ASEAN Journal of Basic and Higher Education *e-ISSN 2719-048x*
https://paressu.org/online/index.php/aseanjbh
Vol 4, No. 1, 2021, 1-14pp

Indigenized Domino Activity Method: Its Effectiveness on Fraction Preliminaries Skills of Blaan Pupils

SHERLYN MAE P. ALBOROTO
College of Education, Mindanao State University,
General Santos City, Philippines
sherlynalboroto570@gmail.com

Abstract
Indigenized Domino Activity method refers to the use of concrete object which is the contextualized domino as aid on visualization and games in improving Fraction Preliminaries Skills of the pupils. This study aimed to find out the effectiveness of Indigenized Domino Activity method on the fractions preliminaries skills of Grade V Blaan pupils. The study employed experimental research design specifically single subject research. It is quantitative by nature that was complemented by qualitative information. It involved forty-eight (48) subjects who were officially enrolled in Ondok Gawan Elementary School addresses during the school year 2016-2017. Test, interview, and pictorial representation were employed to gather the needed data. The statistical tools employed were frequency count, percentage rate, weighted mean, and t-test for dependent samples. The result of the study revealed that the subjects have low fraction preliminaries skills before the indigenized domino application and have high level of fraction preliminaries skills after the intervention. Therefore, indigenized domino activity method is an effective teaching intervention to improve the fraction preliminaries skills of the pupils. The study suggested that the school and teachers should indigenize the lesson activities to improve the fraction preliminaries skills of the pupils.

Keywords: fraction preliminaries skills; indigenized domino activity method; Ondok Gawan Elementary School

INTRODUCTION

Poor skills on complex topics in mathematics are observed to be a problem in the whole world. Yet, it is alarming to know that there is still a huge problem in basic mathematics specifically on basic concepts of fractions skills or fraction preliminaries skills that exist among marginalized group. Fraction Preliminaries skills serve as a foundation and a stepping stone before taking operations of fractions and algebra or even higher mathematics in the future. Hence, it is alarming to note that in four years since the Third International Mathematics and Science Study Repeat (TIMSS-R) in 1999, only seven regions in the Philippines showed improvements in Math competencies based on the results of student achievement test (Carballo, 2009).

The world today is characterized by being scientific, technological, and mathematical. However, among thirty-four (34) countries as participants in the whole world, majority of them had 90% of fourth grade students reaching Low International Benchmarks in mathematics (Trends in International Mathematics and Science Study, 2011). In California, USA, it was recorded that only one-third of students met the mathematics standards compared to the two-third of students who met the standard in English-language arts (Leal, 2015).

In Ondok Gawan Elementary School, Fatima, General Santos City, 80% of 60 Blaan pupils in grade five have been recorded on having 75% and below grades in Mathematics during their 4th grade level during the School Year 2015-2016. It was traced that basic concepts of fractions are considered as one of the most difficult concepts to learn based on their pre-test result during 5th grade level, School Year 2016-2017. There data are alarming because fraction preliminaries skills are supposed to be mastered already by the pupils after finishing grade III based on the K-12 curriculum guide yet due to the poor fraction preliminaries skills, the Grade V teacher repeats the lesson about it before proceeding to the next lesson which is on operations of fractions.

To respond to this problem, teachers must indigenize based on their respective educational and social contexts according to the Enhanced Basic Education Act (2013). Several research show that Domino Activity Method is used in different parts of the world. Lankford (2008) and Knuckleby (2010) proved that dominoes make excellent math manipulative. Schools in the Philippines have the "freedom in adapting a curriculum to local conditions and relating the context of the curriculum to local environment" (Taylor, 2004). However, there has not yet been made, conducted, and cited as intervention of visualization and games on indigenized domino activity in improving specifically the fraction preliminaries skills of learners.

In line with the problem on high-rate number of pupils having 75% and below grades in Mathematics and the deficiency in the existing knowledge towards effective Fraction Preliminaries Skills, it is along with these reasons that the researcher was prompted to undertake this study. This study aimed to determine the effectiveness of Indigenized Domino Activity method on the fraction preliminaries of Blaan pupils.

METHODOLOGY

This section presents the methods used in this study. It includes the research design, subjects, instrument, data collection, and data analysis. They are discussed as follows.

Research Design

This study employed experimental research design specifically a single subject research. Experimental research is defined as having a control to independent variables (Key, 1997). Siegle (2015) stated that "single subject research is useful when the researcher is attempting to change the behavior of an individual or a small group of individuals and wishes to document that change". He also added that in single subject research, "the participant serves as both the control and treatment group". Thus, "one variable only is changed at a time".

Furthermore, this study undergone quantitative method complemented with qualitative research. The figure shown in the succeeding page represents the independent and dependent variables of the study, the data gathering procedures and the statistical treatment to be used.

