



Perspectives of direct instruction using more rigorous mathematics standards

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Abstract

Majestic County Schools (a pseudonym), a large southeastern school district, has implemented changes in instruction to align with more rigorous state and national mathematics standards. The rigor of the new standards has led to changes in instruction to help students master the standards with evidence from the state-wide standardized test. Although the district has made curricular changes, over one-third of the students in Grades 3-5 at Flint Elementary (a pseudonym) are not mastering grade-level standards. This basic qualitative study focuses on one elementary school within the district. The purpose is to understand how teachers implement direct instruction (DI) strategies in the classroom to help students master grade level standards. The study is designed to address the research question by explaining how five upper elementary teachers use DI strategies to teach mathematics at Flint Elementary. The theoretical framework for this study is based on Zig Engelmann's theory of direct instruction. The basic qualitative research design was used to collect rich descriptive details through semiformal interviews. Purposeful sampling ensured that upper elementary mathematics teachers whose instruction prepares students for standardized testing were invited. Inductive analysis was used to code the interview data and to develop themes. The results showed inconsistent use of DI and a need for professional development. The professional development project was designed to help teachers implement the DI curriculum. The implications for positive social change due to this study include opening the minds of stakeholders on ways to improve DI in mathematics and changes in the way DI is used in mathematics by ensuring that the principles of DI are included in lesson planning and school improvement.

Keywords: Direct instruction, curriculum, mathematics, elementary instruction, lesson planning

1. Introduction

The more rigorous national and state mathematics standards like common core have prompted the need for changes in mathematics instruction. Now, mathematics instruction must focus on procedural and conceptual understanding of the standards through using critical and higher order thinking skills to align with the new standards (Georgia Department of Education [GaDOE], 2015) ^[7]. This requirement has led to a gap between instruction and the expectations with more rigorous mathematics standards in many school districts (Bertelsen *et al.*, 2015) ^[1]. The long tradition of solving problems through using rote memorization and applying a specific algorithm is not enough for students to master these standards (GaDOE, 2018). Like school districts across the country, the leaders in Majestic County have explored ways for teachers to adapt to the mathematics standards and improve instruction. A new curriculum that aligned with the new standards and promoted procedural and conceptual understanding was necessary for the school district (School Improvement Plan, 2018) ^[12].

The leaders of the Majestic County School District recognized that designing the mathematics curriculum and instruction to help students master grade-level standards in the early grades leads to a better probability of mastery on standardized tests (School Improvement Plan, 2018) ^[12]. Since students are expected to use mathematical knowledge to help them analyze, reason, represent, and explain their answers in solving problems, providing a curriculum and resources compatible with the expectations for instruction in the Majestic County School District is crucial (School Improvement Plan, 2018) ^[12].

The district-level changes to support teachers in instruction included adopting and implementing Eureka Math and Go Math which are curricular resources based on direct instruction (DI) (School Improvement Plan, 2018) ^[12].

Although the Majestic County School District has implemented resources to address the gaps in instruction and learning, standardized test scores show that at least one-third of the students in Grades 3-5 are not at a level of proficiency of grade-level mathematics standards while using the direct instruction curriculum. The proficiency level of achievement is used by educators to determine whether students are performing on grade-level and have mastered the grade-level standards taught during the school year. According to the state department of education, proficient learners demonstrate the knowledge and skills necessary to master grade-level standards specified in Georgia Standards of Excellence; the students are prepared for the next grade level or course and are on track for college and career readiness (GaDOE, 2018). When students are not proficient in grade-level standards, this implies that students are not equipped with all the required skills needed to be successful at the next grade level.

2. Purpose

The purpose of this basic qualitative study is to explore the strategies teachers use and teachers' perspectives of DI in mathematics. Through teacher interviews, the effective and ineffective aspects of DI would be revealed to stakeholders within the district. Understanding DI instruction from the teachers' perspective and using that information to make changes that promote student proficiency in mathematics is important. Furthermore, an in-depth look at daily mathematics instruction, could enlighten stakeholders by providing detailed accounts of teachers' experiences with DI. Mathematics performance in elementary grades has been a consistent concern shown throughout professional literature. Furthermore, with the advances in technology and the effects of the No Child Left Behind (NCLB) Act recently renamed Every Student Succeeds Act (ESSA), mathematics has been considered a serious area of concern for K-12 education. These concerns are validated when comparing the increased rigor of the new standards with the previous standards which failed to promote critical and higher-level thinking (Conley, 2014) ^[4].

