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Group Dynamic Courseware (GDC): Innovative Strategic Intervention in Enhancing Basic Mathematical Skills

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ABSTRACT

Grade 4 pupils got a low MPS score of 11.11 % in Mathematics pre-test conducted at Banlic Elementary School Division of Calamba, Laguna. As an intervention, the researchers developed Group Dynamics Courseware (GDC) that aimed at enhancing the basic Mathematical skills of the pupil-

respondents. The effectiveness of the Group Dynamic Courseware (GDC) was checked through a pre-test and post-test written assessment. The result revealed a mean difference between the pre-test and post-test results of -10.87, which means a significant increase on the academic performance of the pupils after the integration of the courseware. Furthermore, *t Stat* of the pre and post-test was -14.022 > 2.015 critical value with forty-four (44) degrees of freedom and .000 level of significance. Thus, this directly implies that the Null hypothesis is rejected; therefore, there is a significant difference in the academic performance of the pupil respondents after the integration of Group Dynamic Courseware. As supported by the pupils' reflection, data revealed that the Group Dynamic Courseware is Highly Effective regarding instruction and pupils› activities. The researchers concluded that GDC in Mathematics had a significant impact on the pupils' academic performance. Pupils were motivated and engaged in hands-on activities; collaborate with the groups to accomplish an essential task within the prescribed time.

Keywords — courseware, mixed-method, innovative, Banlic Elementary School, Calamba City, Philippines

INTRODUCTION

Mathematics is always perceived as a difficult subject. Aside from making the class interesting for the learners, keeping them engage in all the activities in spite of their short attention require great effort teachers adopt methods and approaches that truly enhance the learning process. Innovative ways to teach Mathematics class is a very challenging task for the teacher most especially if they do not have enough training and knowledge on how to integrate technology in teaching.

Furthermore, the mathematics community has a long history of supporting intense mathematics content preparation for prospective teachers. Current publications of the professional societies continue to make this case, emphasizing that the new K-12 reforms require teachers to have increased mathematical breadth.

Today's mathematics teachers are experiencing significant changes not only in mathematics but also in the way they teach. Now teachers are called to teach new, more challenging mathematics to a very diverse audience using active learning approaches designed to develop understanding. Teachers who

are engaged in current mathematics education reforms attempt to establish classrooms in which students engage actively and cooperatively in exploration and discussion to solve problems and reason mathematically.

Moreover, Education in Singapore promotes social mobility and the system that provides equal opportunity for every child that they should not be deprived of educational opportunities in investing levelling up programs in primary schools that attempt to help academic weaker students in both English and Mathematics, to improve their foundation for future learning (Lindorff, Hall, &, Sammons 2019).

In addition to that, Dick and Hollebrands (2011) stated that a balanced mathematics program, the strategic use of technology, strengthens mathematics teaching and learning. In support of that, as revealed in the study of the National Council of Teachers of Mathematics (2015) that having access to technology is not sufficient. The teacher and the curriculum play critical roles in facilitating the use of technological tools. The study also emphasizes that teachers and curriculum developers must be good decision-makers, skilled in determining when and how technology can enhance students' learning appropriately and effectively. All schools and mathematics programs should provide students and teachers with access to instructional technology including classroom hardware, handheld and lab-based devices with mathematical software and applications, and Web-based resources-together with adequate training to ensure its practical use.

Pannen (2015) added that technology is seen to support the following educational goals, improve teaching and learning in content areas, develop learners' skills considered to be essential in the modern world, increase motivation for teaching and learning, change the social organization of the classroom to be more learner-centered, enrich interaction among learners, teachers and other schools, and creativity and collaboration.

The future of learning with ICT is about access, learning, and collaborating, locally and globally. The teaching and learning process is going to be social activities. Access to opportunities will be open for both teachers and students to the rich and abundant educational resources available on the internet. Learning can take place in the classroom, as well as beyond. A face-to-face meeting will be important for assessing and confirming students understanding through discussion with teachers, projects, and group activities with their peers. However, virtual learning through the internet is also of high importance where students will gain more information from their network – virtual teachers, virtual peers, etc. as stated by Pannen (2015).