Subjects

The subjects of this study were selected through purposive sampling. This technique is appropriate for this study as Cresswell and Plano Clark (2011) implied that purposive sampling involves "identifying and selecting individuals or groups of individuals that are especially knowledgeable about or experienced with a phenomenon of interest".

This study involved forty-eight (48) Grades V Blaan pupils officially enrolled in Ondok Gawan Elementary School during the school year 2016 - 2017. They were chosen regardless of their age and gender as long as their average score during pre-test is 75% and below. Another, these forty-eight (48) pupils were the subjects in response to the one of the alarming problems of the school which is numeracy and to help the said pupils specifically on their fraction preliminaries skills before taking up operations of fractions. This also involved ten (10) subject interviewees and one (1) teacher interviewee in response for the qualitative research.

Piaget (1977) as cited by Singer-freeman (2006) explained that during pre-adolescence stage or from seven to eleven (7-11) years old, pupils mostly learn using concrete events or objects. He also added that conservation concept is suited in this stage where it talks about the "ability to determine that a certain quantity will remain the same despite adjustment of the container, shape or apparent size". Hence, a study on indigenized domino activity method towards fraction preliminaries skills were conducted considering the psychological nature of the respondents during this stage.

Instrument

The researcher constructed a test on Fraction Preliminaries Skills test in terms of visualizing, ordering, and comparing. It was used to measure the level of fraction preliminaries skills of the pupils before and after the intervention. This questionnaire was content validated by experts to ensure appropriateness and validity of the questionnaire used that generated 4.76 which means very highly valid. This test also was piloted and generated 0.80 of Spearman Brown Prophecy. This result signifies that the questionnaire is very good for the value indicates high reliability.

Moreover, ten (10) special instructional plans were developed by the researcher as a guide during actual conduct of the experiment. Its methodology specifically emphasizes the strategies of conducting indigenized domino activity method which was based on the reading of relevant literature of the researcher. These ten (10) special instructional plans were validated and garnered 4.90 which signify that the plans are highly satisfactory.

To complement the quantitative data, the researcher prepared guide questions composed of two (2) items for interview on indigenized domino activity method based on the quantitative data gathered. In addition, pictorial representation was used because learners can express more through visuals than orally. This claim is supported by Kurt (2008) who stated that through visual representation or drawing, the learners can express themselves due to its value of allowing the learners to express themselves in teaching environment.

Data Collection

Before gathering the data, the researcher prepared a letter of permission to the principal of Ondok Gawan Elementary School to administer her study. After approval of the request, the researcher went coordinate with the adviser of the respondents.

The research activity started with introduction to the respondents the details of the research which may influence their willingness to engage in. Consent forms were sent to the parents and assent forms were given to the pupils two days before the actual data collection.

During the conduct of the study, the researcher explained the objectives and directions of the study to the pupils in the classroom. Before the implementation of the indigenized domino activity method intervention, a pre-test was administered to the pupils. The pupils were given thirty minutes to finish the test. After the given time, the fraction preliminaries test was collected.

The said intervention was conducted by the researcher for a duration period of ten consecutive school days. It was conducted during the morning session either from 7:30 to 8:30 or 9:00 to 10:00. By the end of ten sessions, a post-test was administered in the treatment school. After the ample time, the fraction preliminaries test was retrieved.

Lastly, the researcher conducted an interview to Math teacher and 20% from the total subjects were asked to make picture representation based on the guide questions given for the generation of qualitative data. All the data collected were collated and undergone a statistical analysis and interpretation.

Data Analysis

The data gathered for this study were treated using frequency count, percentage rate and weighted mean. To determine the fraction preliminaries, a five-point scale with description as shown below was used:

Numerical Range	**Description**
90 and above	Outstanding
85 – 89	Very Satisfactory
80 – 84	Satisfactory
75 – 79	Fairly Satisfactory
74 and below	Did Not Meet Expectations

Scale based on DepEd Order No. 8 series of 2015 known as Policy Guidelines on Classroom Assessment for the K to 12 Basic Education Program.

Finally, to determine the effectiveness of indigenized domino activity method in improving the fraction preliminaries of the Grade V Blaan pupils, t-test for independent samples was used. "T-test statistical significance indicates whether or not the difference between two groups' averages most likely reflects a "real" difference in the population from which the groups were sampled" (Statwing Documentation, 2011). The hypothesis was tested at 0.5 level of significance.

RESULT AND DISCUSSION

Discussion

Table 1. Fraction Preliminaries Skills before the Application of Indigenized Domino Activity Method

Indicator	f	%	Description
90-100	0	0	Outstanding
85-89	0	0	Very Satisfactory
80-84	0	0	Satisfactory
75-79	0	0	Fairly Satisfactory
Below 75	48	100	Did Not Meet Expectations
Mean	31		Did Not Meet Expectations

Table 1 presents the level of fraction preliminaries skills of the Grade V Blaan pupils before the application of indigenized domino activity method. The data show that all of the pupils (100%) got below 75% scores described as did not meet expectations level of fraction preliminaries skills. It can be also observed that none of the pupils (0%) have reached the outstanding, very satisfactory, satisfactory, and fairly satisfactory levels in the fraction preliminaries skills test. This only indicates a failed remark and there is a need for improvement of fraction preliminaries skills of the Blaan pupils.