The transition of the standards to daily mathematics instruction has presented a challenge for teachers as they design instruction to meet the rigor of the standards and the needs of the students. Considering that the new mathematics standards are completely different from the previous standards, there is great emphasis on teacher instruction in correlation to student success (Chestnut & Swars, 2016) ^[3]. Consequently, the connections that teachers make between the language of standards and designing instruction are crucial to the success of the students (Taton, 2015) ^[13]. The biggest challenge with translating the language of the standards into instruction is the tendency for teachers to take a traditional approach to mathematics (Kent, 2014) ^[8]. Teachers must be willing to take risks in instruction and be open to new innovative ideas for students to be successful in mastering these standards (Orange, 2014) ^[10].

The following guiding research question for this qualitative study are designed to gain a better understanding of DI at Flint Elementary.

RQ 1: How do elementary teachers use direct instructional strategies to teach mathematics?

3. Materials and Methods

A basic qualitative study was the most appropriate research design for the study of elementary teachers' perspectives of direct instruction with the implementation of more rigorous standards. In this study, teachers' perspectives of direct instruction were explored through open-ended, semi-structured interviews. Data from interviews were explored to develop a deeper understanding of how teachers use direct instructional strategies in the classroom. A basic qualitative study was the most effective choice to answer the research question of how teachers' use DI instructional strategies.

3.1 Participant Sampling

The purposeful sampling strategy was appropriate in this study because exploring DI in mathematics would require specific teachers to share their direct instructional strategies and their perspectives of DI. These specific participants were upper elementary mathematics teachers with students required to take the Georgia Milestone state assessment.

The sample size in this study was five of the possible eight upper elementary mathematics teachers at Flint Elementary. The sample size for this basic qualitative study was conducive to developing themes and conducting inductive analysis. Furthermore, the sample could provide data to address the research question through providing insight for DI.

3.2 Data Collection

To capture the perspectives of the teachers concerning direct instructional strategies and their perspectives of DI in mathematics, one-on-one interviews were conducted. Interviews were the method by which rich data on DI in mathematics were gathered to address the research question. The data collection instrument was a questionnaire. The protocol was aligned with the DI research question and based on related literature and the DI framework. This ensured that the appropriate questions were addressed during the interviews to answer the research question (Creswell, 2012) ^[5]. The data from the interviews were a direct account of the participants' perspective of DI strategies and DI in mathematics. Electronic reflexive journal were kept to document the learning from the data collection tool as each interview was completed.

The data collection process included interviewing the participants using Zoom and email. Zoom and email were appropriate means to interview participants due social distancing during the COVID-19 pandemic. An interview protocol was used for the Zoom interviews, which were recorded with password protection. The interview time frame was limited to a period of one month. After the participant responded to the questions from the interview protocol, participants were asked if there were any additional comments about DI of mathematics. To address reliability and validity member checking was used. The participants were asked to check the findings for accuracy of their data. The participants did not find inaccuracies in their data. There were no discrepant cases.

Clarifying researcher biases was also a part of the data analysis process. During the data collection process, open ended questions were asked during the interview.

The participants expressed their perspectives without any imposed viewpoints. By collecting the data and objectively interpreting the data and literature, personal biases can be eliminated, and true perspectives will be the result of the research (Bogdan & Biklen, 2007) ^[2]. The participants concluded that the findings were accurate, and no changes were made. MAXQDA, a computer program, was used as a tool to organize and store the data.

3.3 Data Analysis

After the data collection process was complete, inductive data analysis began. In this basic qualitative research study, inductive data analysis was used for analyzing the data (Creswell & Poth, 2016) ^[6]. Inductive analysis was the best method to analyze the data. In inductive analysis, researchers use intuitive understandings derived from experience in a particular field. The data collected from observations, interviews, or documents are used to take personal accounts and generalize them. The process began with reading the data multiple times to become familiar with them (Creswell & Poth, 2016) ^[6]. Open coding was used to start coding the data. During the open coding process, codes were created based on the interview data. The codes were used to create categories, then the categories were used to create themes to answer the research questions (Creswell & Poth, 2016) ^[6].

