Research Article

THE EFFECTIVENESS OF THE SPIRAL PROGRESSION APPROACH IN TEACHING JUNIOR HIGH SCHOOL MATHEMATICS IN ZAMBALES, PHILIPPINES

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Abstract

In the School Year 2012-2013, K to 12 curriculum was implemented in the Philippines with the Spiral Progression Approach as the new approach in teaching. This feature of K to 12 exposes the learners to a wide variety of concepts that are allotted the same amount of time whether they are easy or difficult to master which proved to be a real challenge for many educators, especially the Science and Mathematics teachers. Various studies on the effect of Spiral curriculum in Science were conducted but only few studies were done to check whether it is effective in Mathematics curriculum. Hence, this study examined its Effectiveness in Teaching Junior High School Mathematics in Zambales, Philippines where a descriptive research method with the survey questionnaire as the research instrument was used. 570 student-respondents were selected through the quota sampling technique. The academic performance of students was correlated to the Effectiveness of Spiral Progression Approach. Findings revealed that student–respondents' academic performance was rated satisfactory. The spiral progression approach was perceived by the students as effective. A highly significant relationship and moderately significant relationship exist between the effectiveness of spiral progression approach and academic performance in mathematics among 7^{th} and 10^{th} grade students and among 8^{th} and 9^{th} grade students respectively. Recommendations are made for the curriculum developers to look on the ways in improving the academic performance of the students through the Spiral Progression Approach since it has been proven in the study that a relationship between the two exists.

Keywords: Effectiveness, Spiral Progression Approach, Mathematics, Academic Performance

Introduction

Quality education has been achieved by the country in the past years and is still being improved by the different dimensions that make up education. Every year, the curriculum undergoes various types of examination and is being revised or in some cases changed when it comprises an error as well as if it doesn't achieve its goal.

Last 2011, the government implemented a new curriculum in the country to cope with global challenges in education. This curriculum is the K to 12 curriculum which started in 2012. The Republic Act 10533 also known as the "Enhanced Basic Education Act of 2013" enabled the implementation of the K to 12 in the country (DEpEd Order No. 31, s. 2012). By this, a new approach had also been implemented – Spiral Progression Approach.

It is an approach in the curriculum which derived from Bruner's Spiral curriculum model (Lucas, 2011). The idea of the spiral progression approach is to expose the learners to a wide variety of concepts or topics and disciplines until they mastered them by studying them over and over again but with different deepening complexity (Resurreccion & Adanza, 2015). According to Snider (2004), the spiral progression approach avoids disjunctions between stages of schooling; it allows the learners to learn topics and skills appropriate to their developmental cognitive stages.

As stated by Quijano and the Technical Working Group on Curriculum (2012), it also strengthens retention and mastery of topics and skills as they are revisited and consolidated with increasing depths and complexity of learning in the succeeding grade levels. However, according to Gatdula (2016), this feature of K to 12 proved to be a real challenge for many educators, especially the Science and Mathematics teachers. This is because the problem with the spiral design is that the rate for introducing new concepts is often either too fast or too slow. All concepts are allotted the same amount of time whether they are easy or difficult to master. Units are approximately the same length, and each topic within a unit is one day's lesson. There may be some review of previously introduced topics within the chapter, but once students move on to the next chapter, previous concepts may not be seen again until they are covered the following year (Resurreccion & Adanza, 2015).

Various studies on the effect of the spiral curriculum in Science were made and conducted but only few studies were done to check whether it is effective in the Mathematics curriculum. The Mathematics curriculum often builds on information learned in previous years. If a student does not have the required prerequisite knowledge, then a Mathematics teacher is left with the choice of either remediation or forging ahead and covering material the students might not understand. Whereas, the spiral Mathematics curriculum exposes the learners to a wide variety of concepts or topics and disciplines at the rate of too fast or too slow, whether they are easy or difficult to master (Resurreccion & Adanza, 2015). Likewise, Mathematics can be intimidating to students, particularly as they advance from a basic concept to a complex one. In line with this, the complex topics in Mathematics are in its higher branches which are being taught at the secondary level. Hence, this study aims to know the effectiveness of the spiral progression approach in teaching Junior High School Mathematics where the student-respondents would be the students from 7^{th} to 10^{th} grade.

