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MATHEMATICAL INTERVENTIONS THAT STRENGTHEN THE UNDERSTANDING
OF
THE PLACE VALUE CONCEPT FOR SPECIAL EDUCATION STUDENTS

A MASTER'S THESIS SUBMITTED TO THE FACULTY
OF BETHEL UNIVERSITY

BY

HALEY L. HOSKINS

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FOR THE DEGREE OF
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MATHEMATICAL INTERVENTIONS THAT STRENGTHEN THE UNDERSTANDING
OF
THE PLACE VALUE CONCEPT FOR SPECIAL EDUCATION STUDENTS

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ABSTRACT

Many students demonstrate difficulty with number sense, especially those of which struggle academically under a special education label. As a result, educators have the option to teach conceptual place value using a variety of methods which may be beneficial for these students. As students continue to learn these mathematical concepts such as multiplying multi digit numbers, research shows that there are multiple ways in which to teach students place value to a wide range of mathematical ability levels. The application of a variety of manipulatives can be used to help increase a student's understanding of number sense. This thesis will explore a variety of strategies that may benefit students who are learning conceptual place value.

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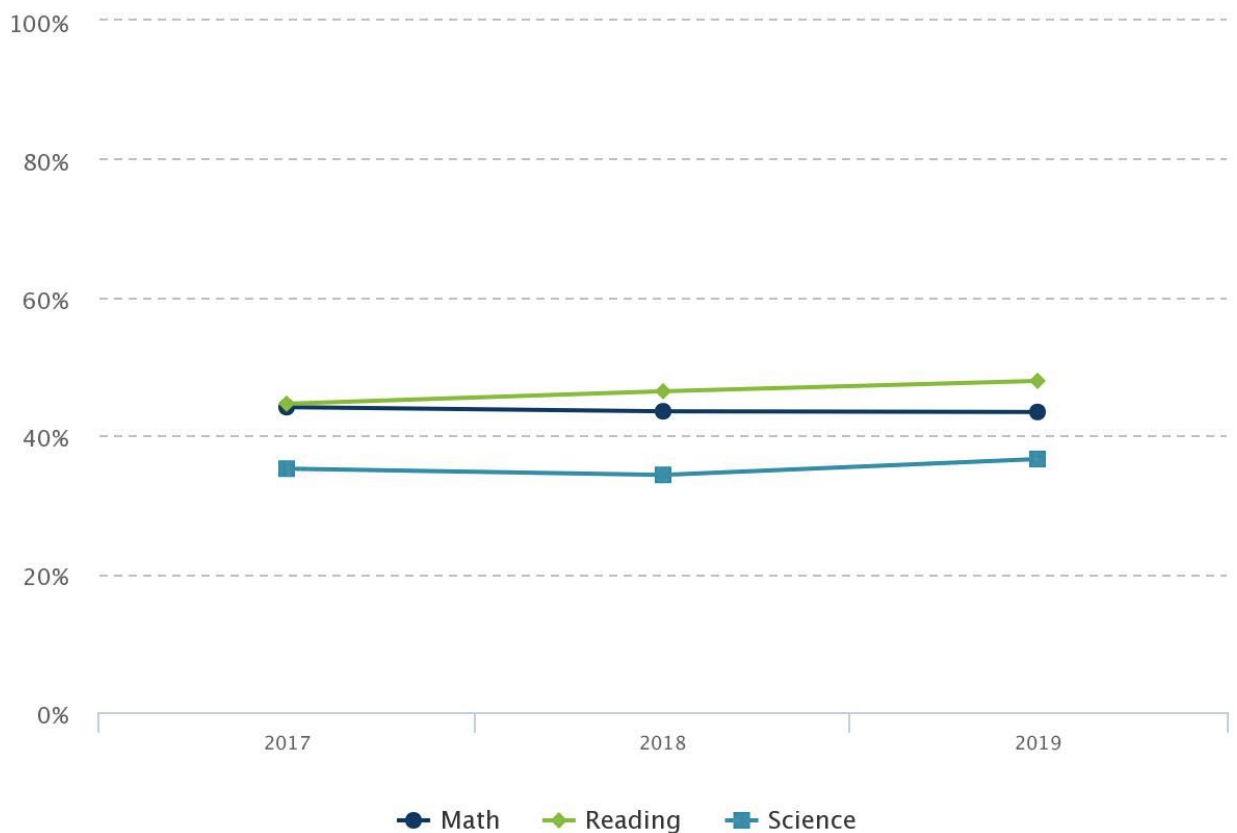
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CHAPTER I: INTRODUCTION

I.D.E.A.