Generally, fraction preliminaries skills test of the Blaan pupils before the indigenized domino intervention garnered a weighted mean of 31% described as did not meet expectations. This implies that the pupils have low level of fraction preliminaries skills.

The result is supported by the performance of the pupils in the previous grade level. Secondary data reviewed show that 80% of Blaan pupils in Grade V had 75% and below grades in Mathematics during their 4th grade, School year 2015-2016. The pre-test administered at the beginning of the School Year 2016-2017 also uncovered that the pupils have difficulty in mastering the basic concepts of fractions. Complementary to this is the result of the Trends in International Mathematics and Science Study in 2011. The data generated uncovered that among thirty-four (34) countries which participated in the said test, 90% of fourth grade students have low international benchmarks in mathematics. Hence, in four years since the Third International Mathematics and Science Study Repeat (TIMSS-R) in 1999 only seven regions in the Philippines showed improvements in Math competencies (Carballo, 2009). In more details, the pupils find difficulty in Mathematics specifically in basic fraction concepts because it is taught in a typical way (Home School Math, 2015). In addition, fraction concepts are not difficult to learn but the various operations in it.

This situation can be attributed to the pedagogical repertoire employed by the teachers. Traditional teacher's strategies do not suit the kind of learning that the pupils need nowadays which affects the learning quality of learners (Hill, Rowan & Ball, 2005). Qualitative data from the interview with the pupils revealed that during this subject, they do copying, writing and reading during Math time which prompt them to do off-task behaviors such yelling-out, distracting others, throwing objects, talking to others and getting out of seat frequently.

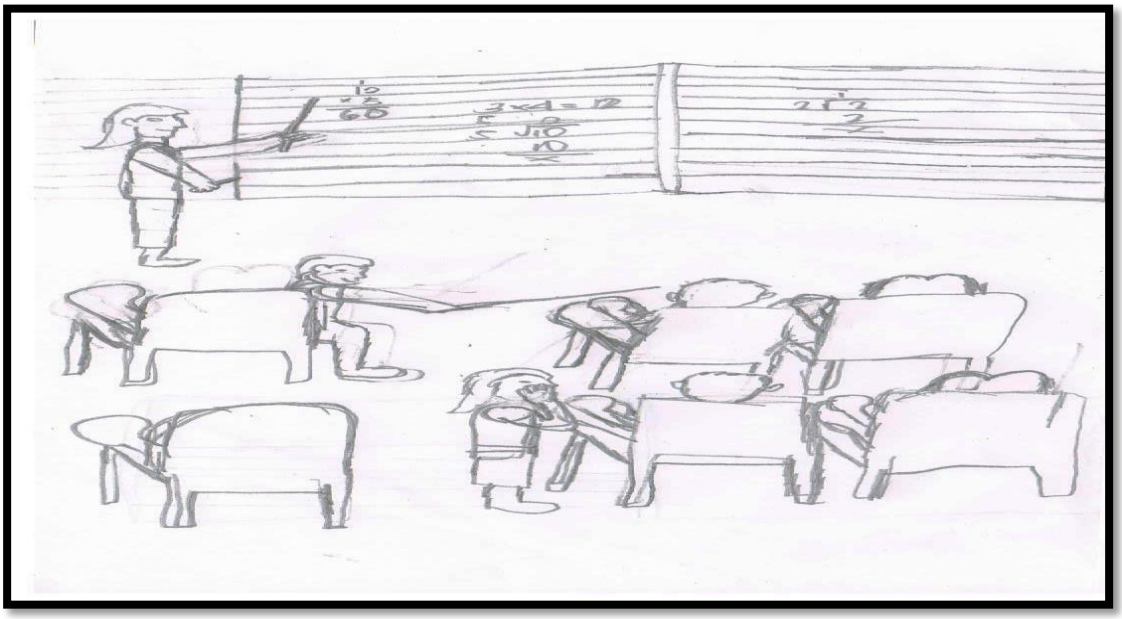

Figure 4. Scenario of Grade V Mathematics Class

The findings of the study are also supplemented by the illustrations presented by the pupils. The illustration depicts that the pupils display off task behaviors during Mathematics class. It can be inferred from the illustration that the pupils have low level of interest in learning. This claim is supported by the study of Gaastra (2016) which uncovered that off task behaviors of the learners are due to the low interest of the pupils towards the activities in the lesson.

