Spiral Review in a Middle School Mathematics Classroom

Haley Birks

Follow this and additional works at: https://nwcommons.nwciowa.edu/education_masters

Part of the Education Commons
Spiral Review in a Middle School Mathematics Classroom

Haley Birks

Northwestern College

An Action Research Project Presented
in Partial Fulfillment of the Requirements
For the Degree of Master of Education
Table of Contents

Abstract ........................................................................................................................................3
Introduction ..................................................................................................................................4
Literature Review ..........................................................................................................................6
  Spiral Curriculum Background .................................................................................................7
  Negative Aspects of a Spiral Curriculum ..................................................................................10
  Positive Aspects of a Spiral Curriculum ....................................................................................13
  Impact of a Spiral Curriculum on Student Learning .................................................................15
Methods.......................................................................................................................................19
Data Collection ............................................................................................................................21
Data Analysis ................................................................................................................................23
  Figure 1 ....................................................................................................................................24
  Figure 2 ....................................................................................................................................25
  Figure 3 ....................................................................................................................................25
  Figure 4 ....................................................................................................................................26
Discussion ....................................................................................................................................28
  Summary of Major Findings ......................................................................................................28
  Impact on Teaching and Learning .............................................................................................28
  Reflection of Published Literature .............................................................................................29
  Limitations of the Study ............................................................................................................29
Future Research ............................................................................................................................29
Conclusion .....................................................................................................................................31
References .....................................................................................................................................33
Appendix .......................................................................................................................................37
  Appendix A .................................................................................................................................37
  Appendix B .................................................................................................................................38
Abstract

The purpose of this action research project was to determine the relationship between daily spiral review bell ringers and students’ assessment scores. The research was driven by the problem of students reaching the end-of-year assessments and being unable to remember material they had learned throughout the year. A quantitative study was used to determine the effectiveness of a ten-week spiral review intervention. The researcher is a seventh and eighth grade math teacher in her fifth year of teaching. Data was collected from a pre-test and post-test created by the researcher consisting of material from the Common Core State Standards and the ISASP Mathematics Blueprint. Data analysis revealed a significant difference in students’ scores from the pre-test to the post-test. Students were more likely to remember the material after being frequently exposed to it. The research findings from this study may prove that spiral review is beneficial for all teachers to implement in their classroom to strengthen students’ understanding of the material being taught.

Keywords: spiral review, bell ringers, mathematics, eighth grade
Spiral Review in a Middle School Mathematics Classroom

Throughout the school year, a variety of topics are covered in the classroom. At the end of the year to assess the retention of these topics, students in grades 3-11 take summative assessments such as the Iowa Statewide Assessment of Student Progress (ISASP). In the Iowa Department of Education ISASP Summary, 76.66% of students in the Le Mars Middle School scored Proficient on the Mathematics assessment (2023). Unfortunately, this falls short of the school wide proficiency goal of 80%. The problem is students are not retaining and recalling information learned prior in the year during the summative exams at the end of the year. Not only do students struggle from the beginning of the year to the end, but they also find it difficult to remember information from one year to the next. In a study conducted in the Philippines, researchers’ findings “revealed that vertical articulation of spiral progression provides deep understanding of science concepts through a thorough review conducted by the teachers. Furthermore, vertical and horizontal articulations in spiral progression are achieved through cooperative learning in consideration of the students’ propensity to easily forget what they have learned from the previous grade levels” (De Ramos-Samala, 2018, p. 555).

According to Ireland and Mouthaan (2020), there are two competing perspectives pertaining to curriculum design including the spiral curriculum model and non-linear models. Many researchers support spiral review as a way to continually revisit material throughout the year to increase student understanding and retention. The design of the spiral curriculum model and the increasing levels of complexity each year are driving factors to positively impact student learning. Researchers have conducted studies on using a spiral curriculum as students progress through grades K-12, but there are few studies that examine the benefit of students engaging in a spiral curriculum throughout one grade level. In the Philippines, the Department of Education
began requiring schools to implement a spiral curriculum due to an increased amount of lack of retention. As they began the implementation, scholars discovered there was a lack of research in this area: “While the debate goes on about whether the approach is more effective than the previous curricular paradigm, research is lacking on its real impact on the students who underwent the new curriculum and the teachers who are implementing it” (Amarilla, 2019, p. 2).

The purpose of this action research study is to identify if spiral review throughout a school year impacts students’ test scores on summative tests at the end of the year better than mastering the concepts and progressing forwards. Findings from this study will inform classroom teachers, both mathematics and other content areas, as well as administration, on the value of spiral review throughout a school year. Classroom teachers can incorporate more review throughout the year so the students are more familiar with the content. Once the value of spiral review has been established, we must establish the means by which spiral review is implemented. In particular, in the middle school system where the researcher teaches, teachers could designate the early out professional development days twice a month where the periods are shortened as spiral review time. The administrators can provide teachers with contracted time to collaborate with their content area colleagues so they can discuss which concepts are most important to review. The administrators can also provide teachers time to design their spiral review so it is implemented effectively.

Resources for this action research study were compiled from the DeWitt Library at Northwestern College, Orange City, Iowa, Google Scholar, and Research Gate. All scholarly journals were peer-reviewed, and a majority of articles were published in the past ten years. Part of this study was to examine the history behind spiral review, so there are a few articles written earlier than ten years ago, which establish this history. The author focused on finding research
studies that examined spiral curriculum in a wide variety of settings, such as collegiate programs and high school courses, and content areas such as science and math. Studies were used to gain knowledge of spiral review, identify how a spiral curriculum is used effectively, and draw attention to negative outcomes of a spiral curriculum.

