

THE UNDERSTANDING OF PLACE VALUE BY  
ELEMENTARY SCHOOL CHILDREN  
TAUGHT WITH THE KUMON  
METHOD

By

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## Chapter 1

### Introduction

An understanding of mathematics is important for our daily lives and provides opportunities for children to experience new areas of possible interest. Children who have an understanding of mathematics are armed with tools to succeed in the future.

Place value is taught in every grade beginning in first grade. It has been shown that not until third or fourth grade, do children begin to develop an understanding of place value (Kamii 1989; Harvin 1984). According to Ross (1990), children are unable to cognitively understand place value until eight to ten years of age.

As children progress through their educational careers, they need to understand place value. Children who do not understand place value cannot be expected to fully understand double column addition (Kamii, 1989). The lack of this understanding could become frustrating to a child.

For children to develop an understanding of place value, there needs to be a solid understanding of ones and tens. Understanding place value can be defined as an internal realization of the number system of ones and tens. Children must be able to determine the value of a digit based upon its position in a numeral. The mastery of the Hindu-Arabic numeral system is based upon it.

The Hindu-Arabic numeration system is based on four basic properties that constitute place value:

1. Where a digit is placed determines its value.
2. The values of the digits increase by powers of ten from right to left.
3. The value of a digit within a given numeral is determined by multiplying the digit by the assigned place value.
4. The value of the whole numeral is the sum of values assigned to each digit. (Bove, 1995 p. 542)

#### **Statement of the Problem**

The purpose of the study was to determine understanding of place value of elementary students, six through nine years of age, who have been taught the Kumon Method as a supplement to mathematical instruction in a small rural school in northeastern Oklahoma. A survey method of interviewing was used to determine the individual child's level of understanding place value. The results were compared to the existing literature on children's understanding of place value.



### Significance of the Study

The significance of the study was to determine children's understanding of place value after exposure to the Kumon Method to help educators make more informed decisions about the use of this method. It has been shown that not until third or fourth grade, do children begin to develop an understanding of place value (Kamii 1989; Harvin 1984). In a study done by Harvin, (1984), which was similar to Kamii's, she found students have little understanding of place value until grade four even though students have been exposed in previous grades. A second grade teacher asked, "Why can't my students add and subtract?" When the numeral 15 was written on the board and the students were questioned about the one and five in the 15, the teacher wondered if her students understood place value. After asking more questions she found children have little or no understanding until the fourth grade even though they are taught place value in previous grades. Harvin's study of 91 students in grades 1 through 4 presented the following table (p. 2):

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 PLACE VALUE UNDERSTANDING
 

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	Understanding of Five		Understanding of One		Understanding of 15	
	Did	Did not	Did	Did not	Did	Did not
	[in the tens column]					
Gr. 1	37	3	14	26	36	4
Gr. 2	18	0	5	13	16	2
Gr. 3	18	0	2	16	16	2
Gr. 4	18	0	18	0	15	3
Total	91	3	39	55	83	11

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**Research Question**

What do children six through nine years of age who were taught with the Kumon Method understand about place value as compared to studies performed by Ross (1990), Kamii (1989), and Harvin (1984)? These studies have shown there is little or no understanding of place value until fourth grade.

Kumon (1987) claims the supplemental program, Kumon Mathematex, increases a child's mathematical ability as the child is capable of completing the Kumon work sheets. Therefore, the children using the Kumon Method possibly understand place value prior to children not using the Kumon

Method.

The children in any one grade level work at many different Kumon levels at the same time. Young children taught at these higher levels can complete the work but do they understand?

A first grade student in a small rural school in Northeast Oklahoma, completed Kumon worksheets, C181-185, which consisted of 100 division problems. The student completed these in 23 minutes without any errors. The principal (Goins, 1991) states,

Out of a class of ten first graders, one is on level D, four on level C, two on level B, and three on level A. Kumon considers level A to be grade level for first grade. [Level B for second grade, C for third grade, and D for third and fourth grade (Kumon, 1988)](p. 1).

Children have shown they can complete the mechanics of mathematical functions required to complete the Kumon worksheets. By asking children to repeatedly do the worksheets are they understanding the concepts being presented? Professional literature has shown that place value is not understood until third or fourth grade even though taught in previous grades.

