When the Spiral is Broken: Problem Analysis in the Implementation of Spiral Progression Approach in Teaching Mathematics

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Abstract: In a spiral approach, a student is introduced to the same topics several years in a row, advancing them slightly on each pass; with topics arranged from the simplest to more complex. The broken spiral on the other hand is the case where students were unable to gain mastery of the previous topics and are introduced to a more complex new topic. This paper examined that case using 66 10th graders subjected to a mathematics aptitude test. Interview with 9 teachers in Junior High was also performed to identify factors contributing to the students’ performance. A literature review was also undertaken to support the concept of a broken spiral. The study revealed that the expected benefit of the spiral progression approach could never be attained in the current promotion and retention practices of teachers. Teachers’ qualifications, resources, and training inadequacy to name a few are factors identified by them that prevent them from producing favourable outcomes.

Keywords: Broken Spiral, teacher factor, educational policies, student retention and promotion, mass promotion, K-12

1. Introduction

Basic education (K-12 or Kinder, Elementary, Junior High and Senior High) performance of students have direct link to their achievements in higher education (Khattab, 2015; ACT 2008; ACT 2007; ACT 2005; AASCU; 2005) and eventually as professionals (Vermeulen & Schmidt, 2008; Tomas, 2000; James & Alsalam, 1993). Application for work resume with high GPAs are most likely to be selected for job interviews (Kool et al., 2016), thus they are the most likely going to get the job. In the Philippines, and other parts of the world, K-12 especially the Senior High School is intended to prepare students to enter into college/university, to work in the industry or be an entrepreneur (Sarmiento & Orale, 2016). Most of those who choose the academic track is inclined to proceed to college or university (ibid). Poorly prepared student in basic education means, poorly prepared individual for post-secondary studies and eventually as a professional.

Mathematics and its application in today’s world are of great importance with regards to science, technology, communications, economics, engineering as well as other fields (Dowling et al., 2001). In the rapidly changing world brought about by technological advancement, the demand for skills in mathematics cannot be discounted and the need is increasing (Burghes, 2011; Norris, 2012). It has deep roots in many cultures and people talented in this area over the years contributed so much to the development of many other fields (Dowling et al, 2001). Mathematics is a
core skill for life (Math Reports, nd.) and the effects of mathematics education are clearly laid out in industrialized countries (Vorderman et al., 2011). In the 2003 Trends in International Mathematics and Science Study (TIMSS), mathematics performance of Filipino students belonged to the bottom 11%, better compared to 1999 results (Mullis et al., 2004). The poor performance in mathematics is of global concern (PISA, 2003) attributed to many factors such as mastery of basic skills, study habits, time management, and attitude towards mathematics (Silao Jr., 2018; Suan, 2014) as well as promoting students without achieving competencies needed for the level (Patena & Dinglasan, 2013; Shahrill et al., 2015).

The declining performance of Filipino students in many subject areas has triggered the need to overhaul Philippines educational systems. One of these reforms is the implementation of the K-12 curriculum which started in 2012. One feature of the new curriculum was the spiral approach to learning believed to provide a smooth transition between grade levels (DepEd, 2012). Students are expected to learn any idea when it is presented from simple to complex as learners construct new ideas based upon their previously learned knowledge (Comparativ, 2014; Bruner, 1960). This kind of approach according to De Dios (2013) is very suitable for enhancing the learning performance of the students.

In a spiral curriculum, students revisit topics, themes or subjects on several occasions during a course (Harden & Stamper, 1999). There is an increasing level of difficulty, new learning is related to previous learning and competencies of students are expected to increase (ibid).

But what if the learners have not developed the needed competencies in a particular topic or subject; can he comprehend the next which is more difficult or complex? This is the case of the broken spiral.

2. Objectives

The paper aims to present the broken spiral concept, specifically;

2.1 Conduct literature review about SPA,
2.2 Present the SPA as it is practiced by Junior High Teachers,
2.3 Assess the performance of Grade 10 Junior High students in mathematics, and
2.4 Introduce the Broken Spiral concept

3. Methodology

3.1 Research Design

The study uses mixed methods such as literature review, interviews and quantitative assessments of student performance in mathematics. The discussion focused on the spiral approach, the retention and promotion standards, written and unwritten policies of authorities shaping teachers practices and the presentation of indicators of the broken spiral.