The purpose of the study is to determine the effectiveness of the spiral progression approach in teaching Junior High School Mathematics. Specifically, the study sought to:

1. determine the academic performance of the Junior High School students in Mathematics.
2. identify the perception of the students on the effectiveness of the spiral progression approach.

3. examine the relationship between the perception of the students on the effectiveness of the spiral progression approach and their Academic performance.

Research Methodology

Research Design

This study employed a descriptive research method with the survey questionnaire as the research instrument. The study described the effectiveness of the Spiral Progression Approach in Teaching Junior High School Mathematics in Zambales, Philippines. The insights were solicited from the student – respondents.

Respondents and Location

The study was conducted in Taltal National High School, Purok 4, Barangay Taltal, Municipality of Masinloc, Division of Zambales, Philippines. It was conducted after the three quarters of the school year 2018 - 2019. The school year was consisting of 208 school days with four quarters – first, second, third, and fourth quarters. During this school year, the first quarter had 48 days which started from the first week of June to the second week of August 2018. Likewise, the second quarter had 48 days which started from the third week of August to the third week of October. On the other hand, the third quarter had 52 days which started from the fifth week of October after the Mid-year break of the students to the second week of January 2019. Consequently, the fourth quarter had 60 days which started from the third week of January to the first week of April. The first three quarters of the school year have the most number of competencies in Mathematics. This means that various concepts are taught within these three quarters. Thus, the questionnaire was disseminated after the third quarter.

The respondents were the students from Taltal National High School. This school is one of the secondary schools in Zambales, Philippines that is under the Mega category that has a large population. The population of the school was used in obtaining the sample size needed for the study. A quota sampling technique was employed in the selection of the respondents. The sample size used in the study was obtained using this non-probability sampling where 570 student-respondents represent the population. The selection of the respondents was based on the grade level of the students since the purpose of the study is to know the effectiveness of the Spiral Progression Approach in every grade level. Table 1 shows the frequency distribution of the respondents by grade level.

Table 1 Distribution of the Student-Respondents

Grade Level	Frequency	Percent
7^{th} Grade	151	26.49
8^{th} Grade	141	24.74
9^{th} Grade	141	24.74
10^{th} Grade	137	24.04
Total	**570**	**100.00**

As shown in Table 1, five hundred seventy (570) Junior High School students were the respondents of the study. Out of 570 respondents, 151 or 26.49% were from 7th grade; 141 or 24.74% were from 8th and 9th grades; 137 or 24.04% were from 10th grade.

Instruments

The questionnaire that was used in gathering the needed data was formulated based on the Learning Competencies in the K to 12 Mathematics Curriculum Guide (2016). These competencies are standardized and are used in the K to 12 curriculum. These were validated by the curriculum developers prior to the implementation of the K to 12 curriculum. The competencies were considered as the indicators in the questionnaire since these are the once that are being tested as to effectiveness.

Part I of the questionnaire includes the academic performance of junior high school students in Mathematics. The academic performance of the students is their final grade from the first quarter to the third quarter. The results obtained from part I were correlated to part II. Whereas part II covers the effectiveness of the Spiral Progression Approach in teaching junior high school Mathematics. This includes the learning competencies used in teaching Numbers and Number Sense, Measurement and Patterns and Algebra, and Geometry to 7th grade students; Patterns and Algebra (A), Patterns and Algebra(B), and Geometry to 8th and 9th grade students; and Patterns and Algebra (A), Patterns and Algebra (B) and Geometry, and Statistics and Probability to 10th grade students.

Data Collection

Before the dissemination of the instrument, the researcher sought permission and approval from the school head of Taltal National High School. The researcher likewise prepared a letter to the respondents for cooperation and support in answering the questionnaire. The researcher allotted one (1) week program for the distribution of the questionnaire to the respondents including the time for the retrieval of data.

After the retrieval of the questionnaire, the data were tallied, re–grouped according to variables, tabulated, and analyzed according to the objectives of the study.

Results and Discussion

The graph below shows the summary of the academic performance of the Junior High School students during the first quarter to third quarter of the school year 2018-2019.

