The Research Probe
Volume 4 Issue 1 June 2024
DOI: https://doi.org/10.53378/trp.0624.1.6

Gamified place valuing tool as manipulative in enhancing number placing skills

[1]Realyn D. Relox, [2]Joylyn B. Laraño, [2]Edgar T. Lozada, [2]Jessabil T. Vega, [2]Haide D. Maravilla & [3]Ivy Rose G. Madarcos

Abstract

This action research identified the proficiency level of two groups of participants - control and manipulative, the significant difference between pretest and posttest results, and confidence levels in answering their test before and after the discussion. A total of 30 pupils participated, and a gamified place valuing tool was developed and used as intervention. Quasi-experimental research methodology was used. Frequency, percentages, mean, standard deviation, dependent and independent t-value were used to analyze the data at a 0.05 level of significance. Results revealed that proficiency level of the manipulative group improved by at least 58% in their posttest after using the innovation, while control group who did not use the innovation improved in posttests by at least 41%. Results also exposed a significant difference between pretest results, with a mean of 3.60 for manipulative group and 2.13 for control group. Meanwhile, study also revealed a significant difference in the posttest of the manipulative with a recorded mean of 9.40 and the control group with a mean of 6.20. Results showed that manipulative group was more confident in answering their posttest than the pretest after the discussion using the innovation, with a recorded mean of 4.19 and 3.07, respectively. Data implies that use of gamified place valuing tool improves the proficiency level of manipulative group than control group and their confidence level. This means that the use of innovation affects and helps the learning and understanding skills of the pupils in Mathematics – specifically in place valuing.

Keywords: *gamified instruction, mathematics, action research, manipulative, place valuing skill*

Article History:

***Received**: December 30, 2023* ***Revised**: February 24, 2024*
***Accepted**: April 17, 2024* ***Published online**: June 15, 2024*

Suggested Citation:
Relox, R.D., Laraño, J.B., Lozada, E.T., Vega, J.T., Maravilla, H.D. & Madarcos, I.R.G. (2024). Gamified place valuing tool as manipulative in enhancing number placing skills. *The Research Probe*, 4(1), 84-92. https://doi.org/10.53378/trp.0624.1.6

About the authors:
[1]Corresponding author. Licensed professional teacher with a degree of Bachelor of Elementary Education, currently taking Master's Degree in Educational Management at Western Philippines University. Email: reloxrealyn@gmail.com
[2]Licensed professional teacher with a degree of Bachelor of Elementary Education
[3]Member of the Philippine Association for Teacher Education (PAFTE), a licensed professional teacher with a degree of Bachelor of Elementary Education

Introduction

Mathematics is a general education subject in primary and secondary school in the Philippines, where pupils are expected to gain an understanding and appreciation of its principles as an applied-using suitable techniques in problem-solving, critical thinking, communication, reasoning, making connections, representations, and making decisions in real life (Guinocor et al., 2020). Additionally, it is critical to reinforce mathematical knowledge and training to pupils from an early age (Roof & Chimuma, 2022).

The Philippines obtained 297 points in mathematics which was significantly lower than the scores of other countries (2019 Trends in International Mathematics and Science Study [TIMMS]). In addition, the mean score of the Philippines in mathematics performance is one of the lowest among PISA-participating countries and economies, with a 353 PISA Score, and ranks 75th out of 77 participating countries (Programme for International Student Assessment [PISA], 2018). The performance of grade three pupils in the National Achievement Test (NAT) 2012 subtests recorded a 59.87% mean percentage score in Mathematics, 4.28% lower than the previous year. This result is significantly lower than the 75% goal of the Department of Education (Philippine Basic Education, 2013).

One of the big schools in Puerto Princesa City is the Sta. Monica Elementary School located in the urban area of the city. There is 374 grade one pupil enrolled in 2020-2021. Based on the gathered data, the grade 1 pupils of SMES have an average of 83.99% in their math subject. This result indicates that their math proficiency level is satisfactory according to the DepEd grading system for K-12. The results suggest that grade one pupils of the Sta. Monica Elementary School needs more intervention and involvement in learning their mathematical skills through practical tools to meet the higher DepEd Grading of 85%-89% with a descriptive rating of very satisfactory and 90%-100% with a descriptive rating of outstanding.