The author believes that the main areas of research found to be effective in improving students’ retention using a spiral curriculum model include revisiting topics, increasing the level of depth and difficulty, relating new information to students’ previously learned information, and increasing students’ confidence with successful repetitions. The belief is that when educators in a middle school math classroom continually revisit math concepts throughout the school year at deepening levels, students’ scores on end-of-year summative assessments will improve due to increased retention. The author says it will work on these grounds, and research in the Philippines backs this hypothesis. Filipino researchers have studied the spiral curriculum in its first years of implementation and identified the positive impact it has had on students as learners: “Additionally, spiral progression seems to lead to a more advanced, sophisticated chemistry content through the involvement of varied teaching strategies…Teachers recounted that there is a growing set of results on how these approaches lead to improved student learning” (Orbe et al., 2018, p. 23).

The author has organized the literature review by key themes deemed effective in implementing a spiral curriculum. The literature review will begin with the background of the spiral curriculum model and its development. Next, the literature review will identify the positive aspects of a spiral curriculum. Then, the literature review will identify the negative aspects of a spiral curriculum. Finally, the literature review will outline the impact a spiral curriculum has on student learning.
Review of the Literature

In the spiral curriculum design, topics are frequently revisited at a more complex level. While there are several negative aspects of a spiral curriculum, such as a superficial understanding and lack of mastery of the concepts, there are also several positive aspects of a spiral curriculum, such as being student-centered and containing higher-level objectives. The design of the spiral curriculum model and the increasing levels of complexity are driving factors to positively impact student learning.

Spiral Curriculum Background

The spiral curriculum model was introduced by Jerome Bruner in 1960. He was mentioned in several articles as the founder of the spiral curriculum idea, which includes revisiting material to strengthen student understanding and retention. Neumann, Neumann, and Lewis included the work of Harden which built on the work of Bruner: “Both Harden (1999) and Bruner (1960) concluded that the concept of a spiral curriculum merits careful consideration. The iterative revisiting of subjects throughout the courses was particularly relevant in integrated and problem-based learning and in outcome-based education” (Neumann et al., 2017, p. 98). Some common themes that emerged from Harden, as well as Neumann, Neumann, and Lewis, included frequently revisiting topics with increased complexity, more depth in the curriculum, connecting new learning to previous learning, and student competence increased until goals and objectives were achieved (Harden & Stamper, 1999, p. 141). Neumann, Neumann, and Lewis also included the work of Masters and Gibbs: “Masters and Gibbs (2007) found that the spiral curriculum can prove very effective for online learning if used as a consistent practice” (Neumann et al., 2017, p. 98).
In a study conducted by Neumann, Neumann, and Lewis (2017) at the Touro University Worldwide, USA, they integrated the Spiral Curriculum Approach with the Robust Learning Model as “part of a continuous improvement process that was designed to improve educational effectiveness” (Neumann et al., 2017, p. 95). University officials created an inverted pyramid model which began with the first course at the bottom, followed by courses with increasing depth and program learning outcomes coverage in the middle, and the capstone course at the top. The first course was essential to lay out the framework and key concepts of the program, while the capstone course encouraged students to “demonstrate their understanding, comprehension, application, and integration of all the competencies and learning outcomes required for successful completion of the degree program” ((Neumann et al., 2017, p. 99). Participants in the study included all students in non-clinical master’s degree programs. The study took place over the three years the students engaged in the Robust Learning Model-Spiral Curriculum combined curriculum. The data for the study was collected from threaded discussion performance, case study performance, signature assignment performance, self-reflective essay, and quality of faculty feedback. The findings of the study suggested that both retention and graduation rates increased, the capstone performance and cumulative GPA improved, and the time-to-degree was reduced within the three years (Neumann et al., 2017). These findings seem to conclude that incorporating a spiral curriculum into the previous curriculum has positive benefits for the master’s programs.

Similarly, Ireland and Mouthaan also mentioned that Bruner believed learning started with a basic concept and spiraled to revisit the concept frequently. They compared Bruner’s spiral model with non-linear models, such as networks or webs, which emphasize the connectedness of concepts. Bruner believed that the concept of spiral review can be applied to
any subject area. However, Ireland and Mouthaan argued that the spiral model has its flaws and must be planned out in great detail to be implemented effectively.

Not only does spiral review take place throughout one school year, but it occurs all throughout a child’s academic career with increasing complexity in material. Orbe, Espinosa, and Datukan say, “Spiral progression approach is when the scope and sequence of the content are developed such that concepts and skills are revisited at each grade level and with increasing depth” (Orbe et al., 2018, p. 19). They conducted research on the perceptions of twelve science teachers in the Philippines who are currently teaching K-12 science in a spiral curriculum. The researchers found that while spiral progression is “learner centered, advanced, and sophisticated, it is not concentrated and extensive” (Orbe et al., 2018, p. 28). In other words, the spiral curriculum has potential to improve students’ retention and understanding by increasing complexity in the material, but it may need some careful examination and revising to be implemented successfully.

In comparison to Orbe, Espinosa, and Datukan, Degorio says that skills are introduced when children are young, around first grade, and then “rediscovered” each year in more depth as the students grow older. He considers this a “ladderized” approach so each year the “learning is extended, reinforced, and broadened each time a concept is revisited” (Degorio, 2022, p. 98). In his study, he examined the effectiveness of the Basic Education Curriculum versus the Spiral Curriculum in high school science taught by secondary science teachers. His study concludes that science teachers are able to choose their preferred curriculum method, or a mix of methods, based on the experiences and difficulties of science teachers who have previously worked with both the new and old curriculum. Again, this research suggests that the spiral curriculum needs to be inspected carefully before it can be implemented effectively.
Ireland and Mouthaan (2020) agree with the importance of increasing the difficulty of material as students move from one grade to the next: “Repeat visits of topics at increasing levels of complexity, a key feature of the spiral, also places importance on the learners’ grasp of core concepts, whereby ideas are built on to achieve mastery” (p. 11). Similar to Orbe, Espinosa, and Datukan, Ireland and Mouthaan also mention scope and sequence, and say that it “ensures knowledge outcomes are preplanned” due to the way the spiral curriculum is designed (Ireland & Mouthaan, 2020, p. 11).