For 7th grade, the overall mean academic performance in Mathematics is 81.227 with a descriptive value of satisfactory. On the other hand, 8th grade students obtained an overall mean of 81.097 with a descriptive value of satisfactory. Moreover, 9th grade students' overall mean academic performance in Mathematics is 82.440 with a descriptive value of satisfactory. Similarly, 10th Grade students obtained 84.047 overall mean academic performance in Mathematics with a descriptive value of satisfactory.

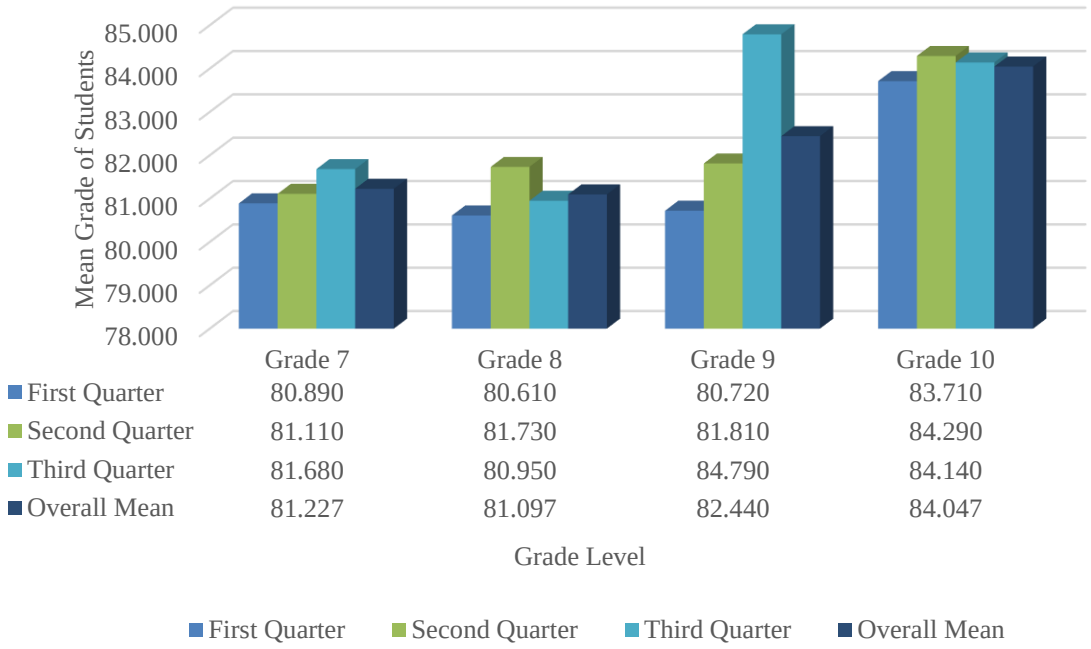

Figure 1 Summary of the Academic Performance of the Junior High School Students

The continuing poor performance of Filipino students in Mathematics is evident in the results of various multicountry assessments such as the one spearheaded by the world bank, the Trends in International Mathematics and Science Study way back in 2019 (TIMSS), and Programme for the International Student Assessment (PISA). The results showed that Filipino students lagged behind other countries in the international assessment for mathematics and Science. This is much related to the study conducted by Batidor and Casinillo (2021) where they found that the academic performance of the students remains below satisfactory in the Mathematics curriculum. Likewise, in the study conducted by Alegre et al. (2020), it was mentioned that the level of academic performance of the grade 10 student-respondents under the spiral progression approach when they were in grades 7 to 9 was already satisfactory and remained unchanged until grade 10. As per the results of this study, the descriptive value of satisfactory was obtained as the level of academic performance of the students in every grade level.

Table 2 Summary of Perceptions on the Effectiveness of Spiral Progression Approach in the Different Areas of Junior High School Mathematics

7th Grade	**First Quarter (Number and Number Sense)**		**Second Quarter (Measurements, Patterns and Algebra)**		**Third Quarter (Geometry)**	
	AWM	**DE**	**AWM**	**DE**	**AWM**	**DE**
	3.65	Effective	3.56	Effective	3.93	Effective
8th Grade	**First Quarter (Patterns and Algebra A)**		**Second Quarter (Patterns and Algebra B)**		**Third Quarter (Geometry)**	
	AWM	**DE**	**AWM**	**DE**	**AWM**	**DE**
	3.64	Effective	3.69	Effective	3.80	Effective
9th Grade	**First Quarter (Patterns and Algebra A)**		**Second Quarter (Patterns and Algebra B)**		**Third Quarter (Geometry)**	
	AWM	**DE**	**AWM**	**DE**	**AWM**	**DE**
	3.76	Effective	3.64	Effective	4.05	Effective
10th Grade	**First Quarter (Patterns and Algebra A)**		**Second Quarter (Patterns and Algebra B and Geometry)**		**Third Quarter (Statistics and Probability)**	
	AWM	**DE**	**AWM**	**DE**	**AWM**	**DE**
	3.77	Effective	3.73	Effective	3.91	Effective