Special Education is very important as we are giving students with disabilities a positive schooling experience, where they are able to either remain in the general education population or they have access to the general education curriculum. Individuals with Disabilities Education Act (I.D.E.A.) is the reason for this.

After looking at the results of the school district this thesis writer works for, it was interesting to see how many students are meeting grade level standards in Math, Science, and Reading. The results are shocking.



In math there is a slow decline of students meeting the standards. Also less than 50% of students, meet the grade level. This makes this writer wonder what the students are missing in

their mathematical skills. At the school this writer works at 91.7% (Minnesota Department of Education, 2017) of students are not meeting grade level standards in math! That is a significant number of students. This is why it is important to find an intervention to help these students begin to increase in their grade level standards.

Special education is extremely important to have as there are students who may not understand grade level material based on their disability in a general education classroom. However, given the appropriate accommodations, modifications and support, the student may begin to have success in the classroom. Some students will not be able to go to a general education classroom; however, they are given the opportunity and the work to learn these grade level standards.

In the school that this writer works at is all special education. When the staff began to see that students need less support, students are bussed to schools where they can have a least restrictive environment. At these schools, they are participating in general education classrooms. In this writer's classroom, we do a large portion of grade level work; however, we also provide many interventions to help students work towards their grade level(s).

What has been personally noticed is that students struggle mostly in the areas of reading, and math. Many of the students have a challenging time adding and subtracting in the 4th and 5th grades. This means they are not meeting grade level standards. This writer needed to find a way to help them gain skills to be able to do basic math, but also to help them keep improving in their grade level standards.

Without I.D.E.A. in place teachers may not have all the resources they need to teach their students. However, because of I.D.E.A. schools are able to help students meet grade level standards given all different kinds of support whether its extra manipulatives, 1-1 support, small

groups, different kinds of software etc. All of these supports can be put into a students Individualized Education Plans where teachers must legally follow them.

Therefore, this thesis will focus on the following questions.

Thesis Questions

- 1) What interventions are there for students to use to develop place value understanding?
- 2) Will these interventions help increase the students' understanding of other mathematical concepts in their grade level work?
- 3) And finally, will this intervention create more work for the teacher and student?

Vocabulary

Place Value Understanding- understanding the value of a number.

Manipulatives- an object to help a learner perceive a mathematical concept such as gaining number sense.

Digiblocks- are colored blocks that are different sizes. There are single digiblocks that are smaller in size that represent the number one, bigger digiblocks that can fit ten singles, which represents the number 10, and an even bigger digiblock that can fit the value 10, 10 times to make a 100 digiblock.

MD - Math Difficulties, these are students that are performing at or below the 35 percentile of students in their grade level.

CHAPTER II: Literature Review

Overview of the Research Process

A review of the literature was found primarily through EBSCOhost search engine using databases such as ERIC. Used searches such as conceptual place value, place value in middle school, mathematics and place value, special education and mathematics were key terms that were used. Other primary sources were used was the curriculum that was used by the researcher that came from three different books, a book given at a professional development conference that the researcher attended called Cognitively Guided Instruction (CGI) that also talked about the use of place value.

Focus of Research

The focus of this research will be on different conceptual place value assessments in mathematics that other researchers have discovered. Many researchers have expounded is that there is not a lot of research on this concept, they often times depend on how they interpret their interviews with the students. Throughout the research findings, the researchers found that how place value is taught and interpreted will differ between researchers. What the researcher will be writing about are different research projects that have been done, and if they believe that using some type of place value will increase the students mathematics. The researcher will try to be specific on what the research says. Further, similarities and differences in the research will be explored. Many of the researchers used some type of manipulatives when teaching about place value, to help the students gain the concept of numbers, such as 25 really means (two - ten values, five ones). Judy Hartnett (2018) stated, "Primary school teachers teach a number of subjects, and while they continue to learn and access professional development, it is not

surprising that they do not have an in depth understanding of the many concepts that underpin mathematical topics such as place value (p. 35).” A number of researchers believed that learning this concept, students will help increase their mathematical skills. However, how the researchers went about doing the research differed. Some research only lasted two weeks, some lasted a whole school year. Grade levels differed, the size of the groups differed as well. Interpreting how the students comprehend place value differs as well because some researchers used an assessments where either you are right or wrong, there is no gray area and went off of that data, others used how the students talked about numbers and decided if they believed they knew what place value was (a gray area), there was no definite answer.