According to the study of Sivakova et al. (2017), ICT educational programs provide a new framework that fosters the improvement of the teaching and learning practices in teaching mathematics. The application of the ICT educational programs in teaching mathematics from the first to the fifth grade affects the training of the students for easier adoption of the mathematical concepts and procedures and easily identifying and resolving problem situations. They also emphasize that students were motivated when ICT is involved in the educational programs of the educational process because they encounter a wide variety of digital tools and resources.

In support of that, interview findings on the utilization of information and communication technologies in Mathematics reveal that most students were visual learners in which the use of the computer is more useful than pen and paper. The respondents recognize educational opportunities by using technology. This also stressed a large number of opportunities in learning using technology. For instance, the findings indicated that technology can (a) provide a visual environment to enhance understanding 3D concepts, (b) use Internet resources to let students feel comfortable and confident in learning mathematics, and (c) apply different software as stimulating learning tools (Saadati, Tarmizi, & Ayub, 2014).

Furthermore, the study of Cartelli (2008) on The Implementation of Practices with ICT as a New Teaching-Learning Paradigm reveals that information system had a significant part in the creation of constructivist learning environments and helps the students to develop cognitive apprenticeship strategies (a system helped the student in improving learning and performance).

Drijvers, Monaghan, Thomas, and Trouche (2014) explained that in mathematics education, it is necessary to integrate content-specific technologies like computer algebra systems, dynamic geometry environments, interactive applets, handheld computation, data collection, and analysis devices, and computer-based applications. These technologies help the student in discovering and identifying mathematical concepts and relationships. Furthermore, it also helps learners to improve their communication and collaboration using Web-based digital media. These integrated technologies also increase students' access to information, ideas, and interactions that can support and enhance sense-making, which is central to the process of taking ownership of knowledge. Findings from a study of the National Council of Teachers of Mathematics (2015) have shown that the strategic use of technological tools can support both the learning of mathematical procedures and skills as well as the development of advanced mathematical proficiencies, such as problem-solving, reasoning, and justifying.

In the Philippine Education, Mathematics subject plays an essential role in facilitating participation in productive life activities, in such a way, examinations in applying a job indicate or measuring mathematics skills of the applicant, these also serve as a means of communication and operating as a gateway to national progress. To establish and maintain a high-quality education system, proper investments, most particularly in ICT, must be made comprehension of different subject areas and highlight students' overall academic performance.

The researchers understand that a lot of pupils struggle with mathematics lessons and it all leads to low grades and Mathematics Phobia or Math anxiety. Blackboards, notebooks, and instructional materials are not enough to address the needs of the diversity of learners. Looking into records, Grade IV pupils got the lowest MPS score of 51.22% in Mathematics among pupils from Grades 1-6. The researcher developed the courseware to merge the three dimensions of teaching and learning, which are class session, practice, and hands-on activities, and to uplift the academic performance of the pupils in mathematics. The courseware is composed of two parts, the teacher's section and the students' section. The teacher section is comprised of the compilation of Teachers Guide, Lesson Plans, and Curriculum Guides. On the other hand, the student section is composed of video tutorials in the various experiences, Mathematics vocabulary tests, and Quiz of the different lessons in Mathematics.

The purpose of this study is to determine the effectiveness of Group Dynamics Courseware (GDC) as an innovative teaching instruction in enhancing necessary Mathematical skills. The researcher chose to study the current situation in the selected Grade IV pupils of Banlic Elementary School, Division of Calamba City. Major innovation and genuine reform require aligning the efforts of all those involved in students' mathematical development: teachers, principals, teacher educators, researchers, parents, specialist support services, school boards, policymakers, and the students themselves. Changes need to be negotiated and carried through in classrooms, teams, departments, and faculties, and teacher education programs. Innovation and reform must be provided with adequate resources. Schools, communities, and nations need to ensure that their teachers have the knowledge, skills, support, and incentives to give the students the very best of learning opportunities. In this way, all students will develop their mathematical proficiency. In this way, too, all students will have the chance to view themselves as powerful learners of Mathematics.