Table 2 shows the summary of the perceptions of the students on the effectiveness of Spiral Approach in the different areas of Junior High School Mathematics.

The overall weighted mean perception of the 7th grade students on the effectiveness of the spiral progression approach in terms of numbers and number sense is 3.65, 3.56 in measurements and patterns and algebra, and 3.93 in geometry. These results obtained a descriptive equivalent of Effective which implies that the spiral progression approach is effective in all areas of junior high school Mathematics taught in 7th grade. Likewise, the spiral progression approach was perceived by the students as effective in all areas of junior high school Mathematics taught in 8th grade. The overall weighted mean in Patterns and Algebra (A) is 3.64, 3.69 in Patterns and Algebra (B), and 3.80 in Geometry. On the other hand, 9th grade students perceived the spiral progression approach as effective in all areas of Mathematics taught in their grade level. The overall weighted mean obtained in Patterns and Algebra (A) is 3.76, 3.64 in Patterns and Algebra (B), and 4.05 in Geometry. Similarly, the spiral progression approach was perceived as effective by the 10th grade students in all areas of Mathematics in 10th grade. An overall weighted mean of 3.77 was obtained in Patterns and Algebra (A), 3.73 in Patterns and Algebra (B) and Geometry, and 3.91 in Statistics and Probability. The results showed that students from 7th to 10th grade viewed the spiral progression approach as effective in all areas of junior high school Mathematics.

Several studies had been conducted in many countries to find the factors that influence the performance of students in Mathematics. Among these factors, perception is one significant factor that has been consistently studied. Students' perception determines their effort toward learning topics on a particular subject. It refers to liking or unliking the subject (Reddy, Sharma, and Chandra, 2020; Hannula, 2002). As shown in the results, students perceived the spiral curriculum as effective in all areas in every grade level. This means that students have a positive perspective toward the new approach in the curriculum.

Table 3 Test of Relationship between Effectiveness of Spiral Progression Approach and Academic Performance in Mathematics among Junior High School Students in Zambales, Philippines

Grade Level	Source of Correlation		Effectiveness	Academic Performance	Decision/ Interpretation
7th Grade	Effectiveness	Pearson Correlation	1.00	0.729**	High Relationship Significant
		Sig. (2-tailed)		0.00	
		N	151	151	
	Academic Performance	Pearson Correlation	0.729**	1.00	
		Sig. (2-tailed)	0.00		
		N	151	151	
**. Correlation is significant at the 0.01 level (2-tailed).					
8th Grade	Effectiveness	Pearson Correlation	1.00	0.680**	Moderate Relationship Significant
		Sig. (2-tailed)		0.00	
		N	141	141	
	Academic Performance	Pearson Correlation	0.680**	1.00	
		Sig. (2-tailed)	0.00		
		N	141	141	
**. Correlation is significant at the 0.01 level (2-tailed).					
9th Grade	Effectiveness	Pearson Correlation	1.00	0.691**	Moderate Relationship Significant
		Sig. (2-tailed)		0.00	
		N	142	142	
	Academic Performance	Pearson Correlation	0.691**	1.00	
		Sig. (2-tailed)	0.00		
		N	142	142	
**. Correlation is significant at the 0.01 level (2-tailed).					

Grade Level	Source of Correlation		Effectiveness	Academic Performance	Decision/ Interpretation
10th Grade	Effectiveness	Pearson Correlation	1.00	0.560**	High Relationship Significant
		Sig. (2-tailed)		0.02	
		N	138	138	
	Academic Performance	Pearson Correlation	0.560**	1.00	
		Sig. (2-tailed)	0.02		
		N	138	138	

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3 shows the test of relationship between the perception of the students on the effectiveness of the spiral progression approach and their Academic performance in Mathematics among Junior High School Students in Zambales, Philippines.