Effectiveness of Strategies

Computational Estimation Procedures

Judith Threadgill-Sowder (1984) stated, “ In everyday situations involving numbers, estimation is often more useful than precise calculations (p. 332).” In this study Threadgill found that estimation is a skill that is often neglected, or taught in isolation. Therefore, kids and adults have trouble with estimating. What Threadgill did was have twenty-nine students that were in grades sixth through nine compute twelve different estimation problems without using a pencil. She found that students were more comfortable with direct computation than estimation. “...Students need to develop a quantitative intuition, a feel for quantities represented by numbers, before they can estimate well (Threadgill-Sowder, 1984, p. 335).” Threadgill believed that with formal instruction and practice of estimation students will begin to have a sense of numbers. The problem with this study is that they only assessed the students once, they were not teaching them anything new for an extended time. They were only seeing how the students number sense was, for one moment in time.

Opitz, et al., Study

In the study “Remediation for Students with Mathematics Difficulties an Intervention Study in Middle Schools”, the authors Opitz, et al., (2017) talked about how often times when secondary level students do not understand the basic arithmetic concepts, they are taught automaticity rather than the concepts they are missing. They found that “67% of the variance in mathematics achievement in grade 9 can be explained by basic quantity-number competencies, such as putting numbers up to 10,000 on the number line, comparing numbers and understanding mathematical conventions (p. 724).” They further indicated that most interventions for arithmetic concepts are taught in primary school. What these researchers did was test middle school students’ arithmetic concepts. The way they did this was by taking 123 students that were in 5th grade or 7th grade (special education), they had to be performing below-average in mathematics. They split the students into three different groups, they put 47 students into small group instruction where they met with an instructor for 90 minutes a week, IPC group where they partially independently worked. There were 36 students in this group where they would meet in a small group for 45 minutes a week, as well as 90 minutes of individualized work in the classroom. The remaining 40 students met in the controlled group where they received no intervention, though they did have some arithmetic concepts taught. The students were taught different concepts using different manipulatives, tasks and activities, they all had the same number lessons per week during regular class time.

The authors took data on three different times they had the students take an assessment. They had the students do a pre-test to show their knowledge before the intervention they were either given a test called the complete mathematics test (COM) or covered concepts (CC). They again were tested after the interventions were over, and then three months later using the test that

they were given previously. What the authors found was that both groups made progress in their mathematical concepts. They found that SGI group only shows significant differences from the control group on the CC test.. Therefore, the authors determined that they were better at “...fostering mathematics learning but only for subject matter covered in the intervention (p. 730).” They found that the IPC group were more effective than the control group in both tests. Therefore, they believed it is important to work on basic conceptual understanding even in middle school to help in their mathematical progress. As the IPC group scored higher than the control group in topics that weren’t even in the intervention.

Fraivillig Study

Fraivillig (2018) completed a study with the main purpose to determine whether pedagogical supports such as using manipulatives, would help the treatment school students increase their knowledge of multi-digit numbers and place value. The different manipulatives were things that the students could see visually such as *digiblocks*. The treatment school was using a consistent routine of counting the days in the school year. They were using place value cards, and tally marks to help count the days of the week. The researcher was attempting to find out if changes in how teachers demonstrate and discuss representations of quantity (such as using words and tally marks) made a difference. Fraivillig (2017) offered a question, “Do days in school counting routine improve children’s proficiency in identifying and applying base-ten number concepts (p. 24)?” What the researchers did was take 36 students from two different schools in the same urban district. They did a random selection and took four students from each grade level classroom. In the control school, they had 20 grade one students, and in the treatment school they had 16 grade one students. Due to unforeseen circumstances, these numbers changed as students left the district. To see whether a pedagogical support could help students understand

