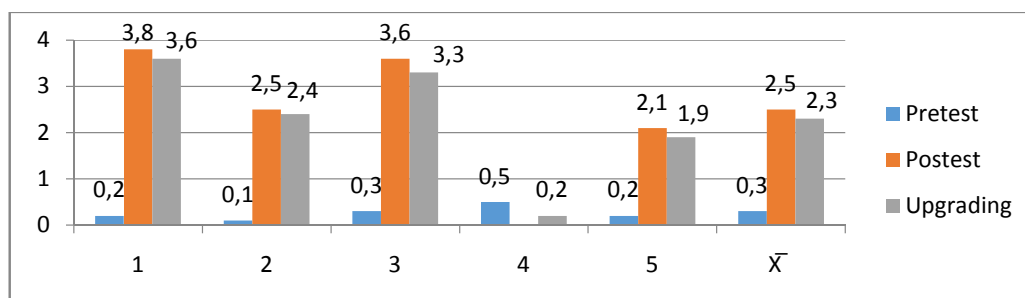

Figure 3. Graphic Development of Students' Ability in Solving Mathematical Problems

Based on Figure 3, it appears that students' ability to solve problems has increased. In questions number 1 to 5 the average ability of students to solve problems has increased from pretest to posttest.

Ability to Interpret Solutions

Based on the analysis conducted on the students 'pretest and posttest answer sheets, the results of the development of students' problem solving abilities in describing solutions are described. The results of these developments can be seen in Figure 4.

Figure 4 Graph Development of Students' Ability to Interpret Mathematical Solutions

Based on Figure 4, it appears that the ability of students to interpret solutions changes. In questions number 1 to 5 the average ability of students to interpret the solutions at the pretest has increased at posttest of 2.23

Hypothesis Test

Based on the test results of the two mean differences for paired data obtained, that $t_{Count} = 11,42 > 1,699 = t_{(0,05;29)}$, H_0 rejected and H_1 accepted. This means that the Kumon learning method influences students' mathematical problem solving abilities in linear program material in class X SMKN 2 Padangpanjang.

Discussion

Based on data analysis, the average improvement in students' mathematical problem solving skills is 59.6 points. In the pretest the average mathematical problem solving ability of students was 15.97 with the acquisition of a maximum value of 28.75 and the minimum value was 2.50. In the posstest the average mathematical problem solving ability of students was 75.57 with the acquisition of a maximum value of 96.25 and the minimum value of 35.00.

So it can be concluded that the students' mathematical problem solving ability after applying the Kumon Learning Method in learning mathematics is better than before applying the Kumon Learning Method in learning mathematics. This happens because before learning students are motivated by conveying benefits in daily life and in learning students are given the opportunity to find their own understanding of mathematical ideas and concepts through problem solving given.

The applied Kumon learning provides the opportunity for students to solve contextual problems in their own way based on the experience and initial knowledge possessed by students. The following are indicators of the ability to solve mathematical problems that students should have, namely:

a. Ability to Identify Problems

In this indicator students are expected to be able to meet the problem solving aspects of identifying what is known and asked in the problem correctly. The ability of students in the pretest for each problem is lower than in the posttest, this is because students are accustomed to solving a problem directly without writing down what is known and asked of the problem. Then in the pretest some students only copy back sentences in the questions and there are also some students who write one of the known and asked questions from the problem, so the score obtained in the ability to identify problems is low. In each problem given, students are trained to identify problems first so that students become accustomed to making what is known and asked from the problem. The teacher also helps remind students at every mathematical problem solving so that they always start by identifying problems in the problem.

b. Ability to Plan Completion

The problem solving aspect contained in this indicator is being able to plan mathematical problem solving. The ability to plan solutions is expected to be able to write students correctly formulas that will be used in solving problems.

Students' ability to plan problem solving in the pretest for each problem is lower than the posttetst. Before the Kumon Learning Method was applied students were still not accustomed to writing correctly the formula that would be used to solve problems.