### Definition of Terms

The definitions relative to this study are the following:

1. PLACE VALUE--An understanding of place value requires children to coordinate numeration knowledge with number concepts. Numeration knowledge is socially transmitted information while number concepts must be constructed by the child individually and represent logico-mathematical knowledge (Ross, 1990).

Physical knowledge--A knowledge of objects that is observable (color, shape, size).

Logico-mathematical knowledge--The relationships created by the individual. Children make relationships among "same", "different", "more" or "less" (There are more green chips than blue chips.).

Social knowledge--Arbitrary conventions created by people (Christmas is on December 25). (Kamii, 1986)

2. KUMON METHOD--A self paced supplemental curriculum consisting of more than 5,000 timed worksheets which are sequentially ordered from prewriting, prior to a symbolic understanding of print, to college level physics problems (Ukai 1994).

3. CHIPS--round plastic disks one half inch in diameter used for concrete representation of numerals and their value.

## Chapter 2

### Review of Related Literature

#### Place Value

Ross (1990) states that an understanding of place value can be described at many levels. She has developed a five stage model which describes children's acquisition of knowledge about two digit numbers:

Stage I Children interpret two digit numerals as the whole number they represent but assign no meaning to numerals individually.

Stage II Children show knowledge of positional property. They know the numeral on the right is "in the ones place" and the numeral on the left is "in the tens place". This is a limited knowledge and does not include quantities to which each corresponds.

Stage III Children see the digits at their "face" value, in a way they sum to the whole. For instance, 25 may be seen as two of one object (dimes) and five of a different object (pennies). The representation of the objects is not required to be equivalent to the quantity of the digits.

Stage IV Children can interpret the tens digit as a group of ten though their understanding is limited and unreliable.

Stage V Children can represent the individual digits

in a two digit numeral into quantities of ones and tens. Their understanding and performance is easily demonstrated and reliable.

Burns (1994), states "Children who have some understanding of the relationship between numbers and groups of 10s and 1s know that if they have three groups of 10 objects and seven extras, they have 37 objects altogether." (p. 14)

Young children find it difficult to understand the same numeral, two for instance, can have a different value when placed in various numeral arrangements. For instance, Bove found that (1995) children can see the numeral two in 123 and say two means two tens, but beyond stating the memorized fact their understanding is limited. Children who know the two in 123 means two tens cannot explain that the two in 241 means two hundreds instead of two tens. Before children are capable of understanding that concept there must be higher levels of thinking, understanding and application.

Kamii (1989, 1986) found that children do not acquire place value understanding until third or fourth grade even though it is taught in preceding grades. Her findings support Piaget's theory and research. It takes many years for children to be able to construct number concepts. Number concepts are a combination of physical, social, and logico-mathematical knowledge.

Of the three types of knowledge identified by Piaget, physical and social knowledge are the simplest to obtain. Physical knowledge is observable and social knowledge is arbitrary or random. Children can observe the color, shape, or size of an object while they learn random facts. A young child, six or seven years of age can describe the color of a ball and remember that Christmas is December 25.

The third type of knowledge is logico-mathematical knowledge, which is the relationships created by the individual. Children make relationships among "same", "different", "more" or "less". Children who can make the relationships are developing logico-mathematical knowledge. An example would be a child stating, "There are more green chips than blue chips." (Kamii, 1986) As children develop logico-mathematical knowledge place value can be understood, but a child of seven or eight years of age is not making these relationships as one who is nine to ten might.

Teaching styles contribute to children's understanding of place value. Children's understanding of place value can vary depending upon teaching and learning methods implemented as determined by Heibert and Wearne (1992). Their focus was on the teaching and learning of place value understanding. Depending upon the teaching method used, children's understanding of place value varied. Children taught using a textbook with brief alternative instruction

improved understanding compared to children taught strictly from the textbook. Heibert and Wearne (1992) emphasized to keep in mind that everyone is an individual and will learn differently.

Japanese children's understanding of place value differs from those of children in the United States. Miura and Okamoto (1989) explain that United States and Japanese representations of understanding place value may be due to the correspondence of spoken numerals. In the United States, we are taught to say eleven, twelve, and twenty. Japanese children are taught to say "ten-one", "ten-two", and "two tens", respectively. By using this type of spoken language when discussing numerals, children correspond the written form to the spoken word.