On the other hand, a teacher in an interview claimed that Math teachers give activities based on their ready-made Daily Lesson Log which has given activities already. The DLL presents good activities such as puzzle, flashcard drills and word problems for the children to work; however, the teachers have difficulty in realizing these planned activities.

Table 2. Fraction Preliminaries Skills after Indigenized Domino Activity Method

Indicator	**f**	**%**	**Description**
90-100	17	35	Outstanding
85-89	3	6	Very Satisfactory
80-84	5	10	Satisfactory
75-79	8	17	Fairly Satisfactory
Below 75	15	32	Did Not Meet Expectations
Mean	82		Satisfactory

Table 2 presents the level of fraction preliminaries skills of Blaan pupils after the application of indigenized domino activity method. The data show that majority of the pupils (35%) got 90-100 scores described as outstanding level of fractions preliminaries skills. It can be noted also that a number of pupils (17%) got 75-79 scores described as fairly satisfactory, (10%) got 80-84 scores described as satisfactory and (6%) got 85-89 scores described as very satisfactory level of fraction preliminaries skills after the implementation of indigenized domino activity method in Blaan pupils. Nonetheless, fifteen pupils (32%) got below 75 score described as did not meet expectation.

Generally, fraction preliminaries skills of Blaan pupils after the indigenized domino intervention garnered a weighted mean of 82% described as satisfactory. This implies that the Grade V Blaan pupils have average level of fraction preliminary skills**.**

This result is supported by the study of Gaetano (2014) which revealed that learners who undergo manipulative activities during math class have already reached the average level of performance compared to those learners who are not exposed. This is also supported by the theory of Piaget (1977) as cited by Singer-freeman (2006) which explained that during pre-adolescence stage or from seven to eleven (7-11) years old, pupils mostly learn using concrete events or objects. He also added that conservation concept is suited in this stage where it talks about the "ability to determine that a certain quantity will remain the same despite adjustment of the container, shape or apparent size". Based on the result of the interview, the subjects of this study found indigenized domino activity as an easy tool to learn fraction preliminaries skills. Hence, it is also fun and exciting which is also a form of manipulatives based on the written comments of the pupils towards the intervention. This output is supported by New Zealand Government (2012), domino concepts provide students with fun, game context in which to practice their equivalent fraction skills. In addition, Almeda, et.al (2013) claimed that the lessening of misconceptions in mathematics specifically in fraction is effective with the use of manipulative materials such as domino.

Interestingly, indigenization of concrete materials has improved the performance of the Blaan pupils towards fraction preliminaries skills. This is because indigenization is one way for learners to be familiar and relate to the used examples-based form their culture. With this, they became participative which led them to learn effectively. This claim is supported by the study of Fien (2010), the use of indigenous materials in teaching can lead the learners to become more participative in the class. This is due to opportunity that their culture and tradition are integrated. Hence, it can improve the learning of the learners.