FRAMEWORK

The study was anchored on several concepts and theories which served as bases of the evaluation of the Group Dynamics Courseware (GDC) as an innovative teaching instruction in enhancing necessary Mathematical skills. The study used Focus Dimension within the Computer Practice Framework (Twining et al., 2013)in general and with specific reference to ICT; a summary of the key points emerging from TWG3's discussions; and recommendations for action. On the basis of discussions held within the TWG3, the authors concluded that effective TPD requires changes at several levels of educational systems (political, institutional and individual wherein computers help children to develop their IT skills, knowledge and understanding learning tool, supports their learning other than IT, using the computer in a way that is not covered by IT or learning tool. Learning objectives stay the same, but the process is automated in some way. Support is about improving efficiency and effectiveness without changing curriculum content. Extend Curriculum content and, or process is different, but these changes could take place in a classroom context without a computer or related information and communication technology.

OBJECTIVES OF THE STUDY

The study aimed to determine the effectiveness of Group Dynamics Courseware (GDC), as an innovative teaching instruction in enhancing basic Mathematical skills. It is also designed to uplift the academic performance of Grade IV pupils of Banlic Elementary School. The courseware offered the opportunity for pupils to have first-hand experiences and help improve their Mathematical skills. Moreover, they can solve problems quickly and accurately, and lastly, pupils interact and learn through collaborative learning. The teacher will also have an Easy Access on Teaching Materials, Automatic Recording of Pupils' Scores, Establish routine activities, Easy uploads of Activities or Quizzes, and Giving remedial instruction and review or training for pupils in competition with lesser teacher supervision.

Also, it sought answers to the following questions: (1) what is the pre-test result of the pupil- respondents? (2) What is the post-test result of the pupil-respondents? (3) Is there a significant difference in the academic performance of the pupil- respondents based on the pre-test and post-test results?

METHODOLOGY

Research Design

The researcher used the descriptive method of research utilizing the teacher made test as a tool for gathering and interpreting data. This method was used to collect data that describe the common observed pupils' behavior and to test if the intervention using the Group Dynamic Courseware has a significant impact on the academic performance of the pupil respondents. The triangulation method**,** which is the most common and well-known approach for the mixed-method approach (Creswell, 2014), was also used in the study. The researcher collected both quantitative and qualitative data, analyzed both data set, and merged the result of the two sets of data analysis to compare the result. This method provides a better understanding of research problems and seeks informative reflection from the respondents (Cameron, 2011).

Research Site

The study was conducted at Banlic Elementary School, Calamba East 5 District, Division of Calamba City, Laguna. Banlic Elementary School is an ISO CERTIFIED large school with 50 teachers, One (1) utility man, and One (1) security guard as the working force. Seven (7) buildings with 36 classrooms as teaching and learning areas and one (1) principal's office with a total of 2 291 sq. m land area catering 2, 074 learners. This school is chosen as the beneficiaries of the Group Dynamic Courseware because the researchers were one of the staff and administrators of this institution.

Figure 1: Map of Banlic Elementary School

Respondents

The present study involved the forty-five Grade IV pupils as pupil-respondents Banlic Elementary Schools in Calamba East District. The pupils include 23 boys and 22 girls with the same level of academic performance. The researcher used a purposive sampling technique to determine the respondents of the study. The honest results of the pre-test and post-test of the pupil-respondents were used as the basis for the affectivity of the Group Dynamics Courseware in enhancing basic mathematics skills. Comparative analysis of the pre-test and the post-test result was also used to determine the impact of the courseware on the academic performance of the pupil- respondents. Conduct of Interview and focused group discussion was also administered.

