Effects of Collaborative Drill Reinforcement on Problem-Comprehension Skill

Julius R. Garzon
Teacher, Department of Education, Philippines
imjuliusgarzon23@yahoo.com

Abstract

Effective comprehension in problem analysis is an essential factor for problem solving success. Critical Thinking is prerequisite to proper understanding of the process in deriving correct solution set. However, poor comprehension remains the bane for learners needing positive reinforcement. Learning by doing and constant drills are considered useful techniques especially when performed in a collaborative manner. Anchored on quasi-experimental design using two comparable groups, analysis of the t-test results revealed significant findings in terms of differences between performances of groups applying the intervention and not. The significant increase from pretest to posttest of experimental group affirms the effectiveness of the collaborative reinforcement model in developing problem comprehension domain. Statistical evidence, thus, leads to conclusion that modified collaborative drill reinforcement tool contributes in reinforcing learners' capacity in problem-solving learning tasks. Making use of drill activities enhances the ability of a learner to have consistent practice of analytical thinking skill through collaboration with peers to provide better understanding of problem content which is essential in the formulation of solution process leading to the right answer. The facilitative role of teacher during drill exercise is necessary to guide learners in getting the concept. Consistent practice in working with worded problems can help develop critical and problem-solving strategies. Hence, the intervention fits to this need and should be modeled across competencies by every teacher in their respective classrooms.

Keywords: analytical thinking, collaboration, problem-solving learning tasks, mathematical problems

CONTEXT AND RATIONALE

Problem analysis requires proper comprehension of content to bring learners on the process of developing of solution set. This becomes manageable by integrating analytical higher order thinking skill. It is known in Philippine education that comprehension skill is very crucial in the acquisition of conceptual understanding about the worded problems. Chard, Simmons, and Kameenui (1998) mentioned that good comprehension and word reading skills are foundation for

learning across subjects such as mathematics. A process on finding what is asked in the word problem is the meat of any problem-solving activity because it is through the right process that the right solution is being obtained. However, a correct process becomes feasible for the solver if he or she understands the main thought or idea expressed by the problem, otherwise, there is no other better way to get into the right track. Hence, problem-comprehension is a vital analytical skill that every student should develop as early as their age.

Problem-solving is one of the twin goals of Philippine K-12 Mathematics Curriculum in the present education system. However, problem-solving skills become a struggle for most teachers to teach because problem-comprehension itself is observed to be the weakness among learners. Around 75% of competencies in K-12 Mathematics curriculum necessitates student's problem-solving skill. In order to make headway to higher grade, one should be equipped with these skills to avoid further learning difficulties. Enabling students acquire consistent ability to find meaning to the worded problem and derive solution set properly has always increasingly challenged mathematics teachers in the 21st century. Better interventions as early as the school age children learning to develop comprehension and understanding of the problem-embedded mathematical structures has been an overlooked issue in the system of mathematics teaching the reason why most grade completers proceed to the next grade level without enough readiness for the expected performance standards on that particular grade (Francis & Stuebing, 1996). In fact, in the classroom setting, the researcher identified quantifiable number of learners who are weak in terms of problem comprehension. This was attested by the results of the diagnostic test on problem-solving where 70% of the class fell below 75% proficiency level.d by supported

Trying to cope with the situation that seems to be a common scenario every year, this study will work for an intervention as integration to the day-to-day math lessons. The researcher has modified a form of drill method called *Guided Collaborative Drill Reinforcement* as a peer-based activity that will consistently practice and reinforce cognitive ability of students in understanding mathematical problems. This strategy becomes a preparatory training to equip necessary readiness prior to problem-solving tasks. It is essential that learners will constantly learn by doing collaboration in interpreting problem texts, thus deepen their thought not just on the literal aspect. This study claims that guided peer-based drill reinforcement activities enable students to consistently practice problem-solving that leads them to consistently acquire and apply proper comprehension skill.