The idea of increasing complexity has been well-researched and was also mentioned by Antipolo and Rogayan. They examined how a spiral curriculum is being implemented in the Philippines: “The spiral curriculum in science presents the concepts and skills in all the branches of science including biology, chemistry, physics, and earth science, with increasing complexity levels from one grade level to another in spiral progression, thus the concrete way to a better understanding of core concepts” (Antipolo & Rogayan, 2021, p. 2). In their research, the participants, thirty prospective science teachers in the Philippines, answered a questionnaire developed by the researchers which included their demographic information and experiences during their practice teaching while implementing a spiral curriculum into the K-12 curriculum. From their research, increasing complexity from one grade level to the next emerged as a common theme.

**Negative Aspects of a Spiral Curriculum**

The most common negative aspect of a spiral curriculum is a superficial understanding and lack of mastery of the concepts. Researchers contributed this to several factors including the failure of revisiting concepts, unnecessary repetition for those who have already mastered the
concepts, an inadequate amount of time allotted to master the content, a de-emphasis of academic learning time, and insufficient time between revisiting of concepts.

In a study by Masters and Gibbs, they were attempting to answer the question, “Does the spiral curriculum really exist?” (Masters & Gibbs, 2007, p. 2). The staff is required to incorporate the spiral curriculum and list it on their curriculum map, but it was undetermined if they were actually implementing the spiral curriculum and revisiting previously learned material. This could be a problem when it comes to students’ mastery of the content if the program’s curriculum is built on the assumption that all material will be revisited on several occasions.

Amarilla mentioned the lack of mastery as a negative aspect of the spiral curriculum, similar to Ireland and Mouthaan. In his study, he examined eight tenth grade math students of a wide variety of ability levels, and eight math teachers with at least three years of experience. The objective of his study was to “know the lived experiences of students and teacher in relation to the implementation of spiral progression in teaching mathematics” (Amarilla, 2019, p. 3). The researcher conducted interviews with the participants and identified common themes among the participants’ experiences with a spiral curriculum. He attributed a lack of mastery to the large amount of time that had passed from one revisit of the topic to the next. “Instead of increasing complexity, the teacher-participants observed that there is often the need to review all the basics before the students can catch up with more advanced problems” (Amarilla, 2019, p. 4). To put it differently, the teachers had to spend time trying to get the students to recall the previously learned information before they could move on to the more complex material.

Similarly, De Ramos-Samala conducted a study and found that teachers had to spend more time than anticipated reviewing the previously learned material. He conducted a study with 133 students and all ninth and tenth grade science teachers in a high school in the Philippines.
The purpose of his study was to identify students’ and teachers’ perceptions of the spiral curriculum, in particular vertical articulation, by interviewing the participants. In his findings he noted, “In order to attain vertical articulation in the spiral progression approach, the students need to connect their previous lessons in the past grade level to the present. One way of doing this is to conduct review before the start of the class; however, the teachers find it hard to limit the review to 5 minutes that was the recommended time for it in a regular setting” (De Ramos-Samala, 2018, p. 564). So, while the students were supposed to be revisiting previously learned material at a more complex level, they first had to recall the information they already learned, which took more time than anticipated.

Ireland and Mouthaan, as well as Caldwell, mentioned unnecessary repetition as a factor that contributed towards a lack of mastery for those who have already mastered the concepts, which Caldwell discussed in her study. She interviewed ten-year-old students learning math in a school in London about their feelings on learning material and doing problems they have done before. She found that a majority of students were bored and frustrated that they were required to repeat the material. She believes that the repetition is portraying to students that math is all about memory and it is important to remember all of the information for assessments: “The high-stakes testing regime and consequent over-reliance on textbooks tend to reduce the spiral curriculum to an endless circle of repetitive tasks, particularly for the lower attainers” (Caldwell, 2008, p. 4). From this study, it appears that the spiral curriculum may not be beneficial for students of any level of math knowledge. The higher math students become bored with the repeated material and the lower math students become lost and frustrated in the constant spiral of material.

Orale and Uy agreed that a spiral curriculum can be ineffective and referred to it as a “broken spiral.” They conducted a study of 66 tenth graders and nine junior high math teachers
to identify whether students can progress through a spiral curriculum if they have not mastered the previously learned concepts. They found that the spiral curriculum is flawed, and echoed Ireland and Mouthaan when they said, “The spiral curriculum leads to superficial understanding of the needed skills vital to learning more difficult concepts, minimizes academic learning time, and providing insufficient cumulative review” (Orale & Uy, 2018, pp. 20-21). In other words, students have not mastered the material they were expected to learn previously, which breaks the spiral when they are supposed to be revisiting the material at a more complex level.

Gibbs mentioned insufficient time between revisiting topics as a negative aspect of the spiral curriculum. In his examination of the spiral curriculum, he described how the concept of the spiral curriculum was to continuously build the curriculum and content upon one another, but it did not occur at a rate quickly enough for students to master the material. In contrast to Amarilla (2019) and De Ramos-Samala (2018), he mentioned that “the assumption that teachers at least one year apart will engage the curriculum with the same intent or plan or begin where students left off is incorrect” (Gibbs, 2014, p. 43). It appears that Gibbs agrees with Bruner’s concept of the spiral curriculum but believes it would be more effective if it was narrowed and moved at a quicker pace.

**Positive Aspects of a Spiral Curriculum**

While there are several drawbacks to implementing a spiral curriculum, there are also numerous positive aspects including a focus centered on the learners, a presence of higher-level objectives, and an increased ability to understand new material.