#### **Kumon Method**

The Kumon Method was developed by Kumon as a supplement for learning mathematics for his own son. In the program children of any age start at a level at which each can individually succeed. Shiba, Professor at the University of Tsukuba, Japan, states,

On average, they start with material 1.5 years lower. However, six months after they start to learn under the Kumon Method, they catch up with their class and begin studying approximately the



same material that they are now studying at school. From that point, most children make remarkable progress and study ahead of their class. (p. 309)

According to Kumon(1987), keys to success in Kumon include:

Individualized Program: Each child has an individual program which is paced for him or her.

Early Starting Program: Children are given a Diagnostic test to determine the perfect starting point.

Good Study Habits: The Kumon program encourages children to set aside a short period each day for Kumon.

Repetition: Children are asked to repeat worksheets completed which are below expected performance. With repetition comes understanding.

Self Learning: Kumon teaches children to think independently.

The Kumon Method uses an approach to mathematics which varies from traditional textbook style learning.

#### The Learning Process

##### 1. 4-7 Sheets Per Day

The instructor decides the type of work and amount suitable for the child, usually between 4-7 sheets per day.

##### 2. Correction

After completion, worksheets are graded by the

instructor. If mistakes are made, these must be corrected by the student. If he or she achieves 100%, the day's work is over.

3. Always 100%

Because the children start at an easy level, they are able to score 100%. This builds confidence.

4. Scoring

The student enters the day's results in the score book which the instructor then checks. This develops self administration. (Gitow, 1992, p.4)

The University of Tulsa School for Gifted Children created a curriculum which incorporates Kumon Method. In this program, children use the Kumon Method as a supplement. Children use the Kumon Method four times a week for those below grade level. Those on or above grade level use Kumon as a choice of class once a week (Hollingsworth, 1991).

Marti Sudduth, (M. Sudduth, personal communication, January 14, 1998), an assistant director and first grade teacher of the University of Tulsa School for Gifted Children is highly supportive of the Kumon Method. She reports in her classroom of 19 children their abilities range from single digit addition to triple digit division with remainders. Sudduth defines the Kumon Method as a successful mathematical program. Children score higher on

achievement tests and place in advanced mathematical classes as they continue to high school.

## Chapter 3

### Chapter overview

The purpose of this study was to determine elementary student's (six to nine years of age) understanding of place value who have been taught with the Kumon Method as a supplement to mathematical instruction in a small rural school in northeastern Oklahoma.

The school district in this study was described in the *Kumon Kronicles* (1991). When this school began using the Kumon Method in 1990, the total mathematics performance score was ranked in the 63rd percentile for grades first through eighth by the *Iowa Test of Basic Skills*. In April of 1993, the same school ranked in the 82nd percentile for total mathematics on the same test. The increased percentile score encouraged further investigation into the Kumon Method.

This study attempted to determine if the Kumon Method enhanced the understanding of place value, and whether it contributed to the increase in the mathematics score.

### Methodology

#### Participants

Students in a small rural school in northeastern Oklahoma were participants in this study. They attended school in self contained classrooms (first, second, third

and fourth grades) with each grade having only one teacher. The students were from upper lower to lower middle socioeconomic backgrounds based on the percent placed in the National School Lunch Program which was approximately 50 percent. In addition to the Kumon Method, all teachers also used Silver Burdette mathematics textbooks in each classroom.

The study consisted of 20 first, second, third, and fourth grade students, five from each grade, five boys and 15 girls, from a small rural school which houses kindergarten through eighth grade. The participants were selected by the teacher. The teacher chose the students who had completed the most sets of Kumon Mathematex worksheets at the time of the study.

Letters of consent for participation in the study were sent to parents of the identified students (see Appendices A & B). Those whose parents gave consent to participate and gave their own verbal consent were interviewed.

#### **Procedures and Design**

The first step to be taken was to obtain the necessary approval of Oklahoma State University and the Institutional Review Board. Secondly, the school was contacted for the necessary approval. The third step was to obtain parental consent. Fourth the children gave personal consent followed

by an interview. The fifth step was to analyze the results.