the concept of base-ten numbers, they used these concepts to count multi-digit numbers. The treatment school changed the way they counted the days in the school year by using the pedagogical supports. They used multi-digit blocks instead of straws to represent the number of days in the school year. They also used place value cards, and tallies. The researchers interviewed four students from each grade level one classroom, they showed them a number and asked them to use tiles to write the number, and then asked questions if they used a one digit for the ten-value place. They interviewed these students three different times to see if they were making progress. They interviewed them in the fall of grade level one, spring of grade level one and spring of grade level two. What the researchers found was that in the spring of grade one all students that the 1 in the number 16 was a place value of one. By the last interview the treatment classroom, 79% of the students understood the 1 is in the tens place rather than the ones place. In the control group 58% of the students believed the 1 was supposed to be in the tens place. The researchers found that the intervention they used will not disrupt the teachers practice or increase any math work they have to do with the students. The intervention can go along with a routine that the teacher has already established such as counting the days of the school year. Results revealed that the children improved place value understanding when using this practice. They believed that understanding place-value will help with other mathematical concepts such as multi-digit subtraction and addition as well as decimal place value understanding. The problem with this study is that the researchers weren't there every day to see if the teachers were implementing the intervention everyday, as well as if they were doing it correctly. The sample sizes were also uneven, and they were only able to interview four students from each class to eliminate distraction. Lastly, the sample size changed due to students leaving the district.

Bailey Study

In the article supporting lower-achieving seven and eight-year-old children with place value understanding written by Bailey (2015), it talked about how teachers would like students whom are achieving below level to still participate in normal mathematics with the other students. The teacher and researcher found that understanding of place value is important. Bailey stated, “since place value is so fundamental to developing deeper number sense, we hoped that an initial focus on this topic would enable the children to make progress with their learning in mathematics (p. 1).”

The teacher and researcher created curriculum for two weeks, to see how the children were best taking in the information. They used four different kinds of equipment to help with the lessons. They decided to use Slavonic abacus arranged in rows of ten, place value blocks (ones, tens and hundreds), numeral cards, and calculators. They decided the goal was for group A to count up to 100 and group B to count up to 1000 by using the concept of ten.

The way they separated the groups was based off of a mathematics achievement test, if the students were performing under expected levels they were grouped into group A (nine) students. If the students were performing at expected levels, they were grouped into group B (remaining students). All the students came from one class, where the teacher could teach them all the same way and see what materials would work, and what did not.

They went through multiple tasks, the first was using no materials and having the students count up to 110 by 10's. When all the students got to 100, they had a hard time figuring out what came next. Once given equipment to help further their understanding, they were able to figure out what came next. The students were then given blocks to help their understanding of tens, they were given a “long” block, the researchers found some of the students had difficulty

making the connection between a “long” ten and small ten blocks “ones”. They found that Group B showed that they understood how the number and the equipment being used correlated.

The next task, they had the students pick a decade number where they would draw a picture of the number they chose. They found that 4 out of 9 students showed correct representation. The following task was a calculator task where the students were asked to explore, the researchers found that there were students in group A that were able to predict the correct number that they couldn't do the day before. One of the students could only predict up to 40, the following day using the calculator she was able to predict up to 240. They found that some of the students in group A were able to make the connection that the same number in the tens column indicates how many groups of tens were in the number. They however stated not all students could make this connection. Two in particular were unable to relate the calculator and the other place value equipment together.

However, even though there were some students that could not make the connections. The researchers found that it takes time to teach place value, and you must give them the time. Choice of equipment matters as all students do not learn the same. They believe just because students appear to understand, doesn't mean they have a full/deep understanding of what place value actually is. They believe that using the calculators increased child involvement, and also helped the children develop mathematical understanding.

Explicit Mathematics

In the journal article, *Explicit Mathematics Instruction: What Teachers Can Do for Teaching Students With Mathematics Difficulties* (Doabler & Fien, 2013), they discussed how many students with math difficulties have a challenging time conceptualizing and understanding

procedures. The authors found that it is critical to understand place value to achieve a proficient level. When a student understands place value they are understanding the whole number, as well as the models that may go with the number such as base ten blocks. The authors talked about how a student that understands place value will see a base ten blocks and understand that it is 10 individual ones whereas a student with math difficulties will most likely see this block as the number 1. In the study they looked at how using explicit teaching would help students with math difficulties to understand place value, and to see if they would increase in their mathematical knowledge. In the study, they did an eight-week intervention of a kindergarten class that was randomly assigned intervention or control group. In the intervention groups, the students did 30 minutes of intervention 3 times a week. When given a standardized math assessment the students whom were in the intervention group showed higher gains than the control group.

When teaching explicit mathematical teaching there are three parts to the concept. First, you must teach the new concept. The teacher will break apart the problem into as simple a form as possible. For example, if the teacher is teaching how to add multi-digit numbers, they will make a model to show the students.