Degorio described the spiral curriculum as holistic and learner-centered, meaning that the focus is placed on the students and their learning, instead of the teachers. As previously mentioned, his study examined the effectiveness of a spiral curriculum and found that “the new
curriculum encourages participation among students” (Degorio, 2022, p. 105). In other words, since the spiral curriculum is learner-centered, students are more interested in the concepts and are more likely to be active participants in their learning.

Amarilla (2019) agreed that a spiral curriculum is learner-centered due to students’ prior knowledge being activated. In his study, which was previously mentioned, he found that students were more motivated to participate in the math spiral curriculum because they were engaging in problem-solving, real-life activities in the classroom. In addition, he found that students were more engaged and interested when they were presented with challenging problems. They were continuously required to go deeper with each topic, which motivated most students.

Similarly, Orbe, Espinosa, and Datukan describe the spiral curriculum as being learner-centered and consider it a positive aspect. The spiral curriculum uses an inquiry-based pedagogy, which means “concepts and skills are taught by providing pedagogy which will enable them to enhance their cognitive, affective, and psychomotor domains” (Orbe et al., 2018, p. 18). Instead of just producing an answer and moving on, students are required to provide an explanation behind the answer. This idea of placing the focus of learning on the students appears to becoming a more common teaching strategy. Degorio (2022), as well as Orbe, Espinosa, and Datukan, used words such as “sophisticated” and “advanced” to describe the learner-centered aspect of the spiral curriculum model.

Taranikanti, Al Rajeibi, and Al Farsi conducted a study to examine the effectiveness of the adoption of a spiral curriculum in the MD degree program at a university. The emphasis in the adoption of the spiral curriculum at the university was on the horizontal and vertical integration of basic and clinical sciences. All students and facilitators at the university were given a questionnaire to describe their viewpoints of the integrated curriculum. Overall, a
majority of the findings of the studies were positive, including the mention of the spiral curriculum being “student-centered,” yet again. “Integration between basic and clinical sciences stimulates profound and self-directed learning among students” (Taranikanti et al., 2019, p. 2). It appears the authors of this study believe that integrating a spiral curriculum is effective for this university’s MD program.

Another positive aspect of a spiral curriculum highlighted by Ireland and Moutaah (2020) includes the presence of higher-level objectives. As mentioned previously, one of the main components of a spiral curriculum is the increase of complexity each time a topic is revisited. As the complexity increases, so does students’ ability to retain the information. Instead of simply recalling the information, the students are applying what they have learned and connecting it to their prior knowledge and experiences. When students are able to connect their background knowledge and experiences to the new content they are learning, the more engaged they are likely to be. This supports what Degorio, Orbe, Espinosa, and Dakutan said about the spiral curriculum being learned-centered and outcome-based.

In contrast, De Ramos-Samala mentioned the students’ ability to manage the increased complexity in new concepts in his study, which was previously mentioned. The most common positive experiences mentioned by the students he found in his study were the ability to understand the new material due to the review of previously learned material. “The students were able to understand the complex lessons by connecting their previous lessons to the new ones” (De Ramos-Samala, 2018, p. 561). The students activated their prior knowledge to relate what they were currently learning in class, including more complex and difficult material, to concepts they had learned in the past.

**Impact of a Spiral Curriculum on Student Learning**
It is important to consider and understand the impact of the spiral curriculum on student learning because it improves understanding and retention, provides a more engaging learning environment, incorporates other content areas, prepares students for real-life situations, encourages problem-solving and higher-order questioning, activates prior knowledge, and increases student motivation. This is generally what researchers have found to be the impact. Understanding this information is essential to implementation and further research.

The overall agreement is that a spiral curriculum is focused on student-centered learning because the goal is improved understanding and retention. Degorio (2022) included the work of Orbe, Espinosa, and Datukan (2018) saying that the spiral curriculum encouraged holistic learning because the students “update” the previously learned information in their brain as the complexity increases. Each grade level is provided with the topic and depth they are required to cover the material in that specific grade level. In his study, Degorio also found that students had a positive attitude towards implementing a spiral curriculum because they were optimistic about it achieving its goal.

Orbe, Espinosa, and Datukan (2018) also credited increased student retention and understanding due to a more engaging learning environment. The students in the study they conducted were more prepared to enter high school and be successful in their science classes after engaging in a spiral curriculum for several years previously. Anyone who has worked with children and teenagers knows they are more likely to be engaged with the material if they are confident in what they are doing and feel like they can be successful.

Antipolo and Rogayan (2021) also discussed the positive impact the spiral curriculum has on student learning in terms of incorporating multiple content areas and disciplines to prepare students for real-life situations. His research took place in a school setting whose current
curriculum incorporates the spiral progression approach which “provided a range of competencies to the learners in a knowledge-based and world of work civilization” (Antipolo & Rogayan, 2021, p. 2). Students were more engaged in the classroom when they knew why they were learning the material and how it would benefit them in the future or in their lives outside of the classroom. Similar to research previously mentioned by Degorio, Orbe, Espinosa, and Datukan, Antipolo and Rogayan (2021) highlighted the benefit of increased student engagement due to a spiral curriculum.

In his research, Thornton also described the positive impact a spiral curriculum has on student learning. He examined the five fundamental principles of knowledge building in school mathematics. He described the importance of “placing knowledge at the center of the school mathematics curriculum and for knowledge building and knowledge differentiation as critical for both equity and excellence” (Thornton, 2022, p. 71). In other words, the curriculum should be designed with student learning and knowledge as the main focus. As previously mentioned, one of the main positive aspects of a spiral curriculum is that it is learner-centered.