The interviewer used a questionnaire (see Appendix C) that determined if students' understanding of place value was comparable to the following concept of place value:

In a two-digit numeral, the whole numeral represents a whole quantity (of objects), while the individual digits represent a partitioning of the whole collection into a 'tens part' and a 'ones part'. The whole must equal the sum of the parts. For example, the numeral '25' can represent the cardinality of a collection of 25 objects; the '2' represents 20 of them while the '5' represents the remaining 5. (Ross, 1990, p. 1)

The level of children's understanding was based on this definition of place value understanding.

The questions for the interview were based upon Kamii's Place Value Task questions for determining understanding of place value. In this task, children were shown a 3" X 5" index card with the numeral 16 written on it. Each child was then asked to count out 16 chips from a pile consisting of more than 20 chips. The interviewer circled the 6 on the card and asked "What does this part (the 6) mean? Could you show me with the chips what this part (the 6) means?" The interviewer then asked "What does this part (the 1) mean," while circling the one. "Could you show me what this part (the 1) means?" The interviewer was consistent in using

"this part" rather than any other word which could give hints to the meaning.

Those children who showed 10 chips for the numeral one will be asked if they could explain their reasoning for why they place ten chips when asked about this part (referring to the one). The interviewer continues,

you showed me all these chips (pointing to chips) for the numeral (circling 16) and these (pointing to 6 chips) for this part (circling the 6) and for this (circling one on the card) you showed me this (pointing to chips shown). What about the rest of these chips (pointing to other chips not used). Is this how it is supposed to be or is there something strange here? (Kamii, 1989 p. 161)

#### **Analysis of Data**

The students' responses were analyzed according to Ross' five stage model of children's acquisition of knowledge about two digit numbers. After the children's responses were rated they were placed on a chart (see Appendix D) which includes the grade level of the child and Kumon level completed.

Results of this study were then compared to results in the professional literature of children's understanding of place value. Implications were drawn for using the Kumon

Method in the teaching of mathematics.



## Chapter 4

### Results

From the 20 children who were selected for the study, 17 participated. Three of the children were not willing to participate or did not produce consent forms.

Of the 17, 13 girls and four boys were interviewed. The following 13 girls were between the range of Kumon levels A and D: of the 13 girls, three were working within Kumon levels A71-A181, three were between Kumon levels B151-B181, two were working within Kumon levels C1-C101, and five were between Kumon levels D-D181. Among the four boys two were working between Kumon levels A141-A151, while the other two were within Kumon levels C71-C171.

The children's responses were recorded in Table II (see Table II) according to their grade, Kumon level completed, and Ross' Stages of two digit understanding at the time of the study.

The Kumon Method worksheets are a self paced supplemental mathematics program in which children work on sequentially ordered worksheets at the level each child is capable of successfully completing (Ukai, 1994). The Kumon levels in this study ranged from A to D. All of the first graders were in Kumon level A; second graders were in Kumon level B; third graders in Kumon level C; and fourth graders

were in Kumon level D.

Ross (1990) developed a five stage model which describes children's acquisition of knowledge about two digit numbers. Her stages are described in detail in chapter two.

Level of Kumon Mathematex Completed

Grade

First                  Second                  Third                  Fourth

Stage

Ross'  
Place  
Value  
Stages

1	Level A 2 males 3 females	Level B 3 females	Level C 1 female	
2			Level C 1 male	
3				
4			Level C 1 male 1 female	Level D 5 females
5				

TABLE II

SUMMARY OF PLACE VALUE UNDERSTANDING IN RELATION TO THE CHILD'S GRADE AND COMPLETED KUMON LEVEL

Among the 17 children 7 had an understanding of place value as measured by Kamii's Place Value Task while 10 did not have an understanding. Of the 10 who did not have an understanding of place value, five were in first grade, three females and two males; three were in second grade, three females; two were in third grade, one female and one male. Of those 10 students who did not understand place value, five were working at Kumon level A, three at Kumon level B, and two at Kumon level C. Among the seven who had an understanding of place value, two were in third grade, one female and one male: and five were in fourth grade, all females. Of those seven students who did understand place value, two were in Kumon level C, and five were at Kumon level D.