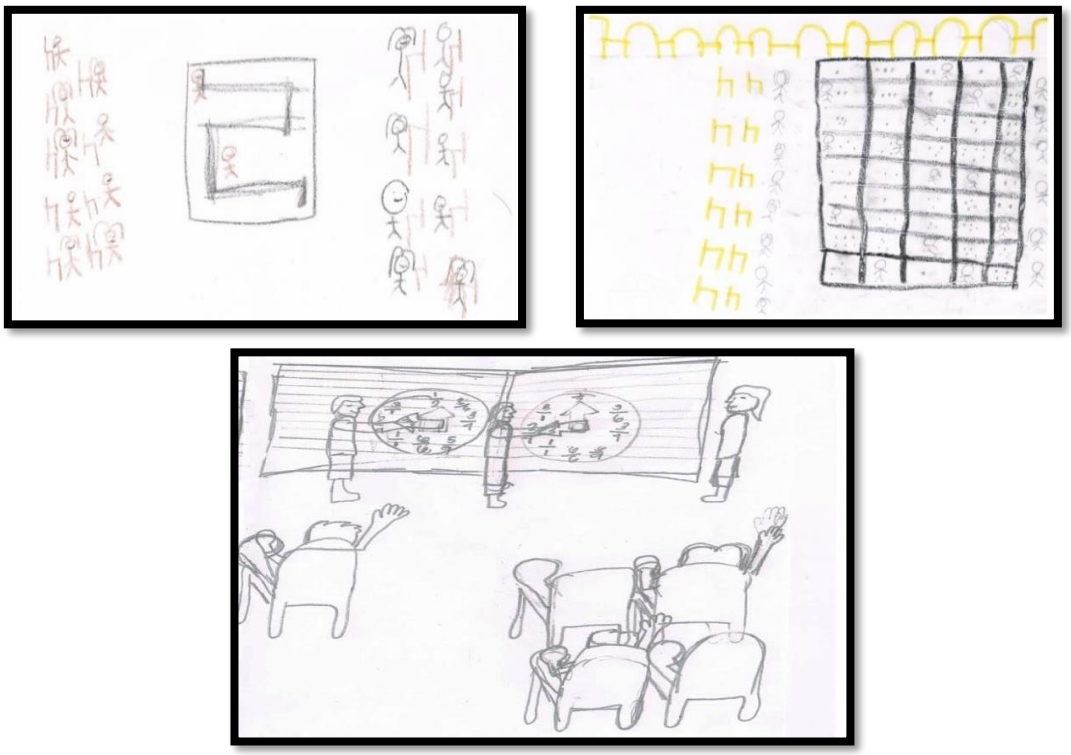

Figure 5. Scenario of Indigenized Domino Activity Method

Figure 5 shows the actual scenario of the mathematics class during the conduct of Indigenized Domino Activity method. It only shows that the use of manipulative like the drawn domino wheel above boosts the interest of the learners. Hence, they are very interested and had fun to learn. This result is supported by Gaetano (2014), Jordan (1998), McNeil and Jarvi (2007) and Home School Math (2015) which yielded increase in fraction skills using manipulative. As discussed in their study, learners who have the opportunity to learn using manipulative are more likely to achieve success than who do not have the opportunity to work with manipulative. For the reason that fractions become something concrete to the student, and not just a number on top of another without a meaning. The student will be able to estimate the answer before calculating, evaluate the reasonableness of the final answer, and perform many of the simplest operations mentally without knowingly applying any "rule". Hence, activities with manipulative are also mechanisms to make pupils apply their learning in the real world.

Figure 6 presents the formative result of the fraction preliminaries skills test of the subjects from day 1 until day 10. The data show that from day 1 until day 10, the average scores of the Blaan pupils are above 75%. During the implementation, no concepts were subjected to re-teaching. With regards to the taught skills, the top skills displayed by the pupils are visualizing similar fractions (90%), arranging similar fractions in increasing and decreasing order (89%) and visualizing fractions that are equal (86%) while the bottom 3 skills are visualizing dissimilar fractions (78%), visualizing, and generating equivalent fractions (83%) and comparing similar fractions (83%).

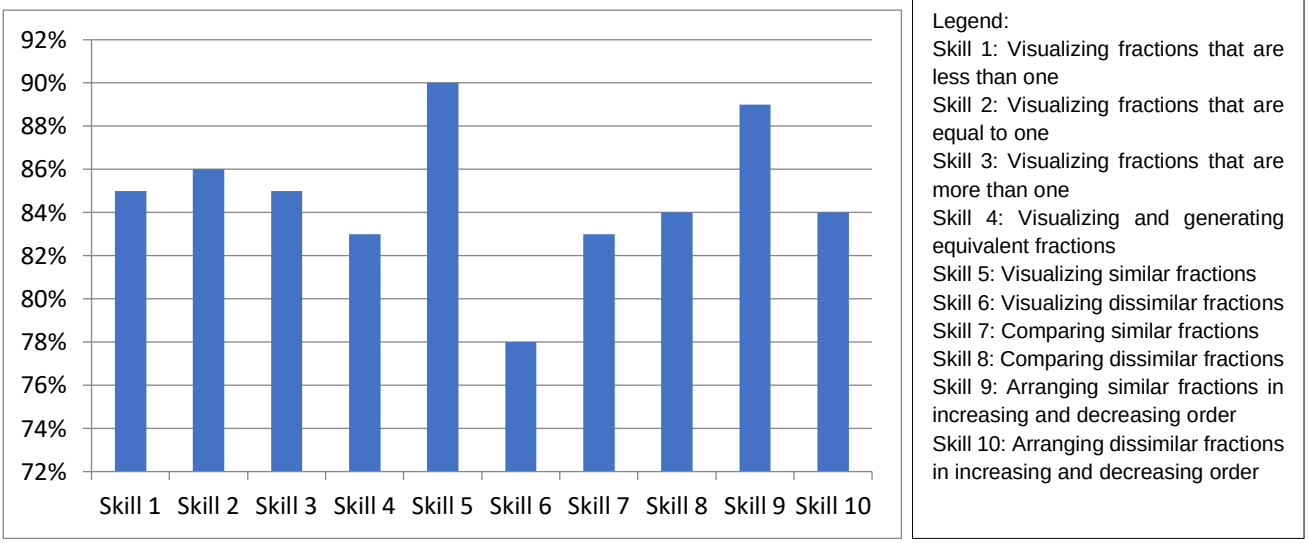

Figure 6. Fraction Preliminaries Skills Test during the Indigenized Domino Activity Method

Overall, the taught skills from day 1 to day 10 have an average score of 78% to 90%. According to the educational system of the Department of Education, the imposed average for the formative test score of the class must be 75% and above to proceed on the next lesson or topic. It only implies that none of the imposed skills taught for 10 days was subjected for re-teaching. This means that the pupils have reached the developing up to advanced level of proficiency. Developing level of proficiency got an equivalent numerical value of 75%-79% (Visualizing dissimilar fractions), approaching level of proficiency got 80%-84% (visualizing and generating equivalent fractions, comparing similar fractions, comparing dissimilar fractions and arranging dissimilar fractions in increasing and decreasing order), proficient level of proficiency got 85%-89% (visualizing fractions that are less than one, visualizing fractions

that are equal to one, visualizing fractions that are more than one and arranging similar fractions in increasing and decreasing order) and advanced level of proficiency got 90% and above (visualizing similar fractions), (Imus Institute, 2017).