Tapanan, Antig, and Tapanan explained the concept of Discovery Learning in their research. They described it as a “learning method that encourages students to ask questions and formulate their own tentative answers, and to deduce general principles from practical examples or experiences in learning Mathematics” (Tapanan et al., 2021, p. 670). There are three key principles to the Discovery Learning, all which coincide with the principles of a spiral curriculum. This includes connecting learning to prior knowledge and experiences, going beyond and deepening the current knowledge level, and structuring the information so students are able to easily understand it. These key principles will positively impact student learning, as well.
In their research, Coelho and Moles also described the positive impact that the spiral curriculum has on student learning. In particular, they said, “the spiral curriculum has been substantiated as a motivational tool to enhance student learning, as it activates prior knowledge, initiates interest, and reinforces learning” (Coelho & Moles, 2016, p. 162). It appears that these three ideas are common themes that have emerged from the benefits of a spiral curriculum. In their study, they used a questionnaire to view the perceptions of third-year medical students at a dental school. They found that a majority of students viewed the spiral curriculum to be beneficial to their learning, particularly in the latter years of the program. At this point, they were able to look back at all the material they had learned and apply it as they were preparing to enter the workforce.

Lastri, Kamsurya, and Kamsurya conducted research similar to Caldwell and discussed the importance of students actually learning the information, instead of just memorizing it. In their study, they used two groups of students, a control group, and an experimental group, to find differences in student learning outcomes between students who were taught using a spiral method versus a lecture method. They found that students who were taught using the spiral method obtained better test results. They attributed this to students being more active in the learning process. They best described this when they said, “Learning is not memorization and not remembering. Learning is a process characterized by changes in a person… Learning will be more meaningful if the child experiences what he learns, not just knowing it” (Lastri et al., 2022, p. 40). In other words, students are more likely to remember information that they have discovered on their own from their hands-on experiences, instead of being asked to memorize the material, therefore positively impacting their learning.
Comediero, Samillano, and Tirol compared the spiral curriculum to John Dewey’s idea of the learning process in their research. Similar to previously mentioned research, this approach by Dewey encourages student engagement and investment in the curriculum to develop learning by application and development of real-world skills. They view the purpose of a spiral curriculum in terms of impacting student learning as to “acquire, apply, and develop their skills, knowledge, and understanding through increasingly challenging situations” (Comediero et al., 2022, p. 1819). Through the spiral curriculum process of revisiting concepts at a more complex level, students are developing not only content area skills, but life skills, as well.

Methods

This action research project attempts to identify the relationship between daily spiral review bell ringers and students’ assessment scores by exploring the following question:

- Does spiral review increase student achievement?

The researcher is attempting to figure out the impact of continuously reviewing material on students’ understanding and retention, particularly when taking end-of-year assessments.

This action research project will be conducted in an eighth-grade math classroom in a public middle school in rural Northwest Iowa. There are families of low, middle, and high socioeconomic status in the community. In the middle school, there are about 520 sixth, seventh, and eighth grade students, as well as 60 teachers, aides, and other support staff. 72.1% of the student population is white, 15.5% Hispanic, 4.7% Black/African American, 4.1% Multi-Racial, 2.7% Hawaiian/Pacific Islander, 0.8% Native American, and 0.2% Asian. 55.2% of the school population is male and 44.8% is female. 15.3% of students have an IEP, 7.4% of students are ELL, and 32.6% of students are of low socioeconomic status (Iowa Department of Education, 2023).
The participants in this action research consist of 57 eighth grade students across four different classes who will participate in the spiral review. There are 27 female students and 30 male students. 11 of these students are English Language Learners and 16 of these students have an IEP. All these students fall into either middle or low socioeconomic status.

The independent variable in the study is spiral review bell ringers covering a wide variety of math concepts throughout the entire school year. The dependent variables are increased student scores and confidence/preparedness for end of year standardized and summative tests. The intervention consists of students completing spiral review bell ringers at the beginning of the class period each day to review previously learned material. The students work through the questions on their own, then engage in a guided classroom discussion and exploration.

The researcher-made assessment tools used in the quantitative study, including the pre-test, post-test, and three formative assessments, will have five questions. The questions will be created using content from the Common Core State Standards and the ISASP Mathematics Blueprint, which includes the domain and depth of knowledge (DOK) level of questions on the ISASP test. The researcher will also collect and analyze data from the aMath fall and winter screeners, as well as the Iowa Algebra Readiness Assessment (IARA) taken in the spring. The students will take the Iowa Statewide Assessment of Student Progress (ISASP) standardized test during March and the aMath spring screener in May, which will also be recorded when the scores are received for future research. The following is information on the reliability and validity of the aMath test: “Criterion validity coefficients were consistently above 0.80 and diagnostic accuracy was above .85” (Nowak, 2023). The following is information on the reliability and validity of the ISASP test: “In numerical value, the reliability coefficient is between 0.00 and 1.00; for standardized assessments it is generally between .60 and .95” (Welch
& Dunbar, 2022). According to the table in this article, the reliability index for the seventh-grade math test in 2019 was 0.88 and the reliability index for the eighth-grade math test in 2019 was 0.90. The reliability and validity of the IARA is comparable to the ISASP.

The study will begin in January 2024 and data will be collected through March of 2024, lasting ten weeks. The researcher will collect data from a pre-test at the beginning of the study and post-test at the end of the study, which will serve as the primary data. The researcher will also collect data from three formative assessments throughout the study. All of the data will be recorded on a digital spreadsheet, accessed only by the researcher. The data will only be shared for educational purposes, if necessary. A dependent samples t-test will be conducted to analyze the data and look for the difference in scores from the pre-test to the post-test. The researcher will also look for the growth rate when analyzing the data. Mean assessment scores will be calculated from before and after the intervention, as well as the standard deviation to determine the differences across all student scores.