All 17 of the students began by identifying the number 16 and counting out 16 chips from a group of more than twenty. Of the 10 students who did not understand place value, a typical response to the question, "What does this part (pointing to the six in the ones place) mean?" was "six". When the student was asked to use the chips to show what it (the six) meant a typical action was to count out six chips and form a pile. Children were then asked, "What does this part (pointing to the one in the tens place) mean?". A common response for these students was "one", while showing one chip from the remaining ten. Next

students were asked "What about these (pointing to the nine remaining chips) is there something strange here?" The typical responses were "don't know" and "there are nine extras and I don't know where they go." The students were then asked, "You said these (pointing to the group of six chips) meant this (pointing to the number six in the ones place) and this (pointing to the one chip) meant this (pointing to the one in the tens place), what about these chips?". The student's responses slightly varied among "don't know" to students shrugging their shoulders and not answering the question.

In comparison to the students who did not have an understanding of place value, the seven students who did have an understanding of place value responded differently to the questions. Their typical responses to the question "What does this part (pointing to the six in the ones place) mean?", was "six ones" or "ones place", and these students showed six chips as did the non place value understanding children. When students were asked "What does this part (pointing to the one in the tens place) mean?", they replied "tens place" or "one ten". Students were then asked to count out chips and show what "that part" meant. The students either counted out 10 chips or stated "the rest of the chips". A typical response to asking students to explain what this means (referring to counting out ten chips

for the one in the tens place) was, "The one is in the tens place and the six is in the ones place."

A child's understanding of place value can be between stages. According to Piaget, two of the interviewed children were at a transitional stage of understanding. These children did not verbally express their understanding but each was capable of demonstrating the ones and tens place with the chips. Each of the children were on Kumon level D.

One child, working within Kumon level D, when asked "What does this part (pointing to the six in the ones place) mean?" stated "half of what that (pointing to the number 16) is?" When asked to explain she said "don't know", but counted out six chips instead of half (8) as stated in the answer. Later during the interview, when explaining what was meant by using ten chips for the one in the tens place the child said, "...half of what is kinda 10 and you just and 10 is half of 16 because that's what it mostly is." The student was capable of demonstrating the correct action but was unable to verbalize it.

Another child, at Kumon level D, responded to "What does this part (pointing to the six in the ones place) mean?" by saying "it's like six over ten". The child counted out six chips. Later the child was asked, "What does this part (pointing to the one in the tens place)

mean?" the child said, "I don't know how to say it." The child was then asked if she could show with the chips what was meant. The child counted out ten chips. While counting the chips, the child used the six chips in a line over the ten chips as a visual representation of six over ten as stated in the first part of the interview.

#### **Ross' Stages and Place Value Understanding**

Nine students were in Stage I of Ross' model. Seven were female and two were males. Of the seven females three were at Kumon level A71-A181, three at Kumon level B151-181, and one at Kumon level C101. The two males were at Kumon level A141-A151. One student, male, was at Stage II working on Kumon level C71. The remaining seven students were in Ross' Stage IV. Of the seven students, six were female and one male. One of the female students was at Kumon level C1, and the remaining five were within Kumon level D-D181. The male student was at Kumon level C171. There were no students who were within stages III or V at the time the study was completed.

A student in Stage I interprets two digit numerals as the whole number they represent but assigns no meaning to numerals individually. A typical Stage I response when asked "What does this part (pointing to the six in the ones place) mean?" was "six", and "What does this part (pointing

to the one in the tens place) mean?" stated "one".

A Stage II student shows knowledge of positional property. They know the numeral on the right is "in the ones place" and the numeral on the left is "in the tens place", but the knowledge is limited and does not include quantities to which each corresponds. The student in Stage II when asked "What does this part (pointing to the one in the tens place) mean?" stated "one" and showed one chip. While completing the interview the child was asked, "You said these (pointing to the group of six chips) meant this (pointing to the number six in the ones place) and this (pointing to the one chip) meant this (pointing to the one in the tens place), what about these chips?" The student replied, "ones and tens". The researcher asked, "Can you show me with chips?" The student then shows the group of six for the ones place and one chip for the tens place.

At Stage IV, a student can interpret the tens digit as a group of ten but their understanding is limited and unreliable. The students who were at Stage IV typically responded to the question "What does this part (pointing to the six in the ones place) mean?", was "six ones" or "ones place", and these students showed six chips. The same students were then asked "What does this part (pointing to the one in the tens place) mean?", they replied "tens place" or "one ten". Students then counted out chips to show what



"that part" meant. The students counted out 10 chips.