Table 3. Effectiveness of Indigenized Domino Activity Method on Fraction Preliminaries Skills of the Blaan Pupils

Test	**t-value**	**p-value**	**Remarks**
Pre-test	-22.11	0.00	Significant
Post-test			

Table 3 presents the effectiveness of indigenized domino activity method in fraction preliminaries skills. The data show that there is a significant difference in the fraction preliminaries skills of the Blaan pupils before and after the indigenized domino activity method. This is supported by **t-value** -22.11 and **p-value** 0.00. The result implies that indigenized domino activity method is effective in improving the fraction preliminaries skills of the Blaan pupils.

This result corroborates with the study of Gaetano (2014) that the students who used manipulative throughout the learning process showed a significant amount of growth (M = 52, SD = 15.33), as discussed in his research, students who use concrete hands-on manipulative while learning conceptualize and internalize concepts. These results are an important indicator that if educators use manipulative when teaching fractions, then students would successfully internalize fractional concepts thus demonstrating significant student growth. They also prove that the use of manipulative when teaching fractions is more effective than teaching fractions using the paper pencil style of teaching the concepts. Similarly, Marsh and Cooke (2006) concluded that using manipulative is especially useful for teaching low achievers, students with learning disabilities, and English language learners.

Moreover, Almeda, et. at. (2013) and Ruzic and O'Conell (2006) supported that manipulative has a positive effect on student achievement by using concrete objects to observe, model and internalize abstract objects. Hence, this manipulative lessens the misconceptions regarding fractions and develops the conceptual understanding.

In contrast, Brown (2005) disputed that the use of concrete materials is not a sure-fire strategy for helping children succeed in the classroom. Instead, concrete materials can help or hinder learning, depending on a number of different factors. The study highlighted the complexities involved in using concrete materials in the classroom and warn educators and researchers that learning from concrete materials can be detailed in a number of ways, such as: choosing the wrong types of materials; structuring the environment in ways that do not support learning from concrete materials and failing to connect concrete representations to abstract representations.

CONCLUSION

Before the intervention, all the pupils (100%) did not meet expectation level. None of the pupils obtained outstanding, very satisfactory, satisfactory and fairly satisfactory levels of fraction preliminaries skills test. The fraction preliminaries skills test of the Grade V Blaan pupils before the indigenized domino activity method garnered a weighted mean of 31%

described as did not meet expectation. The Grade V Blaan pupils have low fraction preliminaries skills before the indigenized domino application. On the other hand, after the intervention, majority the pupils (35%) are outstanding. Some pupils have reached the very satisfactory (6%), satisfactory (10%), fairly satisfactory (38%) and did not meet expectation (31%). The fraction preliminaries skills test of the Grade V Blaan pupils after the indigenized domino activity method garnered a weighted mean of 82% described as satisfactory. The Grade V Blaan pupils have high level of fraction preliminaries skills after the indigenized domino activity application. After testing the intervention, Indigenized domino activity method is significantly effective in the improvement of pupils' fraction preliminaries skills as supported by the t-value -22.11 and p-value 0.00. Hence, Indigenized Domino Activity method is an effective teaching intervention to improve the Fraction Preliminaries Skills of the Grade V Blaan pupils.

Recommendations

1. Academic organizations may create indigenized activity materials to support and upgrade the learning methods of Indigenous People.
2. School administrators may endeavor to conduct training on the use of this indigenization of activities to further widen the skills of teachers in dealing with their learners.
3. Teachers, especially mathematics teachers, may utilize indigenized domino activity method in classroom instruction as a teaching intervention to improve the fraction preliminaries skills of the pupils and may create other indigenized activity methods for other subjects.
4. Learners may practice the use of indigenized materials as a strategy for learning as one way also to value their own culture.
5. Researcher may endeavor to validate the result of this study using classical experiment method with larger sample size.