The next phase of the data analysis consisted of descriptions, classifications, and interpretation of the data (Creswell & Poth, 2016) ^[6]. Interview notes were reviewed, and open codes were assigned to the raw data. The open codes were applied to the data and were used to group similar words, phrases, and/or concepts, giving each group a label that give the group meaning. Once open codes were completed, similar codes were categorized, and themes were developed. The themes emerged as similar open codes were categorized and determined what they meant. Computer files were created to organize the interview data into the appropriate categories this process included renaming categories as the analysis continued or deleting categories that were not substantiated by the data (Merriam, 2009).

The MAXQDA computer program was used to assist in organizing the interview data. MAXQDA is a qualitative data analysis software developed in 1989. The interview data was entered in the computer program and the computer program was used to organize the codes and themes.

4. Results

Zig Engelmann's Theory of Direct Instruction and the research questions were used to guide the study. They were the basis of the interviews on teacher perspectives of DI and how DI strategies are implemented in the classroom. Engelmann stated that DI can improve academic performance as well as certain affective behaviours (Polly, 2017) ^[11].

RQ1: *How do elementary teachers use direct instructional strategies to teach mathematics?*

Theme 1: Instructional Knowledge

Direct Instruction is intended to keep students focused on the increased learning. The interview findings show a variety of instructional strategies used to teach students. The participants used a progressive format that teaches foundational concepts first, then builds upon them. The participants described their instructional strategies and gave examples of how they are used in daily instruction. The

participants expressed time management was also found to be an issue in completing instructional goals and for students who struggle to reach their learning targets. The participants use guided practice, independent practice, and formative assessments as instructional strategies.

Theme 2: Clear Communication

All participants expressed that clear communication during mathematics instruction is critical to ensuring that students are successful. Correcting a mistake later is considerably more difficult than clear instruction and guided practice with teacher feedback. Instruction with clear communication that will not be contradicted helps students grasp mathematical concepts better. For example, if a teacher simply shows a picture of a square when teaching about quadrilaterals, students may incorrectly assume that only squares are quadrilaterals. Pictures of various quadrilaterals, such as a trapezoid, a rectangle, or a rhombus, as well as non-quadrilaterals, such as a triangle, an octagon, or a pentagon, would help students learn better through displaying examples of what is and is not a quadrilateral.

Clear communication through modeling

All participants stated that they used the district-wide curriculum, Into Math, for whole group instruction and modeling. Each participant also expressed the need to model abstract concepts using mathematics manipulatives. Although Participant A used the district-wide mathematics curriculum, the use of several other resources in addition to the curriculum was acknowledged. Teacher and student created Flipgrids and Khan Academy videos were also used in addition to the curriculum.

The participants stated that effective DI is dependent upon effective modeling. The participants were asked: *How do you model or provide examples for students during direct Mathematics instruction?* Modeling was viewed as an essential part of DI.

The participants expressed that modeling helps students move from dependence to a stage of independence. When modeling is effective, the students are prepared and willing to work on their own. Participant B uses the interactive lessons provided by *Into Math* and models using the strategies provided within the curriculum.

Participant D acknowledged that modeling is crucial to student success. Students cannot learn effectively without the use of modeling to lead them.

Teacher understandings and misconceptions

The interview data also revealed teacher understanding and some misconceptions about DI. DI does follow routine and is structured but there are misconceptions concerning limited creativity and small group or one on one instruction. Clear communication about DI principles and strategies could bring clarity as teachers are implementing the district-wide DI curriculum.

Theme 3: Mastery of Grade-Level Standards

The participants expressed that to master new standards, DI lessons should begin with what students already know and then expand on it with logical sequences. To master a concept, students must be given the opportunity for repetition and correction to ensure learning is sequential and concepts are reviewed until familiar and internalized. The DI model incorporates teaching to mastery in this manner, and students

gain confidence in their abilities as they grow.