After applying the Kumon Learning Method students' ability to plan for solving mathematical problems increases. This proves the Kumon Learning Method can improve students' mathematical problem solving skills in planning mathematical problem solving.

c. Ability to Solve Problems

The aspect of problem solving ability contained in this indicator is solving mathematical problems. In the process of problem solving students are required to be able to solve mathematical problems until they get the right answer to what is asked in the problem.

In solving problems given students are trained to be able to solve problems from problems correctly, completely and systematically. This is very helpful to trigger students' thinking in working on a problem and can be seen from the increased ability of students in the posttest in solving problems.

d. The Ability to Interpret Solutions

The aspect of problem solving ability contained in this indicator is to interpret the solution. In the process of solving a mathematical problem students are required to be able to interpret or write the conclusion answers to what was asked correctly and appropriately. The ability of students to interpret the solutions at the pretest for each problem is lower than at the posttest because almost all students only prioritize the final results without correcting the answers obtained so students do not deduce solutions from solving mathematical problems.

In working on problems given students are trained to be able to interpret the solutions of the answers obtained correctly and correctly. This can be seen from the increased ability of students in the posttest in interpreting mathematical solutions.

Alternatively, the comparable gains in both domains of Mathematics could reflect development in an overarching skill. Kumon states that its' the Kumon Learning Method in learning mathematics applying not only Math and Reading, but concentration, study habits, and self-confidence ([12], [15], [16]). Information-processing theory suggests that psychological processes, such as attention and concentration, support and enhance the transfer of information to longterm memory [8]. Therefore, participation in the Kumon Learning Method in learning mathematics applying may lead to equal growth in computation and mathematical reasoning skills as a result of strengthened psychological processing skills. [17] also found that the Kumon group had significantly higher test scores than the non-Kumon group on measures of both mathematical concepts (computation) and problem solving (mathematical reasoning). The following year, retention effects were measured and again the difference between experimental and control groups was significant for both mathematical procedures (computation) and problem solving (mathematical reasoning) [17]. Therefore, Kumon may have a significant, positive, and comparable effect on both Math reasoning and computation skills.

Conclusions

Based on the results of data analysis, it can be concluded: (1) The ability to identify problems, the ability to plan problem solving, the ability to solve problems and the ability to interpret solutions by applying the Kumon learning method has significantly improved, (2) The results of the research hypothesis test state that the application of the Kumon learning method in mathematics learning significantly influences the ability of students to solve mathematical problems in linear program material in class X SMKN 2 Padangpanjang. However, there were so many limitations to the study, namely in sampling, instrumentation, and data collection, that inferences and implications cannot be drawn from the study's results. The main contribution of the current study then, is to raise awareness of the Kumon Math programme and to examine its structure and strategies in comparison to learning theory. This study also contributes several questions and direction for future research in this area.

References

[1] Arends, I. Richard. (2004*). Learning to Teach. Sixth Edition*. New York: McGrow Hill Companies, Inc.

[2] Ardila, A., & Rosselli, M. (2002). Acalculia and dyscalculia. *Neuropsychology Review,12*(4), 179-231.

[3] Arikunto, Suharsimi. (2006). *Prosedur Penelitian*. Jakarta: Rhineka Cipta.

[4] Butterworth, B. (2005). The development of arithmetical abilities. *Journal of Child Psychology and Psychiatry, 46*(1), 3-18.

[5] Cohen, Lauis and Manion, Lavrence. (1990) A Guide To Teaching Practice. London: JEL. Composition,Ltd.

[6] Elfindri, (2010). *Soft Skills untuk Pendidik*. Praninta Offset. Baduose Media. Padang.

[7] Ergusni. (2014). Pemikiran Konstruktivistik dalam Implementasi Kurikulum 2013. Edukasi Jurnal. STKIP Abdi Pendidikan Payakumbuh.