An application for exemption for this action research was approved and permission to conduct the study was granted by the Northwestern College Institutional Review Board in Orange City, Iowa. This research involves normal educational practices by analyzing data from required assessments. The research and intervention will be the same for all students and all students will be treated fairly. Students’ opportunity to learn will not be adversely impacted. The researcher recognizes the importance of maintaining the confidentiality of data collected, ensuring the safety of the participants, and accurately interpreting and presenting the data collected.

**Data Collection**
For this action research, the data collected was quantitative. The data includes baseline pre-test scores and ending post-test scores. The pre- and post-test scores were collected from a five-question formative assessment created by the researcher with a variety of math problems consisting of material from the Common Core State Standards and the ISASP Mathematics Blueprint, which includes the domain and depth of knowledge (DOK) level of questions on the ISASP test. Before the intervention, the researcher used the pre-test to identify the areas of math the students excelled in (80% of students answered the question correctly), as well as the areas in math the students needed to make growth (less than 80% of the students answered the question correctly).

During the intervention, the researcher provided two to three spiral review bell ringer questions (see Appendix A) the students answered as they came into the classroom and began math class each day. These questions were driven by the areas of growth determined before the intervention. Some concepts of math found in the bell ringers included the Pythagorean Theorem, rational numbers, angle congruency, two-way tables, scatter plots, scientific notation, powers and exponents, and rational equations. The students recorded their answers on a weekly bell ringer sheet that was collected for observation, as well as a grade in the gradebook, at the end of each week. The researcher felt this was the most appropriate method of students recording their answers to hold students accountable and help them become more responsible. This is supported by Tyner and Petrilli (2018), who said, “Another approach – one that we believe is more realistic – is to hold students themselves accountable for their performance by ensuring that their work is tied to real consequences. This approach is based in research and used throughout much of the world. By giving students a greater and more immediate stake in their schoolwork
and their learning, such student-accountability policies could bridge the gap between effort and reward” (pg. 28).

Throughout the intervention, three formative assessments, consisting of five questions each (see Appendix B), were given to identify progress being made towards the areas of growth previously identified. These questions also consisted of a variety of math problems made up of material from the Common Core State Standards and the ISASP Mathematics Blueprint. The questions were presented in a similar format to the spiral review bell ringer questions the students had been experiencing daily. The researcher’s goal was for 80% of the students to score 80% or higher on each of these formative assessments.

At the end of the ten-week intervention, the researcher used the same five questions as a post-test that were used at the beginning as the pre-test. The researcher recorded the data and compared it to the scores of the pre-test. The data provided insight on the impact the intervention had on maintaining the knowledge of material students had already excelled in before the intervention. The data also gave the researcher a look into the students’ growth on material needing improvement the researcher had determined previously. By using questions from the Common Core State Standards and the ISASP Mathematics Blueprint, the researcher felt the students were well prepared to take the ISASP math test shortly after the research ended.

**Data Analysis**

There were 57 students who completed the pre-test and post-test. Of these students, 49 improved their score from the pre-test to the post-test, 6 students received the same score on both the pre-test and the post-test, and 2 students scored less on the post-test than the pre-test. On the pre-test, 18 students received a score of 0, 19 students received a score of 1, 9 students received a score of 2, 8 students received a score of 3, 3 students received a score of 4, and 0 students
received a score of 5. On the post-test, 2 students received a score of 0, 4 students received a score of 1, 3 students received a score of 2, 7 students received a score of 3, 15 students received a score of 4, and 26 students received a score of 5. Figure 1 (below) displays the frequency of the data. The range of the pre-test was 4 and the range of the post-test was 5.

**Figure 1**

*Frequency of Student Scores*

![Frequency of Student Scores](image)

Figure 2 (below) displays the baseline and ending mean scores, as well as the pre- and post-test standard deviation. The mean baseline score was 1.28 questions correct out of 5. The mean ending score was 3.88 questions correct out of 5. The pre-test standard deviation was 1.21. The post-test standard deviation was 1.42. This means that the data was not spread out very far and is close to the mean.
Figure 2

*Participant Baseline and Ending Score Means and Standard Deviations*

<table>
<thead>
<tr>
<th>Pre-Test Mean:</th>
<th>Post-Test Mean:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.280701754</td>
<td>3.877192982</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-Test Standard Deviation:</th>
<th>Post-Test Standard Deviation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.20644676 (M = 1.28, SD = 1.21)</td>
<td>1.415099384 (M = 3.88, SD = 1.42)</td>
</tr>
</tbody>
</table>

Figure 3 (below) also displays the baseline and ending mean scores. The mean baseline score was 1.28 questions correct out of 5. The mean ending score was 3.88 questions correct out of 5. This is a 2.6-point increase of the mean from the pre-test to the post-test.

Figure 3

*Participant Baseline and Ending Score Means*
A dependent samples t-test was conducted to determine whether there was a significant change in students’ understanding of eighth grade math content following the spiral review intervention. Figure 4 (below) displays the results of the dependent samples t-test. A baseline assessment revealed students were able to accurately solve an average of 1.28 of 5 (M = 1.28, SD = 1.21) eighth grade level math problems. Students participated in a ten-week intervention where they engaged in spiral review bell ringers, followed by a second assessment of the math problems. Students were able to accurately solve an average of 3.88 of 5 (M = 3.88, SD = 1.42) eighth grade level math problems. Results of the dependent samples two-tailed t-test reveal a significant difference between the baseline and final assessment, t(56) = -11.07, p < 0.001. The intervention of spiral review bell ringers increased students’ understanding of eighth grade math content.