The computed Pearson r = 0.729 for the 7th grade indicates that there is a high relationship between the perception on the effectiveness of the spiral progression approach and academic performance in mathematics among the students. Moreover, the computed Sig. = 0.00 implies that there is a significant relationship between the perception of the effectiveness of the spiral progression approach and academic performance in mathematics among 7th grade students.

The computed Pearson r = 0.680 for the 8th grade indicates that there is a moderate relationship between the perception on the effectiveness of the spiral progression approach and academic performance in mathematics among the students. Moreover, the computed Sig. = 0.00 implies that there is a significant relationship between the perception of the effectiveness of the spiral progression approach and academic performance in mathematics among 8th grade students.

The computed Pearson r = 0.691 for the 9th grade indicates that there is a moderate relationship between perception on the effectiveness of the spiral progression approach and academic performance in mathematics among the students. On the other hand, the computed Sig. = 0.00 implies that there is a significant relationship between the perception of the effectiveness of the spiral progression approach and academic performance in mathematics among 9th grade students.

The computed Pearson r = 0.560 for the 10th grade indicates that there is a high relationship between the perception of the effectiveness on the spiral progression approach and academic performance in mathematics among grade 10 students. Furthermore, the computed Sig. = 0.02 implies that there is a significant relationship between the perception of the effectiveness of the spiral progression approach and academic performance in mathematics among 10th grade students.

Therefore, the null hypotheses in all of the tests of relationship are rejected.

The study of Tudy (2014) revealed that performance in Mathematics can be improved by developing a positive attitude towards the subject. Hence, if the students perceived the spiral progression approach as an effective approach to learning Mathematics, it would eventually improve their academic performance. In the case of the student-respondents, the results of this study revealed a highly significant relationship to

moderately significant relationship between the academic performance of the students and their perception of the new approach. Hence, efforts toward learning Mathematics through a spiral approach will eventually help the students in improving their academic performance.

This is related to the following studies: Recent experimental and Quasi experimental studies point toward differences in curriculum materials having educationally meaningful effects on student achievement (Agodini et al., 2010; Bhatt & Koedel, 2012; Bhatt et al., 2013). Chingos and Whitehurst (2012) argue that relative to other potential educational interventions—and in particular, human resource interventions—making better-informed decisions about curriculum materials represents an easy, inexpensive, and quick way to raise student achievement. Recent studies by Clotfelter et al. (2015); Cortes et al. (2015); Domina et al. (2015); and Dougherty et al. (2015) examine curricular interventions that intensify and/or modify the timing of exposure to mathematics course work. All of these studies identify large effects of curriculum on student achievement.

Conclusions

The results showed that the student – respondents' academic performance in First Quarter, Second Quarter, and Third Quarter, were all rated as satisfactory; the spiral progression approach was perceived by the students as effective in all areas of junior high school Mathematics. In terms of their relationship, the study found that highly to moderately significant relationships exist between the perception of junior high school students on the spiral progression approach and their academic performance in Mathematics. Despite the current academic rate of the students, a more positive achievement rate may eventually be seen in the students' performance as the implementation of the curriculum continues in the succeeding school years. This can be concluded since it has been found in this study that the students see the spiral progression approach as effective and a relationship exists between the perception of the students and their academic performance.

Suggestion

In the light of the foregoing conclusions of the study, the researcher recommends that curriculum, developers, administrators, researchers and teachers should revisit the curriculum more often and test its effectiveness on the academic performance of the students, thereupon, adjustments should be made accordingly; since the students perceived the spiral curriculum as effective, teachers, researchers, and curriculum developers should explore ways and methods that will make the delivery of the lessons in the new curriculum more engaging and exciting for the learners to learn Mathematics; textbooks and other instructional materials should develop the core content of the five areas (Numbers and Number Sense, Measurement, Geometry, Patterns and Algebra, Probability and Statistics) in a focused way, in depth, and with continuity in and across grades; future researchers should also look at the possibility of measuring students' mastery of the subject matter in spiral progression through standardized test in each grade level at the end of the school year; and conduct follow up study that would include a wider scope (e.g., High Schools in the Division of Zambales, Philippines).

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