Using Quotitive Division Problems to Promote Place Value

“In order to develop the concept of place value, a student must have an understanding of part-whole relationships and four key properties: (1) positional (the quantity is represented by the position of a digit within a multi-digit number); (2) base-ten (numbers increase in powers of ten from right to left); (3) multiplicative (the value of each digit is its place value multiplied by its face value); and (4) additive (the total is represented by the sum of the values of the individual digits), (Bicknell, Young and Simpson, 2017, p. 28).”

In this study that Bicknell, Young and Simpson explored, they found that younger children can begin to use multiplication and division, however, when taught they often aren't taught this until much later. They believed that being able to decompose and compose number will help with understanding place value. They further believed that there are many real world situations that children as young as five, can compute and understand. They found that children can answer these questions by using models, drawing them out or acting them out. The students must understand singles vs. groups. What the researchers did was have a two year study where they looked at multiplication and division problem solving with grade three students. They had teachers do a two week lesson where they presented a number between 21 and 40, then hid the number quickly. They asked the students to make a representation of this number using a tens-frame, the teacher then would show their tens frame to see if they got the same answer. They then would discuss any differences that may of happened, and why this would happen. After that the teacher would have a warm-up problem where they recorded the students answers, they then would attempt to write an equation using what all the students said. The students were then asked to do similar problems in their workbook showing pictures, or using manipulatives. Questions that students worked on were "There are 30 eggs. Each carton holds 10 eggs. How many full cartons are there? (p. 30)." The researchers then had them move to more complex questions that had remainders, such as "There are 24 chocolates. Each tray holds 10 chocolates. How many full trays are there (p. 30)?" The students would make models, draw, write an equation to help solve these problems which helped with their understanding. Before the teachers began the two weeks of lessons the researchers did a pre-examination to see the students number knowledge, how they sequenced numbers, subtracted, multiplied, divided and problem solved. They then did an assessment after the teacher was done teaching all the lessons. What they found was that the

students made improvement in multiplication and division groups. They were able to understand how 10 can go into different numbers. They also were able to understand that the 2 in 24, meant two groups of 10. “This Study showed how problem solving using meaningful contexts, and particularly quotative division problems with ten as the divisor, was very powerful for strengthening students’ conceptual understanding of place value (Bicknell, Young & Simpson, p. 32).”

Place Value

James Brickwedde stated, “Common Core State Standards for Mathematics (CCSSM) state the need to recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right (CCSSI 2010, 4.NBT.1). The standard expands at fifth grade to indicate that a digit represents one-tenth of what it represents in the place to its left (5.NBT.1) (p. 31).”

Brickwedde goes on to talk about how we need to look at the language we use while teaching place value. Brickwedde wrote this article after he did research and instructional work for six years. Brickwedde gives an example of teachers buying markers. The teacher can buy 1 box of markers but individually it has 10 markers. Furthermore, if the teacher buys a carton of markers, that has 100 boxes, the teacher has 10.000 markers (P. 31). This example was showing the importance of unit, and understanding how these individual items can make “1” (ten) or “1” hundred. As mentioned, Brickwedde looked at the role language plays in teaching math. Brickwedde discussed multiple different examples of a teacher posing different questions to see his students’ level of thinking. One question that the teacher poses is “In the crate are 638 apples that need to be placed in plastic bags and tied shut. If 10 apples go inside each bag, how many full bags can be filled and placed on the shelf for sale to customers (Brickwedde, P. 33)?” What

Brickwedde noticed from this was that a student was able to state that they noticed that “10” tens makes the number 100. They also knew were able to determine that 60 tens would go into 100. They began to understand multiplicative rate of ten. The teacher was able to show this through an equation such as 10×10 . From this, teachers are able to expand the students thinking by getting them to understand double digits times multiple digits. Brickwedde (2018) stated, “Place value is more than just naming a digit’s value within a particular location. At its most robust level, it is a rate of ten. It is grounded in the conceptual underpinnings of multiplication (p. 34).”