Schofield, (1972) defines drill, as "the formation of good or bad habits through regular practice of stereotyped exercises". Various drill and practice techniques have been evaluated as a means to increase the overall instructional effectiveness when presenting academic content (MacQuarrie-Klender, Tucker, Burns, & Hartman, 2002). Burns (2004) suggested that drill tasks are an important means of academic remediation for children who do not have the prerequisite skills needed to perform higher order tasks. In the same vein, Roberts and Shapiro (1996) recommended that practitioners turn to drill techniques for academic remediation because they allow for high repetition of new items. Standard drill and practice techniques consist of new material being presented over and over for the learner to practice until the response is automatic (Cooke & Guzaukas, 1993). This allows the student to have greater fluency with the new material. Practice activities help learners master materials at their own pace. Effective use of drill and practice depends on the recognition of the type of skill being developed, and the use of appropriate strategies to develop these competencies.

However, there are very few studies in literature that focus on collaborative form of reinforcement drill guided through proper mentoring and provision of close supervision. Furthermore, there is minimal empirical evidence on the utilization of drill practices especially in relation problem comprehension difficulties among pupils. This study is designed test the effectiveness of the teacher-initiated approach using pretest-posttest non equivalent control group design using two comparable groups of secondary mathematics students who needs immediate intervention in the classroom facilitated through collaborative and cooperative learning activities.

RESEARCH QUESTIONS

Generally, this study aims to test the effectiveness of Collaborative Drill Reinforcement in improving the comprehension domain of students. Specifically, this study attempts to find answers to the following questions:

1. What is the level of comprehension skill of the pupils in analyzing mathematical problems based on the pretest and posttest scores?
2. Is there a significant increase in the test scores of students on problem comprehension?
3. Is there a different between the scores of students who were exposed and not exposed to the Drill method?

METHODOLOGY

This study is an experimental action research making use of pretest-posttest control group design. Two comparable intact groups were involved in the study. One group served as the experimental group engaged with the proposed drill intervention while control group follows the usual traditional approach. The sample for each group are selected via purposive sampling taking into consideration the number of students whose proficiency level in problem-solving fall below 75% as shown in the diagnostic test performed by the Grade 7 students during the start of the school year 2017-2018. This study was conducted in Libhu National High School. The intervention focused on basic elementary competencies which involve problem-solving activities. The duration of study was set for a period of two (2) months where interventions are provided preparatory to the actual three (3) step problem-solving for the intended respondents. For data collection, the researcher utilized necessary instruments which include adopted and expert –validated pretest and posttest questionnaire, and a learning guide using the principles and theories of peer-based drill practices. Three processes are involved in the data collection. First is the pre-experiment period which was a preparatory stage prior to the start of experiment which includes: consent to conduct study, pilot-testing of questionnaires, brief orientation of the purpose, followed by the conduct of pre-test to have a baseline data. Second is the experiment proper which was already the implementation of the drill approach as reflected in teacher-developed learning guide. During experiment, the experimental group was engaged in collaborative drill practices supervised by the teacher. Facilitated collaborative activities that perform the drill about problem analysis, structures, statements and vocabulary which lead to proper comprehension among pupils were integrated. The control group, on the other hand, utilized the conventional methodology. This study followed the specified time schedules as reflected in the work plan. Lastly, the posttest evaluation followed after the duration of experiment. Here, the respondents took the assessment scale on comprehension as posttest. This was followed by analysis of data. Appropriate statistical tools via SPSS 17.0 software were employed to facilitate accurate computations using specific test statistics such as frequency, percentage, mean, t-test measurements for two samples.

RESULTS AND DISCUSSION

Level of Students' Comprehension Skill of Math Problems Before and After Experiment

Table 1 reflects students' level of development in the comprehension of worded problem analysis and problem-solving before and after the intervention was made. Cross-analysis revealed an increase in mean scores of both groups from pretest to posttest. However, it can be shown that there s only a slight difference in the pretest scores between the control (3pts) and experimental (7pts) groups. Although both groups started at "Developing" level, the experimental group marks higher mean gain than control group (5pts. vs. 7pts.) which reflects that the peer-based drill intervention works better than the conventional method. This is supported by the findings of Cooke and Guzaukas (1993) showing that the drill practices allow the students to have greater fluency with the new material such as worded mathematical problems and help them gained analytical skills and contribute to a better understanding of problem content as well as active thinking.