Educational gamification is the application of game components and game design approaches in an academic setting (Manzano-León, 2021). Gamification of education is a relatively new concept, with encouraging outcomes from early trials. Along with improving performance, students also appear to be more interested and willing to participate in gamified learning (Barata et al., 2014). Game-based learning could help pupils learn more effectively because motivation is present. In the realm of education, motivation is regarded as one of the

most important components for effective teaching and learning. Motivation is defined as the ability to be motivated to do something or carry out an activity (Lawlor et al., 2016). It also improves their spatial abilities and attention span, and they enjoy it a lot while learning (Li & Tsai, 2013). The application of game features to non-gaming environments, or gamification, has been utilized to boost online learning performance (Lo & Hew, 2020) and student engagement (Bai et al., 2021).

Since digital technology is not necessary for gamified teaching, using local materials in utilizing manipulatives still has the same level of effectiveness as employing advanced technologies (Svanberg & Bergh, 2023). Thus, using bottle caps as manipulative in teaching mathematics has been effective since they are easy to modify, easy to find at home or schools, and suitable for rural areas. Children who used bottle caps as manipulative have significantly improved arithmetic ability more than those who did not. A modified bottle cap is a valuable instructional tool for enhancing children's math skills, particularly ability (Diningrat, 2019).

The researchers developed a game-based instructional tool using localized materials such as bottle caps and bamboo to help the pupils in the elementary level, specifically the grade one pupils, and unconsciously stimulate pupils' mathematical skills and concepts. The researchers believe this innovation could help the pupils enhance their basic skills in mathematics subjects, precisely place valuing. Additionally, this research also focuses on identifying the confidence level of the pupils in answering place value questions before and after using the innovative manipulative.

Methodology

The researchers innovated a game-based instructional tool to help pupils enhance their mathematics skills, precisely place valuing skills. This innovation is made from localized materials - bottle caps and bamboo. This innovation is called Gamified Place Valuing Tool. The caps attached are color-coded, each for the value; yellow for ones, green for tens, and red for hundreds.

Materials: 21 in. bamboo for the stand; 6.5 in. bamboo sticks for spikes; 6 in. bamboo for holders; 21.5 in x 6 in plywood for foundation; 27 pieces bottle caps (9 pieces each color: yellow, green, red); Lollipop numbers; Mini whiteboard; Rewards (school supplies for motivation).

Figure 2

Gamified place valuing tool actual picture

The study was conducted in Sta. Monica Elementary School, Barangay Sta. Monica, Puerto Princesa City. The study participants were limited to the Grade One pupil officially enrolled in the School Year 2021-2022. The researchers purposively selected the participants. A total number of 30 pupils participated in the study. The research participants consisted of two groups: control and manipulative.

The quasi-experimental research methodology also known as pre-post intervention design; a tool frequently used to assess the advantages of interventions was used to assess the outcome of the intervention (Harris, et al., 2006). For ethical considerations, the researchers submitted a request letter to the principal to formally ask for consent regarding the conduct of the research in the school Following this, the researchers presented a consent letter to the class adviser regarding the study and asked permission to let the pupils participate in the study.

The researchers demonstrated and observed the participants during the class intervention. The pretest and posttest exam papers were distributed before and after the discussions. The researchers provided a self-formulated questionnaire to collect data regarding the level of confidence of pupils in answering the posttest after the intervention. The questionnaire consisted of only one part about the level of confidence of pupils. The questionnaire was provided after the posttest and was answered by the participants from two groups – control and manipulative.

For the statistical treatment of data, the researchers utilized appropriate tools to ensure the accuracy and reliability of the examined and interpretation of the data collected.

Frequency, percentages, mean, standard deviation, and dependent and independent t-value were used to analyze the data. Jamovi software was used as an overall statistical analysis. The confidence level was interpreted according to the DepEd Order no. 8, series of 2015, also known as "Policy Guidelines on Classroom Assessment for the K To 12 Basic Education Program."