Base Ten Model

In the research article, “*Grounding the Symbols for Place Value: Evidence From Training and Long-Term Exposure to Base-10 Models*,” Mix, Smith, Stockton, Cheng & Barterian (2017), the authors stated, “Acquiring place value is a watershed in mathematical development. Children cannot progress very far without it, and those who struggle with place value in the early grades tend to face lower mathematics achievement throughout elementary school and beyond (no page number indicated in reference).” The researchers took two different groups of students to determine whether the students would have more success understanding place value by just using symbols or by using symbols and base-10 blocks. The students that were using the base-10 blocks and symbols, were also given mats that showed written numerals. The students that used only symbols were provided with notecards and handwritten numerals from 0-9. During this experiment students were given a pretest and posttest place value test that consisted of 12-16 questions. Questions had to do with numeral ordering, numeral interpretation and multidigit addition. What the researchers found was that both groups of students had significant improvement from the pretest to the protest. However, the students that had more training with the manipulatives, scored higher than the students whom were only given the

symbols to use. What the researchers found is that teaching students mathematics using concrete methods, where they are understanding a specific process. They found that this can help when students are beginning the multiplicative process using base tens.

CHAPTER III: Application of Research

In this chapter the thesis will explain findings, and what the researcher found to be most beneficial for all teachers. The researcher will state the material that she is currently using and will begin using in her class and why she believes it will help for her students to make gains in the classroom. It should be noted that the researcher is not doing an experimental distortion. Therefore, findings will only be based off the readings that this researcher has found.

After my findings from reading different research, it was found that many researchers used manipulatives to represent numbers. Therefore, they would use some kind of small piece to represent the number “one”, a bigger item that could fit 10 small pieces to represent the number “10”, an even bigger item to represent the number “100” that would fit 10 medium pieces inside. Some researchers would bundle sticks, some would use tally marks. Almost all believed that students need to understand number sense to understand place value. The researchers differed on the type of math problems that they had the students solve. Some researchers just had the students show that they knew the meaning of a two to three digit number, others had them add or subtract, another had them estimate, one researcher had them divide and multiply, another had them do algebra to get a deep understanding of place value. This shows that place value should truly be talked about in almost all the math skills a teacher teaches, when dealing with numbers. The better understanding a student has of number sense, the researcher believes they will be able to truly improve in their mathematics. The researcher also has found that it is okay to let students use manipulatives even in the later grades to understand the numbers and complex equations they are working with.

After the researchers first year of teaching place value as an intervention on top of fourth and fifth grade math standards, she found that all five of her students improved on their fourth and fifth grade mathematics assessments, as well as improved on their place value assessments. The students were given an assessment called conceptual place value that was written by the School district in which the researcher works. The assessment had 14 different tasks that the students could do. They would start with task one, depending on how the student did they would either continue to the next task or stop. Once the document told the student/teacher to stop, it would state what level the student is at. From here the district set up different placemats to help create lessons to teach students skills they may possibly be missing. These lessons came from the books Developing Number Concepts by Kathy Richardson Books 1-3.

Conceptual Place Value Assessment			
Student:		Classroom:	
Assessor:	Assessor:	Assessor:	Assessor:
Date:	Date:	Date:	Date:
Level:	Level:	Level:	Level:
Fall – Green Winter – Pencil Spring – Red			
Task 1: Quantify with 10's and 1's			
Do: Place the cards in front of the student		Say: "How many squares?"	
Counting to establish the length of the first stick, does NOT make the child "emergent".			
36	Correct	<input type="checkbox"/> Counted by 10s and 1s	Continue
	Incorrect	<input type="checkbox"/> Counted by 1s <input type="checkbox"/> Counted by 10s and 1s <input type="checkbox"/> Counted by 1s	STOP (Emergent)
61	Correct	<input type="checkbox"/> Counted by 10s and 1s <input type="checkbox"/> Counted by 1s	Continue
	Incorrect	<input type="checkbox"/> Counted by 10s and 1s <input type="checkbox"/> Counted by 1s	STOP (Emergent)
Task 2: Increment and Decrement with 10's and 1's			
B = Bundle S = Sticks			
Do: Establish that 1B is the same as 10 sticks. Then display 2B and 4S.		Say: "How many? How do you know?"	
If the student is able to respond using language of 10s and 1s, cover the collection and continue by briefly showing and then covering.			
24+1B →34	+4S →38	+3B →68	68 – 2B →48
-3S →45	- 1B →35		
Notes:			
Correct	<input type="checkbox"/> Counted by 10s and 1s	Continue	
Incorrect	<input type="checkbox"/> Counted by 1s only <input type="checkbox"/> Counted by 10s and 1s <input type="checkbox"/> Counted by 1s only	STOP (L.1)	