Table 1. *Level of Comprehension Skill for both Groups before and after Experiment*

	Control Group [Using Conventional approach]		**Experimental Group** [Using Guided Peer-based Drill Reinforcement]	
	Pretest	Posttest	Pretest	Posttest
Mean	3.54	9.04	7.04	14.03
Standard Deviation	1.233	2.045	2.167	1.991
Description	***Developing***	***Approaching Proficiency***	***Developing***	***Proficient***

Legend: (1 to 4) Beginning; (5-8) Developing; (9-12) Approaching Proficiency; (13-16) Proficient; (17-20) Advanced

Test Results on the Significance of Improvement of Students' Comprehension Level from Pretest to Posttest Using Guided Collaborative Drill Reinforcement

Table 2 illustrates the results of the test measuring the significance of increase in the mean scores from pretest to posttest of students exposed to the drill reinforcement exercises. Data were derived using Paired t-test at 1% level of significance. Results showed that the improvement of students' comprehension skills (M-increase=7.81) after being taught using the teacher-initiated intervention is highly significant (t=28.80, df=9, p-value=0.000). This implies

that the drill reinforcement activities guided through peer-based approach significantly developed students ability to find meaning ideas, meaning, prospective process to the problem , hence effective for learning secondary mathematical problem solving competencies. MacQuarrie-Klender, Tucker, Burns and Hartman (2002) revealed the significance of the drill method and practice techniques as it is guided strategy to increase the performance of young learners involved in problem solving analysis. It as well leads teachers' instructional effectiveness when presenting academic content particularly on mathematics concepts that require understanding. Burns (2004) suggested that drill tasks are an important means of academic remediation for children who do not have the prerequisite skills needed to perform higher order learning tasks.

Table 2. *Significance of Improvement of Students' Comprehension Level from Pretest to Posttest*

	Paired Differences				
Tests Compared	Mean	Std. Deviation	t	df	Sig. (1-tailed) *p-value*
Pretest Experimental Group to Posttest Experimental Group	7.81	2.053	28.801	9	0.000**

***Relationship is significant at α = 0.01 probability level*

Test Results on the Significance of Difference of the Performance between Students Exposed and Not Exposed to Collaborative Drill Reinforcement Activities

Table 3 reveals the computed values of the t-test analysis with the assumption of equal variances after testing homogeneity of variance through Levene's test. It can be observed that there is a highly significant difference (t=4.74, df=16, p-value=0.000) in performance between students exposed and not exposed to the teacher-initiated intervention. Due to higher mean gain in experimental (M=14.03) than control group (M=9.04), this difference favors the peer-based drill intervention. This indicates that the peer-based intervention gives stronger impact on performance of the pupils, hence considered more effective than the conventional method (M-difference=5.01).

Table 3. *Significance of Difference of Posttest Performance in Algebraic Expressions between Control and Experimental Group*s

Test Compared	Test Used	Mean Score		t-test for comparison of means			
		Control	*Experimental*	Mean Difference	t	df	Sig.
Posttest	Independent Two-Sample t-test	9.04	14.03	5.02	4.736	16	0.000

Note: Levene's Test Results: F-value= 0.215, sig. value=0.645; equal variances assumed. Result is highly significant at $p<0.01$)

CONCLUSION AND RECOMMENDATION

In the light of the findings, this study concludes that the guided drill reinforcement model when performed collaboratively contributes better in increasing the level of comprehension skill of pupils in problem-solving learning tasks. Making use of the drill enhances the ability of learner to have consistent practice of analytical thinking skill through collaboration with peers to provide better understanding of problem content which is essential in the formulation of solution process leading towards the right value required. The facilitative role of teacher during drill exercises is necessary to guide learners in getting the concept. Consistent practice in working with worded problems can help in developing the critical and problem-solving strategies. Hence, the intervention fits to this need and should be modeled by every teacher in their respective classrooms.

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