3.2 Literature Review

Literature about SPA, its strength and weaknesses were extracted from on-line published literature which includes journal articles, books, essays as well as commentaries. These papers were used to provide varied views and in support of the broken spiral concept. Combined with the results of the interviews made, issues about the SPA were identified. A total of 56 published literature related to SPA, methods of teaching, student behaviour and belief/perception were examined and 28 were relevant to this study.

3.3 Research Participants and Environment

This interview and survey were made in Samar, Philippines. For ethical
consideration and in the protection of the school assessed, the teachers and the students, their identities were withheld. A total of 66 Grade 10 students from two classes took the test to determine their level of proficiency in different mathematics subjects with questions taken from various levels (Grade 7, 8, 9 and 10). Participants considered in the assessment were Grade 10 students primarily because they were the first batch to have fully undergone the enhanced secondary education program of K-12 which started during the school year 2012-2013.

Teaching practices of junior high school teachers from various schools were collected from 2016 to early 2018. Interviews performed with them are semi-structured with questions focusing on their experiences in teaching mathematics, their grading system and the promotion as well as their retention of students as practiced.

3.4 Research Instrument

In the assessment of students’ performance in mathematics was based on an 80 item quiz covering Algebra, Geometry, Statistics, Probability and Trigonometry taking into consideration the grade levels. The exam was administered to the students who were informed one week before the assessment to give them the opportunity to prepare. The interview used an open-ended questionnaire as the guide. A recorder was used during the interview. The file was deleted after it was transcribed and processed.

3.5 Data Presentation and Processing and Statistical Analysis

Concepts and themes generated from the literature review were intertwined with the primary data collected through the assessment and interviews. Data collected from the assessment of student performance in mathematics was grouped according to subjects and levels giving emphasis on their achievement scores. Data were presented in a bar graph. Data gathered from interviews were summarized in a thematic manner.

4. Results and Discussion

4.1 The Spiral Curriculum and its Implications

The benefits of Spiral Curriculum and Spiral Progression Approach. Spiral Curriculum is where a wide number of topics are taught in the early grades and are cycled throughout the years. It is aimed at developing a deeper understanding in the next levels. Spiral progression approach was derived from Bruner’s Spiral curriculum model. Some of the expected benefits of this approach are (1) it helps reinforce learning, (2) it allows a logical progression from simple to complex ideas, (3) it encourages students to apply their previous learning to later topics and new situation, and (4) it helps learners appreciate the connections among the different content standards. (Diwa, 2018).

Figure 1. The Ideal Spiral Progression Approach

The approach provides multiple opportunities for learners (including teachers) to gain mastery as they are exposed to the same content as the topic
progresses. The benefit of the curriculum is felt more conclusively in the later years (Coelho & Moles; 2016) as everything they have studied are beautifully intertwined to create a more cohesive knowledge. When implemented as intended, the spiral approach is effective for all learners including struggling learners (Everyday Mathematics, nd). Learning difficulties can be addressed in the early phases of the spiral and interventions can be implemented especially when the needed concepts are encountered later (ibid).

Mastery of Subject Matter. One of the key elements in the SPA is the need for the mastery of the subject matter that helps retention of the concepts by the students (Ramos-Samala, 2018). The easier to grasp concepts are introduced to students and ideas are built from there, progressing from the simple to harder topics (Cabansag, 2014). American school spends a substantial proportion of time on review each year sometimes repeating the topic over and over again just to master the topic (Gamoran, 2001).

Teachers are also expected to have expertise on all topics. For example, teachers who handle the math area must have expertise in Algebra, Geometry, Trigonometry, Probability and Statistics to name a few. This will allow him/her to interconnect one mathematics field to another considering the goal for the year and future levels. Sequencing of topics is crucial as it provides linkages of lessons previously covered as the students' spirals upward in their course of study (Dowding, 1993). Topics are constantly revisited to reinforce learning in the new topic. Revisiting the old topic does not mean re-teaching it but rather use it in understanding the new topic.

Progression in Accordance with Student Phase. Cabansag (2014) emphasizes that student learn the subject matter at their own phase. This will allow them to develop expertise or mastery of the subject matter before proceeding to a more complex topic.

The idea of staying longer on a topic to ensure mastery will affect the attainment of entire learning outcomes of the current year and effects will spill over to the next. Topics scheduled for the current year may not be covered entirely thereby affecting the next level lectures. American students who perform poorly in arithmetic are subject to a special form of the spiral curriculum; they repeat the topic over and over again until they stop studying math (Gamoran, 2001).