REFERENCES

Almeda, A. et.al (2013). Addressing students' misconceptions and developing their conceptual understanding and procedural skills on fractions using manipulative materials. Retrieved from http: //www.dlsu.edu.ph

Amato, S. (1989). The Understanding of the Concept of Fractions as Numbers by 11 years old. Retrieved from https://www.pearsonhighered.com

Amato, S.(2005). Developing students' understanding of the concept of fractions as numbers. Retrieved from https://www.emis.de/proceedings

Arnon, I., Nesher, P., Nirenburg, R. (2001). Where fractions encounter their equivalents? Int. J. Compute. Math. Learn. 6, 167-214 https://doi.org/10.1023/A:1017998922475

Aspiras and Behr', M.J. (2008). *Rational numbers, ratio and proportion. In grouws (ed) handbook and research on mathematics teaching and learning.* New York: Macmillan Publishing Company: 296-333

Ball, D.L. (1992). Magical hopes: Manipulatives and the reform of math education. American Educator. Available: https://www.aft.org/sites/default/files/periodicals/ae_summer1992_ball.pdf

Banfill, J. (2009). Fraction preliminaries skills. Retrieved from http://www.aaamath.com/fra

Bellonio, J. (1969). Multi-sensory Manipulatives: Linking the abstract to the concrete. Retrieved from http://teachersinstitute.yale.edu

Belvez, V. (1990). *Mathematics an appreciation*. Boston: Houghton, Mifflin Co.

Black, P. and William, D. (1998). *Inside the black box: Raising standards through classroom assessment.* Phi Delta Kappan

Braswell, J. S., 2001). The national assessment of educational progress report, institute of education sciences: 5. Available: https://www.ets.org/k12/assessments/federal/naep/

Burns, M. (1992). *About Teaching Mathematics: A K-8 Resource.* White Plains, NY. Math Solutions Publication

Burris, A.C. (2005). Understanding the math you teach content and methods for prekindergarten through grade 4. Edition, p. 8 - 10. Available: https://www.pearson.com

Cain-Caston, M. (1996). Manipulative Queen. Journal of instructional psychology. 23(4): 270-274. Available: http://www.journalcra.com/sites/default/files/issue-pdf/14637.pdf

Cresswell JW, Plano Clark VL (2011). *Designing and conducting mixed method research.* 2nd Sage; Thousand Oaks, CA. Available: https://us.sagepub.com/en-us/nam/designing-and-conducting-mixed-methods-research/book241842

Dienes, Z. (1969). The role of manipulative materials in the learning of mathematical concepts. Retrieved from http://www.cehd.umn.edu

Domingo, A. C. (2004). Problem-based learning and change in students' conceptual understanding of fractions. Philippines: De La Salle University, Manila. Available: http://xsite.dlsu.edu.ph/conferences

Fennema, E. & Franke, M. (1992). *Teachers' Knowledge and Its Impact in D.A. Grouws (Ed). Handbook of research on mathematics teaching and learning.* New York, Macmillan Publishing.

Gaetano, J. (2014). The effectiveness of using manipulatives to teach fractions. (Master's Thesis University of Rowan). Retrieved from rdw.rowan.edu/cigi/viewcontent

Ginsberg and Opper. (1969). *Manipulative Materials. In T. Post (Ed.), Approach to modern mathematics*. New York, Prentice Hall

Groff, P. (1996). Is Teaching Fractions a Waste of Time. Clearing House. Retrieved from https://doi.org/10.1080/00098655.1996.10114308

Hill, H., Rowan, B. and Ball, D. (2005). Effects of Teachers' mathematical Knowledge for Teaching on Student Achievement. Retrieved from http://www.umich.edu

Home School Math. (2015). Domino Activity and Fractions. Retrieved from http://www.homeschoolmath.net

Jordan, L., Miller, M., & Mercer, C. D. (1998). *The effects of concrete to semi- concrete to abstract instruction in the acquisition and retention of fraction concepts and skills. Learning Disabilities.* Multidisciplinary Journal

Jordan, N., Hansen, N., Fichs, L. et. al. (2013). Developmental Predictors of Fraction Concepts and Procedures. Retrieved from http://www.sciencedirect.com

Joyner, J. M. (1990). Using manipulatives successfully. Arithmetic Teacher, 38, 6-7. Retrieved from https://doi.org/10.5951/AT.38.2.0006

Jumao-as and Vigafriam, O. (2010). *Development of validation manipulative materials for mathematics readiness.* NDDC

Kawas. T. (2008). Investigating Dominoes. Retrieved from http://mathwire.com

Key, J. (1997). Research design in occupational education. IRB, Thesis Handbook. Retrieved from http://www.okstate.edu/ag/agedcm4h/academic

Kurt, A. (2008). Teacher Candidate's Perceptions of Social Networks in their Pictorial Representations. Retrieved from aakurt@anadolu.edu.tr

Learners Dictionary. (1828). *In Merriam-Webster Dictionary (New Edition, p.288)*. Springfield, Massachusetts: Merriam-Webster Inc..