[8] Hetherington, E. M., Parke, R. D., & Schmuckler, M. (2005). *Child psychology: A contemporary viewpoint.* Canada: McGraw-Hill Ryerson.

[9] Himawati, Hanif. 2013. *Peningkatan Hasil Belajar Siswa Kelas X A pada Kompetensi Dasar Jurnal Umum Perusahaan Jasa melalui Metode Pembelajaran Kumon Berbantuan Modul "General Journal Training Module" di SMK NU Wahid Hasyim Talang Kabupaten Tegal tahun ajaran 2013/2014*: Economic Education Analysis Journal. Semarang. Vol. 3, No. 53.

[10] Huda, Miftahul. (2013). *Model-Model Pengajaran dan Pembelajaran. Yogyakarta* : Pustaka Belajar.
[11] Huda, Miftahul. (2014). *Model-Model Pengajaran dan Pembelajaran:* Isu-Isu Metodis dan Paradigmatis.Yogyakarta:Pustaka Pelajar.

[12] Izumi, L. T. (2001). *Facing the classroom challenge: Teacher quality and teacher training in California's schools of education*. San Francisco, CA: Pacific Research Institute for Public Policy.
[13] Junaidi,dkk. (2013). Pengaruh Metode Pembelajaran Kumon Terhadap Peningkatan Hasil Belajar Matematika Siswa di Kelas VII MTs Sigli pada Limas. Journal Sains Riset (online).Vol 3. No.18. di akses tanggal 13 Desember 2017, dariHttp://journal Education.
[14] Klein, A., & Starkey, P. S. (1987). The origins and development of numerical cognition: A comparative analysis. In J. A. Sloboda & D. Rogers (Eds.), *Cognitive processes in mathematics* (pp. 1-25). Oxford, England: Clarendon Press.
[15]Kumon North America. (2008). *About Kumon.* Retrieved June 27, 2008, from http://www.kumon.com/ about/default.asp?language=USA.

[16] Kumon Toru Research Institute of Education. (2002). *Expanding one's strong point even further.* Japan: Kumon Toru Research Institute of Education.

[17] McKenna, M. A., Hollingsworth, P. L., & Barnes, L. L. B. (2005). Developing latent mathematics abilities in economically disadvantaged students. *Roeper Review, 27*(4), 222-227.

[18] Mudjiran.(2014) *Pengembangan Model Penugasan Terstruktur Kepada Peserta Didik*. Padang: Sukabina Press.

[19] Sardiman A. M. 2006. *Interaksi Motivasi Belajar Mengajar*, Jakarta: Rineka Cipta.

[20] Shalev, R. S. (2004). Developmental dyscalculia. *Journal of Child Neurology, 19*, 765-771.

[21] Soepono.Bambang.(1994) *Statistik Terapan*. Jakarta : PT Rineka Cipta.

[22] Suherman dkk, Erman. (2003). *Strategi Pembelajaran Matematika Kontemporer*.

[23] Suryabrata, Sumadi. (2011). *Metodologi Penelitian*. Jakarta : Raja Grafindo Persada.

24 Tsui, J. M., & Mazzocco, M. M. M. (2007). Effects of mathematics anxiety and perfectionism on timed versus untimed mathematics testing in mathematically gifted sixth graders. *Roeper Review, 29*(2), 132-139.

[25]Uno, H. B. (2014). *Model Pembelajaran Menciptakan Proses Belajar Mengajar yang Kreatif dan Efektif*. Jakarta: Bumi Aksara.

[26]Usmadi. (2016) Pengembangan Model Pembelajaran ARCSI dengan Pendekatan Saintifik. Disertasi Universitas Negeri Padang. Proceding Seminar International ACER 2016.

[27]Would,Jenna. (2010), The Relationship between Kumon and achievement in mathematics. https://hdl.handle.net/10133/3072 *Downloaded from OPUS, University of Lethbridge Research Repository.*