If time devoted to introducing new topics is inappropriate, learning time may decrease due to the level of difficulty and boredom (Snider, 2004). To avoid the boredom of students, teachers uses fun activities which may not be related to math (ibid), thus eating up the limited time. Because of many topics presented, the time provided for every topic is brief. Porter (1989) estimated that only 30 minutes of instructional time of the entire year for a close to 2/3 of the topics needed to be covered.

4.2 The Spiral Progression Approach as Practiced by Sampled Teachers

Teachers play a vital role in the delivery of instruction no matter is the approach used. This section of the paper presents the practices employed by teachers in delivering their classes using the SPA under a spiral curriculum.

Unprepared. Out-of-field teaching is prevalent despite the presence of a policy by DepEd (1994). The policy states that only those teachers with appropriate majors or any of its subgroup are qualified to teach.
Teacher 1: I am not a mathematics major, but I was requested to teach the subject for lack of available mathematics teacher. I have not availed of any capacity building from my school. I have my graduate schooling on my own to help myself.

Teacher 5: I need to study so many topics just for me to be able to connect it to other topics within the same level and their previous level. I rely on the textbooks and other learning materials to understand. But I feel it’s not enough.

Teacher 6: We have limited resources at school, we do not have enough textbooks and other teaching materials come from my own pockets.

In 1992 survey by DECS, 45% of those teaching in mathematics were not specialist (DECS, 1998), unverified reports says the number was reduced. In a paper published by the World Bank suggests that some teacher education graduates in the Philippines are weak in subject matter content (Acedo, nd). Orleans (2007) also reported that only about 30% of the teachers are academically qualified. A teacher expected to have knowledge on many topics is unlikely in this scenario.

Mass Promotion. It is not a written policy of the government to practice mass promotion. However, some of the systems used by DepEd and of the government are misinterpreted as recommending mass promotion like the pending bill entitled No Filipino Child Left Behind Act of 2010 (Senate of the Philippines, 2010) and the Philippine Education for All 2015 National Plan of Action (Lapus, 2008).

Teacher 3: I have never dropped or retained anyone in my class; my principal would not allow me. Yes even if the student has incurred so many absences.

Teacher 1 to 9: Our school and our principals are also rated based on the number of students promoted or retained to the next level.

Teacher 8: I have more than 6 nonreaders but they will be promoted. If I insist on retaining them, I will be required to conduct remedial classes without remuneration. I rather promote them, and my principal will be happier.

Promoting students without learning has several long-term effects to the student and impact to the country as a whole. Promoting students without learning results into higher dropout rate in later years (King et al., 1999) while other studies says differently (Jimerson, 2001; Jacob & Lifgren, 2009; Lorence, 2014). Rewards for performance often are forces that encourage schools heads to allow mass promotion despite the foreseen impact. Performance indicators of schools includes dropout rate and graduation rate or promotion rate (Read, 2017), therefore lower retention means better performance.

Teacher 4: My principal himself told me not to drop my student and blame me even for his absences.

Teacher 2: At this level, (Grade 10), I should have no non-
readers, but I have several of them. How much more mathematics, when reading and comprehension is almost null. I would like to render remedial classes for the student, but I have other concerns. His case is beyond my scope. He should have not been promoted to Grade 4.

Lowering of Standards. Most of the time students are not able to meet the required standard at the end of the grading period. However because of the flexibility of rating system, students passed the subject no matter how poor his performance is.

Teacher 1 & 8: We lower the standard and adjust the passing mark or give them high grades on performance tasks; sometimes the performance task is not related to the subject. Many times we provide them simpler questions in exams for them to pass.

Remedial Class. Students’ learn at their own phase. In a heterogeneous section, there will always be students who learn fast and the slow learners. Trying to slow down the class for the benefit of the slow learners will not be advantageous for the entire class, the reason why a remedial class is in order. For government teachers’ students who failed to achieve the desired competency are expected to attend remedial classes either every after the day’s class or weekends or during summer time. Teachers' conducting remedial classes are allowed to receive service credit (DepEd, 2003). The policies laid out as per DO 13 S. 2018 or the implementing guidelines for remedial classes is a bit complex.

Teacher 9: There was a new department order from DepEd about remedial class, for me it’s complicated and not attractive. I doubt my colleagues will conduct the much needed remedial classes.

Teacher 7: I and my co-teachers have discussed the DO 13 s. 2018. For us it is easier to just promote the slow learners than conduct remedial class and submit many requirements.