Formative Assessments

The participants used formative assessments as another method of helping students master grade level standards. Formative assessments were used in a variety of ways by the participants. Participant A uses a thumbs up or thumbs down approach to assess understanding throughout a DI lesson and a ticket out the door as a daily lesson assessment which was used to form small groups for upcoming instruction. Participant B, D, and E also use tickets out the door for formative assessments after adequate modeling and guided practice.

Student Confidence

Student confidence was viewed as important to mastery of grade level standards. Since upper elementary students are administered a state standardized test, teachers must address student confidence as it relates to direct mathematics instruction. When the participants were asked, *how do you help students improve academically and improve their self-image as well?*

To promote the desired learning outcomes, the participants thought it was necessary to emphasize the positive and do so precisely. A teacher uses Direct Instruction to provide numerous possibilities for praise because of its inherent rapid pace and repetition, which allow for many correct replies. Additionally, teachers must project genuine motivation and encouragement to convey the value of education and their faith in their students' capacity to master the topic. This fosters not just an internal need for knowledge in students, but also a sense of self-worth, both of which benefit students in the future. These beneficial effects on students are rewards for both students and teachers, who see real-time results and tangible student improvement in their classrooms.

Participant B believes taking concepts one little chunk at a time and making the goal smaller helps students feel confident. It is also necessary to celebrate the small successes. This helps them improve academically and helps their self-image. Participant C focused on relationships to build student confidence. Relationships are very important. If you build a relationship with each of your students, they will want to learn from you. The teacher-student relationship goes together with student confidence. Bringing enthusiasm and positive thinking into the classroom makes students will want to succeed. It also makes students happy to be at school. Participant D stated that students will rise to the expectations that you have for them. These students are told that they are mathematicians and are made to feel important. Praise and affirmation are important to use so students don't give up when problems are more challenging. Participant E acknowledged that students fear mathematics because they are not confident in their abilities. Setting goals that students can achieve helps them to succeed and want to keep trying. Teachers must have patience and use creative ways to keep students enthusiastic.

Theme 4: Small Group/One-on-One Instruction.

The participants used small group or one on one instruction for remediation and to help struggling learners. All student learning must be addressed through DI. To make sure all students are learning, all participants utilized the WIN (What I Need) block of time to offer differentiated instruction to students. During this time, the needs of all students are

addressed whether the need be remediation, independent practice, or acceleration. Participant B stated that the problems that students complete on their own after whole group instruction are used the gage student understanding. If there are students struggling on their own, those students are pulled into small group instruction while the remaining students complete the independent practice. Participants C, D, and E used small group instruction, but also stated that one-on-one instruction is needed as interventions for some students.

5. Conclusion

This basic qualitative research was conducted with five upper elementary teachers but, it has the possibility for further research. A clear understanding of DI using the principles upon it which it was founded is important learning for all teachers. Although this professional learning project was specifically designed for upper elementary grades, it has the capacity to be used for all elementary mathematics teachers. This study explored the instructional strategies of DI for five upper elementary teachers since the implementation of more rigorous mathematics standards at Flint Elementary. Future research could explore the perspectives of other elementary teachers since the implementation of more rigorous mathematics standards at Flint Elementary. This research included five elementary teachers but, future research could also include district-wide elementary mathematics teacher or even across the state of Georgia.

Supporting teachers and students as mathematics standards have become more rigorous has been a goal for many school districts. In support of teachers and students, the Majestic County school district sought a DI mathematics curriculum to meet those needs. DI is founded on five main principles and each phase involves a variety of research-based instructional strategies. Understanding the principles and phases of DI is crucial information for effective planning and implementing the district-wide curriculum.

Through one-on-one interviews in this qualitative study, it was found that teachers used district-wide curriculum in a variety of ways, but there was no consistent use of DI. In exploring teacher perspectives of DI, it was concluded that the understanding the foundational principles and phases would be worthwhile for planning and implementing research-based instructional strategies to meet the needs of students. Furthermore, meeting the needs of students results in an increase in student achievement on standardized assessments. The professional development project includes three days of professional development rooted in research-based knowledge on DI. The project also includes large group discussions, collaborative group activities, and collaborative lesson planning to promote academic achievement for all students. The research was designed to be a support to teachers and educational leaders as they continue meet the diverse needs of students. As a result of this research, the hope is that the evidence-based strategies will be used by other educators seeking to meet the diverse needs of their students.

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