## Chapter 5

### Conclusion

The purpose of the study was to determine understanding of place value of elementary students, six through nine years of age, who have been taught the Kumon Method as a supplement to mathematical instruction in a small rural school in northeastern Oklahoma. A survey method of interviewing was used to determine the individual child's level of understanding place value. The results were compared to the existing literature on children's understanding of place value.

This study supports professional literature. Of the 17, only seven had an understanding of place value and these children were in the third and fourth grades. According to the research of Kamii (1989), Ross (1990), and Harvin (1984), it is in third or fourth grade that place value is understood without any particular mathematical programs. Constructivists say there is more to understanding place value than completing mathematical worksheets and computations. Children need to be able to look at a two digit numeral and see it as a whole unit, for example the numeral 16. At the same time they also need to be capable of reorganizing their thinking to see the whole unit as a group of ten and a group of six ones, before place value is

understood.

The Kumon Method claims to assist children in learning mathematics. In the Kumon Method, children at the end of level A are being asked to do addition and subtraction with carrying and borrowing. This assumes children understand place value. In this study, the children do not begin to understand place value until third grade.

Although children did not begin to understand place value until third grade, the understanding was not sequentially ordered as the Kumon worksheets are ordered. Even though children are capable of working on a more advanced level of Kumon, this does not mean the children understand place value. To illustrate this, a child working on Kumon level C1 was at Ross' stage IV, having an understanding of place value, while another child at Stage I, where children interpret two digit numerals as the whole they represent but assign no meaning to the numerals individually, was on Kumon level C101, which is considered to be more difficult than level C1. Therefore, are children being asked to do mathematics they do not understand?

#### **Limitations**

This study was not designed to show a cause/effect relationship. It was designed to compare children's understanding of place value who use the Kumon Method to the

existing literature on children's place value understanding.

A limitation of this study was the number of children who participated. A larger sample could provide more in-depth information about the understanding of place value while using Kumon Mathematex as a supplemental mathematical program. Another limitation to take into consideration is the school size. Some small rural schools do not have the ability to offer children the variety of curriculum or specialization as larger urban schools. The teacher to child ratio in a rural school could effect the results found in this study. At times rural schools are capable of providing more one on one attention than the larger urban schools where class sizes are larger. These limitations should be taken into consideration when further studies are performed. Furthermore, additional research is needed in non rural settings.

#### **Implications for the Classroom**

Children find place value difficult to understand, and teachers find it difficult to teach. In teaching place value, teachers must be aware that young children have limits to their understanding. At times young children who are being taught place value are merely following directions and not developing an understanding. Children who are

introduced to place value concepts before understanding are able to complete the mechanics, but this may be doing more harm than good.

As educators ask children to complete these worksheets, are good educational practices being promoted? Those taught with the Kumon Method experience repetitive practices of addition and subtraction facts leading the children to commit them to memory. However, this could develop roadblocks in the children's understanding of place value. The children know  $19 + 12 = 31$ , but they can not explain the process of arriving at the answer.

Young children need to develop a strong understanding of mathematics to be armed with the tools to succeed in all areas of life in the future. Place value is an important portion of this understanding. As young children mature, so does their thinking. Teachers who pose questions where children are to think about the answer will eventually be capable of explaining the relationship among numbers and their place value.

"Teaching place-value concepts separately as a prerequisite to double digit addition and subtraction is ineffective and unnecessary." (Ross, 1990, p. 15). Understanding comes from thinking. Children must be encouraged to construct their own knowledge of numbers and the relationships they hold in comparison to their placement

in a number. Children who are encouraged to solve problems in challenging ways will develop means to divide numbers into groups, which will later progress into an understanding of place value.

Within this study, seven of the children showed an understanding of place value. These children were all in Ross' Stage IV, where they know there are one and tens place but their understanding is limited and unreliable. Although the Kumon Method promotes a self paced supplemental mathematical program, it has not shown to increase the rate in which children develop their understanding of place value. Further studies need to be done on the Kumon Method focusing on place value understanding to determine if it is possible that those children who are capable of completing Kumon level C prior to the third grade are capable of understanding place value. As stated by Ukai (1994), concepts in the Kumon Method are not explicitly taught, but it is through the repetition of computations that children see the patterns and discover their own strategies. A question for a future study would be to focus on the effects of combining the Kumon Method with encouraging children to construct their own knowledge in promoting place value understanding prior to third grade?