4.3 Students Mathematics Performance

The foregoing result shows that about 71% of students who are about to move to Grade 11 are still beginners of Grade 10 mathematics. This suggests that the spiral progression approach is not working as teachers seems to advance to next more complex subject matter without the mastery required.

Figure 3. Grade 10 Mathematics Performance

The students also were assessed using test items from Grade 7 to Grade 8 and the result was the same. Most of the students are just in the beginners’ level, proof that they have not mastered the topics they have had in the previous years. Teachers handling the subject per level are not necessarily the same leaving the new teacher clueless where the students stopped. Only an average of 4% of the students exhibited advance level of aptitude, but only one of the 66 tested was consistent.
The result suggests that students have been promoted to succeeding levels without attaining the mastery level. This result is true as Ginsburg (2012), shared his first teaching experience to an 11th grade, 9th grade and 7th-grade Algebra classes.

Ginsburg (2012) noticed that the ability of some 11th-grade students is the same with that ability of 7th-grade students and some skills of 11th-grade students were not far different with that skill of 9th-grade students. He expressed that the approach results into stifling and not spiraling. The requirement for mastery is supposed to be addressed in the topic re-visititation. However many times revisiting concepts at each grade level with increasing depth do not happen. Therefore building on students’ prior knowledge and skills is not possible and gaining mastery from one topic to another will not occur.

4.4 The Broken Spiral

The DepEd is trying to cover too many subjects and deliverables at one time, without focus and prioritization (www.philippinesbasiceducation.com, 2012). DepEd does not see the importance of prerequisites, the essence of mastery that instead of progressing upward it's a downward spiral (ibid). This paper however focuses on one key element, attaining proficiency before proceeding to the next topic. New information or skills are introduced are related back and linked directly to learning in previous phases of the spiral (Harden & Stamper, 1999) if such is not attained; there is a case of a broken spiral.

The regression instead of progression effect of the spiral approach was proven in the United States as early as 2000 (US Department of Education, 2001). Though there was improvement year on year, the percent gain in lower year is smaller than later years (ibid). There is therefore slump in mathematics achievement until grade 12 (ibid). Based on TIMSS results, it appeared that US students do not start out behind but fall behind during the middle-school years (Snider, 2004) suggesting that the longer the child stays in American schools, the worse they became (America’s Education Choice, 2000).
providing insufficient cumulative review (ibid).

The idea is ideal if there is enough time and handful number of students under your supervision. Students learn at their own phase, therefore some will be ahead and others will be left behind. Slowing down the phase for the sake of the slow learners will be unfair. At the end of the curriculum, students are expected to have garnered the minimum competencies and that is time bounded. Everything needs to be completed within the given period.

5. Conclusion and Recommendation

The spiral curriculum and the SPA are ideally good but its applicability in the current educational set-up is not. Without the necessary pre-requisites available such as resources, appropriate teachers’ competencies and favourable policies, the spiral progression approach does more harm than good.

The mass promotion which is indirectly imposed by the authorities is one reason why the spiral is broken. Promoting students without the needed remedial classes to catch-up and master the topic is a deathblow to the promise of SPA. Making remedial classes for slow learners more attractive for teachers and student alike may help in attaining the needed mastery of topics crucial for the next level.

6. Bibliography


ACT (2005). Courses Count: Preparing Students for Postsecondary Success. ERIC.

ACT. (2007). The role of nonacademic factors in college readiness and success. ERIC.

ACT. (2008). What we know about college success: Using ACT data to inform educational issues. ERIC

ACT. (2009). The Path to Career Success: High School Achievement, Certainty of Career Choice, and College Readiness Make a Difference. ERIC


Comparativ, E. (2014). The Role of Jerome Bruner’s Spiral Approach in the Reformation of the Philippine Educational System


Everyday Mathematics. (nd.). The Spiral: Why Everyday Mathematics Distributes Learning. Resource and Information Center, the University of Chicago, School of Mathematics. http://everydaymath.uchicago.edu/about/why-it-works/spiral/ Accessed March 5, 2018


Lorence, J. (2014). Third-Grade Retention and Reading Achievement in Texas: A Nine Year Panel Study. Social Science Research, 48

Mathematics Report. (nd.). Mathematics is important. https://mathsreports.wordpress.com/overall-narrative/mathematics-is-important/ Accessed March 2, 2018


Senate of the Philippines (2010). No Filipino Child Left Behind Act of 2010. Senate Bill 75 introduced by Senator Manny Villar


Graduates. Studies in Higher Education, 33