Findings

The results revealed that the 36% proficiency level of the manipulative group is higher than the 21% proficiency level of the control group after their pretests. This data shows that both groups did not meet the expectations and needed more intervention to improve their performance. After the intervention, results of manipulative group's 94% proficiency level is higher than the 62% proficiency level of the control group after their posttests. The data also shows a 58% increase in manipulative group scores from their pretest, meanwhile a 41% increase in the control group. The results show that both groups improved their performance in math. But, although the control group improved, they still did not meet the expectations, unlike the manipulative group, who got an outstanding rating in their posttest. This data means that the proficiency level of the manipulative group who used the gamified place valuing tool is higher than the control group. This variable implies that using a gamified manipulative affects the learning and understanding skills of the pupils in Mathematics – specifically in place valuing.

Furthermore, the participants in manipulative group perceive a very confident level in answering the pretests before the intervention, as the finding reveals a mean rating of 3.073. Meanwhile, the group professes a very much confident level in answering the posttest after the intervention using the innovation with a 4.19 mean. This infers that after the intervention using the manipulative, the pupils are more confident in answering their test than in their pretest. Self-confidence is one of the unacknowledged key aspects influencing pupils' mathematical success (Santosa & Kunhertanti, 2018). This concludes that self-confidence is essential in developing the mathematical achievement of pupils. Students with higher mathematical abilities were often more confident and successful in mathematics. Moreover, children with high self-esteem are eager to learn. These students are not distracted and they tend to learn from their failures (Nalbur, 2021).

Conclusion

The gamification tool's success is perceived. The results show that the participants' posttest performance in the manipulative group is significantly different from the control group's posttest performance. This discovery indicates the success of using a gamified place valuing tool in developing and helping the learning and understanding of the participants in the manipulative group in mathematics subjects. The usage of game-like aspects in education has grown, and as more and more fresh dynamics emerge, more teachers are starting to think about using game-like features in the future. Furthermore, the idea of integrating games in the classroom has gained acceptance among the younger population (Brigham, 2015).

Game-based learning improves the experimental group's mathematical ability significantly more than the control group (Antonio & Tamban, 2022). Teachers, regardless of their level of education or subject matter expertise, also have a favorable opinion of digital skills and gamified techniques (Nunez-Pacheco et al., 2023). Since gamification provides students' motivation, which is one of the most crucial elements of a teacher's efficiency that affects both their participation in the learning process and their academic achievement (Leitao et al., 2021). Students who use mathematical manipulation perform better on the posttest than those who do not use manipulative (Liggett, 2017).

An increase in the achievement score of the manipulative group in which gamification elements were used is significantly higher than the increase in the control group in which the gamification elements were not used. This implies that using the Gamified Place Valuing Tool as manipulative helps develop and increase the math skills of the pupils, precisely in place valuing. The researchers suggest the continued use of the innovation to enhance pupils' skills in the said field.

References

Antonio, J. M. A. & Tamban, V.E. (2022). Effectiveness of gamification on learner's performance and attitude towards mathematics amidst the covid19 pandemic. *United International Journal for Research & Technology, 3(03).* https://uijrt.com/articles/v3/i3/UIJRTV3I30013

Bai, S., Gonda, D. E., & Hew, K. F. (2021). Effects of tangible rewards on student learning performance, knowledge construction, and perception in fully online gamified

learning. *2021 IEEE International Conference on Engineering, Technology & Education, Wuhan, China,* 899–904. https://doi.org/10.1109/TALE52509.2021.9678741

Barata, G., Gama, S., Jorge, J., Gonçalves, D. (2014). *Identifying student types in a gamified learning experience.* https://eric.ed.gov/?q=gamified+strategy&id=EJ1111193

Brigham, T. (2015). An introduction to gamification: adding game elements for engagement. *Medical Reference Services Quarterly*, *34*(4), 471–480. https://doi.org/10.1080/02763869.2015.1082385

DepEd Order No. 8, S. 2015. (April 1, 2015). *policy guidelines on classroom assessment for the K to 12 basic education program.* Department of Education. https://www.deped.gov.ph/2015/04/01/do-8-s-2015-policy-guidelines-on-classroom-assessment-for-the-k-to-12-basic-education-program/

Diningrat, S. W. M. (2019). Modified bottle cap for improving children's arithmetic ability. *Jurnal Pendidikan Usia Dini, 13(10), 249-259.* https://doi.org/10.21009/JPUD.132.04

Dzulkifli, M. A. & Mustafar, M. F. (2013). The influence of colour on memory performance: a review. *Malays J Med Sc, 20(2), 3-9.* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3743993/pdf/mjms-20-2-003