Instrumentation

The researcher used the following tools to gather needed data to answer the problems stated in the statement of the problem. (1) Pre-test and Post- Test was administered to the Grade IV pupils to determine the academic performance of the pupil- respondents. The pre-test and post-test are 40 items of multiple choice teacher-made tests that were administered using the courseware. (2) Interview- The researcher interviewed forty- five (45) Grade IV pupils towards the impact of the Group Dynamics Courseware concerning their academic performance in the first to fourth quarterly assessment for the school year 2018- 2019. (3) Focus Group Discussion was conducted to validated activities/ lesson/ video tutorials included in the courseware. (4) Documentary Analysis - A record refers to the performance of the Grade IV pupils in Mathematics based on the results of the first to fourth quarterly assessment for the school year 2018-2019. (5) Library/ internet – The researcher gathered data from unpublished and published theses from the libraries visited. Internet linkages were also considered to facilitate comprehension of the sources.

Validation of Instrument

The pre-test was administered to the Grade IV pupils to determine the least learned competence within a grading period. Based on the Pre-test Assessment of the pupils-respondents, the following were the identified least learned competence in Mathematics Grade IV. (1) Dividing 3 to 4- Digit Numbers by 2 Digit Numbers without and with remainders (2) Solving Multistep Routine and Non-routine Word Problems Involving Division (3) Performing Series of Operation (MDAS) (4) Adding and Subtracting Dissimilar Fraction (5) Solving

Word Problems Involving Addition and/ or Subtraction of Fractions (6) Elapsed Time (7) Solving Routine and Non-routine Problems Involving Area of Squares, Rectangles, Triangles, Parallelograms, and Trapezoid. (8) Finding the missing number in an equation.

Content and validity of the teacher made test was checked by the Master Teachers and Principal of Banlic Elementary School to make sure that all the items were aligned with the competencies. Mathematics teacher was also interviewed to checked and validate the topic listed as least learned. Then, activities in courseware were created and validated by the Mathematics Teacher and Master Teacher of Banlic Elementary School. During every lesson of courseware were integrated, lastly, after every grading period Post- Test was administered to check the effectivity of the Group Dynamics Courseware. Focused Group Discussion and Interview with the respondents were administered to support the results from the pre-test and post-test.

To check the reliability of the interview and test questionnaire, Cronbach's alpha test was also administered to the other grade four pupils who were not included as respondents of the study. Ethical considerations were applied to the whole process of this program. The researchers gave a letter to the principal to inform them on overview of the whole program and to seek permission to administer the program and focus group discussion in respect to what the program was about, who was undertaking the program, the benefits of the research, and what was exactly involved for the participant. Then, the researcher also seeks permission to the parents that they are allowing their son/ daughter to be part of the pupil-respondents of the study.

Data Analysis

The data in this research tested and analyse to check the effectiveness of the GROUP DYNAMIC COURSEWARE (GDC) using Pre-test and Post-test written performance assessment. It was validated using T-Test two paired-sample mean, and the result is supported by Focus Group Discussion and reflection from the forty- five (45) Grade IV pupil-respondent. The paired sample t-test was conducted to evaluate whether a statistically significant difference existed between the mean math achievement scores before and after the integration of the Group Dynamic Courseware.

RESULTS AND DISCUSSION

Pre- Test and Post Test Result of the Pupil-Respondents

Table 1. Shows the Summary of Pre-Test and Post Test Result of the Pupil-Respondents

PAIRED SAMPLE STATISTICS				
PAIR 1	MEAN	N	Std. Deviation	Std. Error Mean
PRE- TEST	11.1111	45	5.18837	.77344
POST- TEST	21.9778	45	6.25768	.93284