**Figure 4**

*Dependent Sample T-Test*

<table>
<thead>
<tr>
<th></th>
<th>Variable 1</th>
<th>Variable 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.280701754</td>
<td>3.877192982</td>
</tr>
<tr>
<td>Variance</td>
<td>1.455513784</td>
<td>2.002506266</td>
</tr>
<tr>
<td>Observations</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>0.093769784</td>
<td></td>
</tr>
<tr>
<td>Hypothesized Mean Difference</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>df</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>t Stat</td>
<td>-11.06645624</td>
<td></td>
</tr>
<tr>
<td>P(T&lt;=t) one-tail</td>
<td>5.11642E-16</td>
<td></td>
</tr>
<tr>
<td>t Critical one-tail</td>
<td>1.672522303</td>
<td></td>
</tr>
<tr>
<td>P(T&lt;=t) two-tail</td>
<td>0.0000000000000010</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>t Critical two-tail</td>
<td>2.003240719</td>
<td>Difference is significant.</td>
</tr>
</tbody>
</table>

\[ t(56) = -11.07, \ p < 0.001 \]
On the spreadsheet, the researcher included secondary data that was not the main focus of the study but helped analyze students’ progress towards mastering eighth grade math content. When the students took the aMath screener in the fall and again in the winter, 29 students improved their score, 5 students received the same score, and 21 students lowered their score. There were 6 students who did not take both tests due to moving in or moving out of the district. The students also took the Iowa Algebra Readiness Assessment (IARA) which was included as secondary data on the spreadsheet. Out of the 60 questions, 22 students answered 30 or less questions correctly, 16 students answered between 31 and 40 questions correctly, 14 students answered between 41 and 50 questions correctly, and 3 students answered between 51 and 60 questions correctly. There were 2 students who did not take the IARA due to chronic illnesses.

Also included on the spreadsheet was the secondary data from the three formative assessments. On the first formative assessment which consisted of 5 questions, 51 students answered 3 or less questions correctly and 6 students answered 4 or 5 questions correctly. On the second formative assessment which consisted of 5 questions, 42 students answered 3 or less questions correctly and 15 students answered 4 or 5 questions correctly. On the third formative assessment which consisted of 5 questions, 39 students answered 3 or less questions correctly and 18 students answered 4 or 5 questions correctly.

In conclusion, the data showed improvement from the pre-test to the post-test, proving that the intervention was effective. The average mean score jumped over 2.5 points, which is significant. The data from the formative assessments given throughout the intervention also proved the intervention was effective. The aMath screeners and IARA data displayed a collective increase in scores, as well. Overall, each of these assessments showed the students were making growth towards mastering eighth grade content.
Discussion

Summary of Major Findings

The action study results prove that an intervention consisting of spiral review bell ringers is successful in increasing student achievement. Students were able to make significant progress towards mastering eighth grade content and as a result, were more prepared to take end-of-year summative assessments. This study states that 86% of the participants made growth in the questions answered correctly from the pre-test to the post-test. The reasoning behind this is the concept of spiral review, meaning students frequently revisited math concepts at a deeper level. Orbe, Espinosa, and Datukan say, “Spiral progression approach is when the scope and sequence of the content are developed such that concepts and skills are revisited at each grade level and with increasing depth” (Orbe et al., 2018, p. 19).

Impact on Teaching and Learning

The impact this has on teaching and learning is profound. Throughout the entire school year, teachers should be continuously bringing back previously learned material. Teachers must be intentional about spiraling material students learned in previous years, as well as material the students have already learned during the current year. Degorio says that skills are introduced when children are young, around first grade, and then “rediscovered” each year in more depth as the students grow older. He considers this a “ladderized” approach so each year the “learning is extended, reinforced, and broadened each time a concept is revisited” (Degorio, 2022, p. 98). Spiral review only requires five to ten minutes of class time and can be in the form of bell ringers, exit tickets and/or formative assessments. The students will have frequent exposure to previously learned material which helps strengthen their understanding of the content. This
impacts student learning by providing the students with multiple opportunities to be successful and master the content.

**Reflection of Published Literature**

The findings of the study did reflect other published literature. Students were more engaged and were active participants in their learning because their prior knowledge was activated. This observation was consistent with Degorio (2022), who examined the effectiveness of a spiral curriculum and found that “the new curriculum encourages participation among students” (Degorio, 2022, p. 105). In addition, Amarilla (2019) had mentioned in his study that students were more motivated to participate in the math spiral curriculum because they were engaging in problem-solving, real-life activities in the classroom. Finally, Orbe, Espinosa, and Datukan (2018) had described the spiral curriculum as learner-centered, which was consistent with the results of the study, as well.

**Limitations of the Study**

There were three limitations of the study which included time, participant attendance, and access to data. The study was conducted over only ten weeks due to the short amount of time between the holiday break and the week the ISASP test was given. The ideal amount of time would be approximately 16 to 32 weeks to allow for adequate intervention. In addition to a lack of time, participant attendance was a limitation as many of the participants were absent several days throughout the study. These students either had to make up the assessments or did not complete the assessments at all. Finally, access to the data was a limitation because due to the deadline of the action research project, the ISASP data will not be available to include in the project. This is due to receiving the results towards the end of the school year.

**Future Research**
The next step will be to implement this action research into other middle school math classrooms. Teachers will be presented with the findings and analysis of the results to encourage the use of spiral review, particularly in the form of bell ringers, as intervention with the students in their middle school math classrooms. Teachers will participate in professional development to identify the key concepts that need to be included in the spiral review throughout the year. Then, teachers will be given time to create materials to use for their daily spiral review. When Antipolo and Rogayan (2021) conducted their study, they also mentioned the importance of instructing teachers about the components of spiral review and how to implement it with fidelity: “An orientation on spiral progression approach of the K12 science curriculum may be conducted to make science preservice teachers be aware of the curriculum policies, standards, and guidelines” (p. 7).