Ma, L. (1999). Knowing the Teaching Elementary Math: Teachers understanding of fundamental mathematics in china and us: Mahwah, NJ. Retrieved from https://doi.org/10.4324/9781410602589

Maher et al. (2004). Children's different ways of thinking about fractions. Proceedings of the 18th Conference of the International Group for the Psychology of Mathematics Education.3,208-15. Available: https://www.emis.de

Marsh, R. & Cooke. (2006). "Development and validation of manipulatives and english language". Retrieved from http://www.cast.org/ncac/Manipulatives1666.

Mcguire, K. (2004). Exploring an interdisciplinary strategy for teaching fractions to second graders. International Journal for Mathematics Teaching and Learning. Retrieved from http://www.cimt.plymouth.ac.uk/journal

McNeil & Jarvi (2007). Manipulatives work! The Educational Forum. Retrieved from https://internationalpublishers.org

Moscovici, S. (1984). *The phenomenon of social representations*. Cambridge University Press.

Moss, J., & Case, R. (1999). Developing Children's Understanding of the Rational Numbers: A new model and experimental curriculum. Journal of Research in Mathematics Education 30(2), 122-147. Available: https://doi.org/10.2307/749607

Moyer, P. S. (2001). Are we having fun yet? How teachers use manipulatives to teach mathematics. Educational Studies in Mathematics, 47. Retrieved from https://doi.org/10.1023/A:1014596316942

National Council of Supervisors of Mathematics. (2013). *Improving student achievement in mathematics by using manipulatives with classroom instruction.* Denver Inc.

New Zealand Government. (2012). Correctional study of dominoes & fractions. Retrieved from https://nzmaths.co.nz/resource/fraction-dominoes

Nickson, M. (2005). *Teaching and Learning Mathematics. A guide to recent research and its applications.* London: Continuum Inc.

Pennant, J. and Woodham, L. (2013). Understanding Fractions. Retrieved from https://nrich.maths.org

Piaget, J. (1971). Developmental Psychology. Retrieved from http://www.simplypsychology.org/piaget.html

Piaget, J. (1977). The role of action in the development of thinking. In Knowledge and development (pp. 17-42). Springer US. Retrieved from https://doi.org/10.1007/978-1-4684-2547-5_2

Pikelets and Lamington. (2003). NSW Department of Education and Training. Retrieved from www.curriculum supporteduc.nsw.gov.au

Ron, G. and Dreyfus, T. (2004). The Use of Models in Teaching Proof by Mathematical Induction. Retrieved from http://emis.ams.org

Ruzic, R. O'Connell. (2006). "Manipulatives" Literature review. Retrieved from http://www.cast.org/nsac/manipulatives

Sadi, A. (2007). Misconceptions in Numbers. UGRU Journal, Vol. 5. Retrieved from http://www.ugru.uaeu.ac.ae

Siegle, D. (2008). Education research basics. University of Connecticut. Retrieved from http://researchbasics.education.uconn.edu/single-subject-research/

Singer-Freeman, Karen E. "Concrete Operational Period." Encyclopedia of Human Development. Ed. Neil J. Salkind. Vol. 1. Thousand Oaks, CA: SAGE Reference, 2006. 291-292. Gale Virtual Reference Library Web. Retrieved from http://go.galegroup.com

Smith, S. (1997). *Early Childhood Mathematics*. USA. Allyn & Bacon Publisher

Stein, M. K. & Bovalino, J. W. (2001). Manipulatives: One Piece of the Puzzle. Mathematics Teaching In Middle School, 6(6): 356-360. Retrieved from https://doi.org/10.5951/MTMS.6.6.0356

TIMSS Assessment. (2007) International Association for the Evaluation of Educational Achievement (IEA). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College. Retrieved from http://www.iea.nl/

Tooke, D.J. Hyatt, B., Leigh, M., Snyder, B. & Borda, T. (1992). Why aren't manipulatives used in every middle school mathematics classroom? Retrieved from https://doi.org/10.1080/00940771.1992.11495172

Torio, M. (2015). Development of instructional material using algebra as a tool in problem solving. Retrieved from http://www.ijern.com/journal/2015

Uttal, V. & Scudder. V. (1997). Applied Developmental Psychology. Manipulatives as symbols: a new perspective on the use of concrete objects to teach mathematics, Volume18 (01 93-3973), P.37. Retrieved from https://doi.org/10.1016/S0193-3973(97)90013-7

Van de Walle, J., & Folk S. (2005). Elementary and middle school mathematics. Toronto, Canada, Pearson Education. Available: https://www.pearson.com/us/prek-12.html

Wearne and Kouba. (2000). *Intuitive Understanding & Fractions*. McGraw Hill Book Co.

Wenglinsky, H. (2000). How teaching matters: bringing the classroom back into discussions of teacher quality. Princeton, NJ: Educational Testing Service. Available: https://www.ets.org

About the Author

Sherlyn Mae P. Alboroto; sherlynalboroto570@gmail.com; Department of Education, General Santos City, Philippines