The mean percentage score of the pre-test was 11.11% with a standard deviation value of 5.18, while the post-test result was 21.98%, with a standard deviation value of 6.26. An increase of -10.87% percent was visible comparing the mean percentage score of the pre and post-test. This directly implies a significant increase in the academic performance of the pupil respondents after the integration of the Group Dynamic Courseware. In the study of Pannen (2015), he cited that technology is seen to support improvement in teaching and learning in content areas; thus, Group Dynamic Courseware is an essential tool to increase the academic performance of the pupils. In support of that, 42 out of 45 pupil-respondent being interviewed answered: "The use of Group Dynamic Courseware was EFFECTIVE in learning Mathematical Concepts." Furthermore, in a focused group discussion, Pupil A responded that the courseware is easy to use and was able to help them understand their lesson. While Pupil B said that even without the teacher, they could learn their experience because of the Video Tutorials installed in the courseware**.** Pupils C said that with the use of the courseware, they acquired the mathematical skills by providing them varied activities that would involve them individually and collaboratively. The result is supported by the study of (Andalis et al., 2017) wherein they stated that gamified environment or technology-based environment for learning is more effective than traditional learning methods, and suggests that more focus be put on said learning method in order to increase the speed and efficiency of learning, particularly in children learners. It is therefore concluded that the pupils were able to increase their academic performance because of the integration of the courseware. It is also observed that the courseware is user-friendly, offers first-hand experiences, and have interactive activities that help pupils understand the lesson.

Table 2. Shows the Significant Correlations of Pre-Test and Post Test Result of the Pupil-Respondents

PAIRED SAMPLE CORRELATIONS			
PAIR 1	N	CORRELATIONS	Sig.
PRE- TEST & POST- TEST	45	.601	.000

The table showed that there were 0.601 correlations between the pre-test result and the post-test result of the pupils' respondents with .000 level of significance.

T-test Result of the Pre-test and Post-test of the Pupil- Respondents

Table 3. Shows the Paired Sample T-Test ofthe Pre- Test and Post- Test Results

	Paired Differences							
				95% Confidence Interval of the Difference				
Pair 1	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2tailed)
Pre-Post	10.86667	5.19878	.77499	12.42855	9.30478	14.022	44	.000

Based on the data presented, the mean difference between the pre-test and post-test results is -10.87. This denotes an increase in the academic performance of the pupils on the post-test result. Furthermore, *t Stat* of the pre and post-test was -14.022 > 2.015 critical value with forty-four (44) degrees of freedom and .000 level of significance. Thus, this directly implies that the Null hypothesis is rejected; therefore, the alternative hypothesis is accepted that there is a significant difference in the academic performance of the pupil respondents after the integration of Group Dynamic Courseware based on the pre-test and post-test results. This result was supported by the study of Wagner et al. (2005), wherein students who used computer tutorials in mathematics, natural science, and social science score significantly higher on tests in these subjects. Students who used simulation software in Mathematics also scored higher. In addition to that, in the study of Bocconi, Kampylis, and Punie (2013) stated that computers should be used to enhance the aspect of teaching through the presentation of information in different forms. Pupils should manipulate and make changes to information on computers so that they can develop an understanding of the relationship

between different types of information or through the process of changing that information dynamically. Pupils should be encouraged to make connections between others' learning and what they do and learn on computers. In addition, the result of Focused Group Discussion were as follows; Teacher A said that GDC helps the teacher to deliver the lesson by using modern technologies and other local materials that will enhance pupils' interest. Teacher B said that through GDC, pupils initiate and encourage them to learn without fear and allow themselves to participate with the class on their own. Lastly, Teacher C noted that the teacher could efficiently conduct a remedial intervention with lesser teachers' participation because of the GDC, unlike other courseware, GDC allows the teacher to edit and create appropriate activities in Mathematics. Furthermore, in the study of (Samonte & Guzman, 2019)it aimed to (1, they concluded that teachers' professional development is a critical factor in the successful integration of computers in teaching. It is recommended that administrators must allocate budget for ICT, most notably on the technological resources, and teachers shall undergo seminars and trainings that will help further enhance and improve their computer skills and knowledge.

CONCLUSIONS

The researcher concluded that with the aid of the integration of Group Dynamic Courseware in Mathematics, pupils had improved their Academic Performance. It directly implies that the teacher should integrate technology into teaching. It is concluded that GDC can save time and effort of the teacher in training or conducting remedial classes in Mathematics. GDC also help the teacher to automatically record the pupils' score and allow them to edit or create activities in line with the pupils' ability. In addition to that, an increase in the rating on their pre-test and post-test is an indication that Group Dynamic Courseware in Mathematics had a significant impact on the academic performance of the pupil-respondents.