Guinocor, M., Almerino, P., Mamites, I., Lumayag, C., Villaganas, M. A., Capuyan, M. (2020). Mathematics performance of students in a Philippine state university. *International Electronic Journal of Mathematics Education 15 (3).* https://doi.org/10.29333/iejme/7859

Harris, A. D., McGregor, J. C., Perencevich, E. N., Furuno, J. P., Zhu, J., Peterson, D., & Finkelstein, J. (2006). The use and interpretation of quasi-experimental studies in medical informatics. *Journal of the American Medical Informatics Association, 13(1), 16–23.* https://doi.org/10.1197/jamia.m1749

Lawlor, J., Marshall, K., & Tangney, B. (2016). Bridge21 - exploring the potential to foster intrinsic student motivation through a team based, technology-mediated learning model. *Technology, Pedagogy and Education, 25(2), 187–206.* https://doi.org/10.1080/1475939X.2015.1023828.

Leitão, R., Maguire, M., Turner, S., & Guimarães, L. (2021). A systematic evaluation of game elements effects on students' motivation. *Education and Information Technologies, 27(1), 1081–1103.* https://doi.org/10.1007/s10639-021-10651-8

Li, M. C. & Tsai, C.C. (2013). Game-based learning in science education: a review of relevant research. *J. Sci. Educ. Technol. 22, 877–898*. https://doi.org/10.1007/s10956-013-9436-x

Ligett, R.S. (2017). The Impact of Use of Manipulative on the Math Scores of Grade 2 students. *Brock Education Journal, 26(02).* https://eric.ed.gov/?id=EJ1160704

Lim, E. J. (2021). Math class gamified! Effects on the mathematics performance of Coed students of Eastern Samar State University, Philippines. *Indian Journal of Science and Technology 14(23) 1970-1974.* https://doi.org/10.17485/IJST/v14i23.902

Lo, C. K., & Hew, K. F. (2020). A comparison of flipped learning with gamification, traditional learning, and online independent study: The effects on students' mathematics achievement and cognitive engagement. *Interactive Learning Environments, 28(4), 464–481*. https://doi.org/10.1080/10494820.2018.1541910

Manzano-León A, Camacho-Lazarraga P, Guerrero MA, Guerrero-Puerta L, Aguilar-Parra JM, Trigueros R, Alias A. (2021). Between level up and game over: a systematic literature review of gamification in education. *Sustainability, 13(4), 2247.* https://doi.org/10.3390/su13042247

Mathematics MELC. (2020). Mathematics most essential learning competencies. *Department of Education, 260.* https://www.deped-click.com/2020/05/melcs-in-mathematics-sy-2020-2021.html

Nalbur, V., (2021). Interdisciplinary art education and primary teaching students' self-confidence. *Cypriot Journal of Educational Science. 16(4), 2010-2024.* https://doi.org/10.18844/cjes.v16i4.6070

Núñez-Pacheco, R., Barreda-Parra, A., Gutierrez, E. G. C., Turpo-Gebera, O., & Aguaded, I. (2023). Professor's perception of the use of digital skills and gamification in a Peruvian university. *Journal of Technology and Science Education*, *13*(2), 431. https://doi.org/10.3926/jotse.1737

Philippine Basic Education. (2013). The national achievement test in the philippines. https://www.philippinesbasiceducation.us/2013/07/the-national-achievement-test-in.html?m=1

PISA. (2018). Philippines student performance (PISA 2018). *Educational GPS.* https://gpseducation.oecd.org/CountryProfile?primaryCountry=PHL&treshold=5&topic=PI

Roof, H. & Chimuma, L. (2022). The relationship among reading, math and science achievement: Exploring the growth trajectories over three time points. *Educational Research: Theory and Practice, 33(2), 32-49.*

Santosa, R. & Kunhertanti, K (2018). The influence of students' self-confidence on mathematics learning achievement. *Journal of Physics: Conference Series* https://doi.org/10.1088/1742-6596/1097/1/012126

Svanberg, M., & Bergh, D. (2023). Effects of gamification in a teacher education program, 2010 to 2020. *SAGE Open, 13(1), 215824402311609.* https://doi.org/10.1177/21582440231160995

TIMSS. (2019). International results in mathematics and science. *TIMMS and PIRLS International Study Center*. https://timss2019.org/reports/achievement/