What the researcher did in her math class was an intervention with 1-2 students a day. She picked students whom were at the same level or close to, to be together. During this time, she would do an activity that helped the student gain number sense in whatever operation they were working on. While she was working on the interventions with 1-2 students, the other students would complete an individualized activity that had to do with place value at their instructional level. All these activities came from the developing number concepts. Once this intervention was done, the researcher would move on to grade level work (4-5) that met the state standards. After the lesson, the students would work independently on a math program called “Dreambox” on their computer. This program is very interactive and teaches the students grade level standards with many visuals. Each quarter, the researcher would assess the students to see if they needed to move up, down or stay at the same level for conceptual place value. Every single student of hers moved up a new placement level or passed out of the placements. The students also took a math assessment during the fall, winter and spring called aMath, this test was to measure the student’s annual growth in mathematics. Every single student of hers had growth, however one student stayed the same from winter to spring. It should be noted that this student had also tested out of the place value assessment, therefore he was not getting individualized place value interventions during that time, he only worked on grade level work.

After much review on many articles, the researcher plans to continue with the conceptual place value. However, she would like to put a bigger emphasis on place value when teaching grade level standards. For example, when she has her students multiply, dividing, learning algebraic equations, she will give the students more opportunities to learn and to try and teach themselves using manipulatives. This goes back to the cognitively guided instruction, where the students are given material they need to try and answer the questions the teacher gives. The

students will then explain what they believe the answer is and why. This creates classroom discussion, and more opportunities for the students to learn different ways to solve one problem. Giving the students more manipulatives to work with, will hopefully help them with their number sense, as many articles had suggested this.

CHAPTER IV: Discussion and Conclusions

Personal Experience/Researcher's Interest

This researcher teaches at an urban setting school in Minnesota. This school specializes in special education for students Kindergarten through eighth grade. Currently, this teacher is teaching fifth grade students; she began working on grade level standards with her students at the beginning of the year when she realized they are missing some kind of foundational understanding of mathematics. This teacher began to question what exactly that foundational understanding is that they are missing.

The reason the teacher started to question was because she had one of her students multiply double digit numbers but could not explain the place value of each individual number such as 124. He could not explain that the one is in the hundreds place, the two is in the tens place, etc., he could not explain that 124 meant 124 individual items/things. The teacher wondered if he had a better understanding of place value, would he begin to make larger gains in math such as increasing test scores. Place value concept is used frequently in learning mathematics, Bailey found “some children, even if successful at reading, writing and ordering numbers, do not necessarily fully understand two- and three-digit numbers” (2015, p. 4). The researcher found this quote to be true when she looked at assessments she had taken on her students. She wondered if her students truly understand place value, would this help them to understand more in-depth concepts they are being taught currently.

As previously mentioned, the school the researcher works at specializes in special education; therefore, the teachers do many different interventions for all subjects. They also have a lot of professional development to help increase their knowledge of different interventions that

are available as well as the intervention programs that the district provides. One new concept or intervention that was brought to the researcher's school's attention is Conceptual Place Value (CPV). When she began to hear about this intervention, there were a number of questions, such as; why a student who is exceeding or almost meeting grade level standards needs an intervention such as Conceptual Place Value. Fravilig believed understanding place value will help with other mathematical concepts (2018).

As discussed, she observed the skills that her students were missing even if they displayed understanding of grade level work. After hearing about this intervention, there was a need to know more. The researcher wants to know how she can implement this into her student's current academics, as well as how can other teachers implement this concept. Another thing she is interested in is will this truly increase her students grade level academics in math? She hopes that is that this intervention will give her students an understanding of what place value is so that they can truly understand the concepts of decimals, and rounding numbers as well as estimating with multiplying and dividing.

After looking at the research of Field Day (2013), this author talked about how place value is important when learning new mathematical skills, even higher skilled mathematics. Field talked about using place value in problems to divide, if a student is unable to understand place value, how can they learn new mathematical concepts that relate to PVC – Place Value Concepts. Costello (2016) suggested that instead of having guidelines of when you should teach a concept, and move onto the next, that it should flow more easily, and it should be continued to be taught. He indicated that place value should be taught when adding, subtracting, multiplying and dividing so that students can get a deeper understanding of what place value is. Which leads this author to some thesis questions.

Summary

“Place value is more than just a digit’s value within a particular location. At its most robust level, it is a rate of ten. It is grounded in the conceptual underpinnings of multiplication (Brickwedde, 2018, p. 34).” When students enter later levels such as middle school or even 4th and 5th grade when the students begin to divide and multiply multi-digit numbers, they need to understand what these numbers mean to help compute in more complex equations.