Based on the findings of the action research project, the researcher would like to conduct future research on the implementation of spiral review bell ringers throughout all the middle school. The researcher would also like to conduct action research on implementing a spiral curriculum into the middle school math classrooms, with the potential of expanding the research to include elementary and high school math classrooms, as well. This has the potential to create a strengthened vertical alignment and make the transition from one grade level to the next smoother for students. De Ramos-Samala (2018) mentioned vertical alignment in his study and found that “spiral progression approach in science through vertical articulation provides better understanding and deepens the learning capacity of the students” (p. 566). The researcher would also like to repeat the action research from this project, but instead of only ten weeks, collecting data and providing intervention throughout the entire school year. The researcher could also
include data from all middle school students in the repeat of the action research project, instead of just a portion of the students of one grade level.

Research that could be conducted by other researchers includes implementing spiral review in all content areas of the middle school. The research could be expanded to include elementary and high school classrooms, as well. In his study, Amarilla (2019) agreed that “similar studies over extended periods and broader coverage, such as at the district or division levels should be conducted” (p. 8). The findings from this study could contribute to more collaboration and implementation of professional learning communities throughout each of the school buildings. As a result, there would be more continuity and flow among grade levels and content areas.

**Conclusion**

Throughout the school year, a variety of topics are covered in the classroom. The problem is students are not retaining and recalling information learned prior in the year during the summative exams at the end of the year. Spiral review is a way to strengthen students’ understanding of the content, as well as increase confidence with successful repetitions. Common themes of a spiral review include frequently revisiting topics with increased complexity, more depth in the curriculum, connecting new learning to previous learning, and student competence increased until goals and objectives were achieved (Harden & Stamper, 1999, p. 141). The most common negative aspect of a spiral curriculum is a superficial understanding and lack of mastery of the concepts. However, there are also numerous positive aspects including a focus centered on the learners, a presence of higher-level objectives, and an increased ability to understand new material. A spiral curriculum greatly impacts student learning because it improves understanding and retention, provides a more engaging learning
SPIRAL REVIEW IN MATHEMATICS

environment, incorporates other content areas, prepares students for real-life situations, encourages problem-solving and higher-order questioning, activates prior knowledge, and increases student motivation.

The purpose of this action research project was to identify the impact daily spiral review bell ringers has on student achievement, including students’ assessment scores. After a pre-test was given, a ten-week intervention was conducted, followed by a post-test. The quantitative data collected proved that an intervention of spiral review bell ringers was successful in increasing student achievement. 86% of the participants showed growth in the questions answered correctly from the pre-test to the post-test. Going forward, the researcher plans to incorporate more spiral review throughout the school year, in the form of bell ringers, exit tickets, and other formative assessments. These will include material covered in previous grade levels, as well as material covered in the current grade level. The students will have a better understanding of the content and will be more prepared for end-of-year assessments. In his study, De Ramos-Samala (2018) confirmed the findings from this study when he said, “Review is essential in order to gain mastery of the subject matter” (p. 566).
References


https://www.researchgate.net/publication/363566254_How_spiral_is_the_spiral_progression_in_mathematics


https://www.researchgate.net/publication/365486911_Teaching_and_Assessment_Practices_in_Mathematics_in_the_Spiral_Progression_of_the_K_to_12_Curriculum


KnE Social Sciences, 3(6), 555–555. https://doi.org/10.18502/kss.v3i6.2404

Kappan, 95(7), 41–41.


Harden, R. M., & Stamper, N. (1999). What is a spiral curriculum? Medical Teacher, 21(2), 141-
143. https://doi.org/10.1080/01421599979752

e=SGP&k=12571&y=2021

and the Network Models. Research Matters, 7-12.


outcomes between spiral methods and lecture methods set material. Indo-MathEdu
Intellectuals Journal, 3(1), 39–50. https://doi.org/10.54373/imeij.v3i1.36

Curriculum: Implications For The Educational Effectiveness Of Online Master Degree
Nowak, P. (2023). Are the FastBridge aMath and aReading assessments based on the Common Core standards or state standards? FastBridge by Renaissance.
https://fastbridge.illuminateed.com/hc/en-us/articles/1260802309110-Are-the-FastBridge-aMath-and-aReading-assessments-based-on-Common-Core-Standards-or-State-standards-
#:~:text=aMath%20has%20robust%20criterion%20validity,with%2080%20to%2085%25%20accuracy.


Appendix A

Examples of Spiral Review Bell Ringer Questions

#1: Which of the following equations is represented by the number line?

A.) \(-3 + 6 = 3\)  
B.) \(5 - 8 = -3\)  
C.) \(0 + (-3) = -3\)  
D.) \(3 + (-6) = -3\)

#2: The perimeter of the triangle below is \(8m + 7\), determine the unknown side of the triangle.

#1: Billy has 4 red pencils out of 5 pencils. 85% of Brian’s pencils are red. Who has more pencils?

#2: Evaluate each expression if \(y = -7\) and \(w = 2\).

\[y + w\]  
\[w - y\]

#3: Find the volume:
Appendix B

Examples of Spiral Review Formative Assessment Questions

The value of $\sqrt{8}$ is between which two consecutive integers?

- A. 2 and 3
- B. 4 and 5
- C. 16 and 17
- D. 64 and 65

The four parts of a function, $f(x)$, are labeled.

Which of the four parts of the function has a constant rate of increase?

- A. W
- B. X
- C. Y
- D. Z
The area of the base of the cylinder shown below is $64\pi$ square inches. The height of the cylinder is 2 inches. What is the volume of the cylinder, in cubic inches?

○ A. $32\pi$
○ B. $128\pi$
○ C. $4,096\pi$
○ D. $8,192\pi$

What is the value of $x$ in the equation below?

$$x^3 = 21$$

○ A. $\frac{1}{7}$
○ B. 7
○ C. $\sqrt{21}$
○ D. $\sqrt[3]{21}$

Which graph shows the strongest linear association?

○ A. [Graph A]
○ B. [Graph B]
○ C. [Graph C]
○ D. [Graph D]