TRANSLATIONAL RESEARCH

The crafted Group Dynamic Courseware (GDC) of the study may be best translated through benchmarking. Training on how to install and use the courseware can also be administered to all interested schools administrator and teachers. User Manual can also be provided by the researcher to utilize the

courseware better. Additionally, this study is beneficial to curriculum developers, administrators, teachers, and pupils in planning courses and improving quality education in Mathematics. This material can also be used as remedial learning activities that could be useful to elementary pupils to enhance their basic Mathematical Skills.

RECOMMENDATIONS

The following were the recommendations offered by the researcher based on the drawn conclusions**.** (1) The teachers are encouraged to ensure the content of the mathematics curriculum is articulated and possessed an in-depth understanding of the subject area's learning goals, instructional procedures, and content-based curriculum. A related domain, knowledge of content, and teaching (KCT), by (Loewenberg Ball et al., 2008), the knowledge that combines knowing about education and knowing about mathematics. Many of the mathematical tasks of education require mathematical knowledge that interacts with the design of instruction. Teachers need to sequence appropriate content for guidance, deciding which example to start with and which examples to use to take students more in-depth into the material. They need to evaluate the instructional advantages and disadvantages of representations used to teach a specific idea. During a classroom discussion, they have to decide when to ask for more clarification, when to use a student's remark to make a mathematical point, and when to ask a new question or pose a new task to further students' learning. Each of these requires interaction between specific, accurate understanding and an understanding of pedagogical issues that affect student learning. (2) The teachers should demonstrate skills in the use of ICT in teaching and learning. The teachers are encouraged to use the manipulative/ mathematical tools related to developing mathematical concepts of the pupils to learn concepts in a developmentally appropriate and hands-on way. From the results of the study of (Buabeng-Andoh, 2012), recommended that teachers need sufficient training on how to use ICT into teaching and learning processes to acquire the requisite knowledge and skills in integrating the technology in classrooms. It will provide opportunities for teachers to support student-centered learning. According to Russell et al., (2007) teachers should be trained on specific instructional use of technology instead of the general use of computers. Also, training should be provided on the use of ICT software other than simple word processing.

(3) The teachers are encouraged to develop and utilize creative and appropriate instructional plans and demonstrate the ability to cope with varied teaching milieu. Furthermore, the study of Safdar, Yousuf, Parveen, & Behlol (2011) suggested that to meet the demand of the present era, in the field of technology it was suggested to make its application more effective in education, students must be trained in IT from the grass-root level. Therefore, it is recommended that Information and communication technology (ICT) can be introduced as a separate discipline in the curriculum of the primary level. To promote ICT in education at the secondary level and for students to become more familiar with the use of ICT, libraries in the educational institutions can be converted to on-line libraries. As the students from the deprived families do not have the IT facilities available at their homes, so to make the use of ICT effectively in the teaching-learning process, the vital role of teachers in this process may be enhanced by giving them in-service training for technology. For the same reason mentioned above, application of ICT can be comprised as an integral part of the syllabi for before-service training in teachers degree program, and also at the time of induction of new teachers in any educational institution in any sector/region (4) The teachers and administrator should invest or seek stakeholders that will provide computers and innovative technology to cope- up with the needs of the 21st Century Learners. Concerning that, Keong & Horani (2005) cited that the Malaysian Ministry of Education has spent a large sum of money on the PPSMI project, which uses ICT as an enabler. It should not only view using ICT as a mere tool for teaching and learning as mathematics educators, and teachers alike can derive more value from it. Therefore to encourage more teachers to integrate ICT into mathematics lessons, the devised program must be user-friendly. The e-portal proposed for this purpose is geared towards fulfilling such needs. (5) The GROUP DYNAMIC COURSEWARE crafted by the researcher would be considered as a way to acquire better school performance through various best practices in K to 12 Mathematics instructions and highly recommended to apply in all grade levels.

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