After my first year of teaching, I realized some students do not have a true understanding of their numbers. They are doing a procedure, rather than being aware of the concept of what they’re doing. I realized about half way through the school year, that manipulatives are a much better way of teaching concepts especially when it has to do with multi-digit numbers or multiplication. Often times, manipulatives are taken away from the students as they get older. I know that I had to personally go get my own manipulatives, as the curriculum that was given to me did not provide the base 10 blocks.

I have found that teaching conceptual place value comes with a lot of work upfront. Many teachers do not want to do any extra work on top of what they are teaching with their curriculum. I have found that teaching conceptual place value is better done in a station. This could be a time where you group students together at similar levels, and they work to achieve a problem. Conceptual place value can also be very fun, as there are many games that can help the students learn. I found Kathy Richardson Developing Number Concepts books to be very helpful when creating new curriculum for the students. I think that every student should be tested in conceptual place value, even if they are able to do grade level work well. I say this because I had a student whom did his grade level work in his head. However, once I test him in conceptual

place value, I realized that there were gaps in his learning. He wasn't truly understanding the concepts of numbers, he was understanding the procedure of doing a certain problem such as 23×15 . This exact student, conceptual place value scores went up from fall semester to winter semester where he ended up testing out of all the placemats "work provided by the district" as well as the developing number concept assignments, as well as the assessment that is made up by the school district. Due to the student passing out of conceptual place value by winter semester, the student no longer received an intervention for conceptual place value. He ended up not increasing his score in grade level work from winter to spring. I have to wonder, if we continued with higher level conceptual place value skills, would he have increased his score.

Professional Application

I have already discussed how I will use the information that I learned in Chapter III. I am currently using this methodology in my classroom. I have found success in the last year and a quarter by using these assignments and assessments. All my students from the school year of 2018-2019 have increased their scores in conceptual math, as well as their grade level work!

Conclusion

After reviewing many different studies, I found that most of the researchers found that manipulatives are important in a student understanding number sense. Place value is often taught at lower primary grade levels, it then isn't taught again until later when students begin working with larger numbers. Place value is often taught as a unit, but does not co-assign with other units. Some researchers found that place value should be taught with different units. They even found that conceptual place value should be taught when teaching higher level math such as division, algebraic equations, and multi-digit multiplication. The way a teacher can teach

conceptual place value is having it align with the work students are already doing, but providing the student with manipulatives to truly help them understand and grasp the numbers they are working with. These manipulatives can be for equations such as 435×16 . The students will be able to group base 10 blocks in a way where they are able to gain number sense. Another way a teacher may teach conceptual place value is by having an intervention groups, where they are pulling aside students they know are truly struggling with understanding the concepts of place value, and testing them to see where they are at. Teachers can find different assignments using the “Developing of Concepts” books by Kathy Richardson. In these three different books there are designed lessons to help teach your students conceptual place value.

Limitations of Research

There are obvious limits to this study, the first being my own results. I only had four students of my own that I worked with and saw test scores on. This is a very small sample; therefore it may not be very accurate. One thing I would like to do, and am planning to do, is take my own data on all my students throughout the years to see how conceptual place value works with my students. I am curious if I end up having other students pass out of the conceptual place value placemats and assessments, would their grade level assessments have no gain, little or a large gain. Another limit that has previously been mentioned, is that the material I was using, eventually stops. The student ends up passing the assessment, then they are just done with the conceptual place value interventions. I found from the research articles that students can continue to learn place value, it can be used to teach multiplication, division, and algebraic equations. I was not able to find material that continued giving assignments to teach the students. Therefore, this would be on a teacher to decide what conceptual place value assignments and formative assessments the students should use/take after the student has passed out of the initial

assignments and assessments. This would be even more time consuming as the teachers would have to create their own assignments. The reason that the material currently being used by me is time consuming is because the assignments come with manipulatives, therefore you may need to do cutting with the material, finding different blocks or other material to use when teaching conceptual place value.

Implications for Future Research

After reviewing these informative research articles, I would like to take more of my own data. I have found that conceptual place value is fairly new, and there are not many studies done on it, or studies that did not last very long. As I only had four students last year, I believe this data can be skewed. It would be nice to get data for the next five years, on all the different students that come into my classroom who participate in conceptual place value. I would like to see if all the students would continue to gain number sense.

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