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APPENDICES

## Appendix A

## Parent Letter

I am Amy Johnson, an OSU graduate student working on my Master's thesis under the supervision of Dr. Kathryn Castle, School of Curriculum and Educational Leadership. I am doing a study entitled *The Understanding of Place Value by Elementary School Children Taught with the Kumon Method*.

I would appreciate your and your child's cooperation in this voluntary survey. Your child's knowledge of Kumon Mathematics will assist my study to better understand the development of place value. If you and your child agree to participate, I will also ask your child for verbal consent. If your child consents, I will ask your child some questions about numbers. An example of the type of question is "What does the three in 13 mean?" This will take 10 to 15 minutes and will take place at your child's school at a time and location in the school convenient to your child and the teacher(s). If you have any questions or concerns, I encourage you to contact me at (405) 743-4351 after 4 pm.

## Appendix B

The Understanding of Place Value by Elementary School  
Children Taught with the Kumon Method

I, (print name) \_\_\_\_\_ authorize  
my child, (print name) \_\_\_\_\_ to  
participate in the study guided by Oklahoma State  
University, graduate student, Amy Johnson. Amy Johnson is  
under the supervision of Oklahoma State University,  
Professor, Dr. Kathryn Castle, School of Curriculum and  
Educational Leadership. I understand my child will be  
interviewed by Amy Johnson at his/her school at a time and  
place convenient for both child and teacher(s).

**Purpose:** This study is created to gain knowledge of  
children's understanding of place value who have been taught  
with the Kumon Method.

Place value is defined, in this study, as a child's  
ability to determine the value of a digit based upon its'  
position in a numeral. (Bove, 1995) For example, the numeral  
'25' can represent the cardinality of a collection of 25  
objects; the '2' represents 20 of them while the '5'  
represents the remaining 5. (Ross, 1990, p. 1)

**Procedures:** If you and your child agree to participate  
in this study, your child will be asked for his/her thoughts

on numbers. The questions will be similar to those asked by a teacher in the classroom and should be looked upon as a learning experience. Your child will be shown a number and asked to represent that number with colored plastic counting chips.

**Duration:** Your child's participation will require 10 to 15 minutes at his/her school at a time and place convenient for both child and teacher(s).

**Confidentiality:** The researcher will record written notes in order to maintain anonymity. Data will be kept in a locked cabinet. Results of the study may be presented at professional meetings but anonymity will be preserved with no identification of individual children.

**Risks:** Your child would face little to no risks during the interview. The questions asked will be similar to those a classroom teacher would ask. The researcher is a certified classroom teacher, working as an elementary teaching assistant, with experience working with children.

**Benefits:** Your child may benefit from the ten to fifteen minutes of individual attention given by the researcher in the interview. The information gained from the study could contribute to the knowledge in the field of education about children's understanding of place value.

**Consent Statement:** I have been informed about the

procedures listed here. I am aware of what my child will be asked to do, the risks and benefits of this study. I also understand the following statements:

My child's participation is part of a study entitled *The Understanding of Place Value by Elementary School Children Taught with the Kumon Method*.

I understand that my child's participation is voluntary, that there is no penalty for refusal to participate, and that my child is free to withdraw my consent and participation in this study at any time without penalty after notifying the project director. I may contact Amy Johnson, the researcher, at (405) 743-4351 or Dr. Kathryn Castle, her supervisor, at OSU at (405) 744-8019. I may also contact Gay Clarkson, IRB Executive Secretary, at (405) 744-5700; 305 Whitehurst, Oklahoma State University, Stillwater, OK 74078.

I have read and fully understand the consent form. I sign it freely and voluntarily.

Signed: \_\_\_\_\_ date \_\_\_\_\_

I certify that I have personally completed all the blanks in this form and have explained them to you and your child before requesting you sign this consent form.

---

Signature of Project Director or Authorized Representative

## Appendix C

**What is 16?**

Place Value Tasks from Kamii (1989 p. 161)

1. What numeral is written on this card? (16)
2. Would you count out that many chips (pointing to the numeral 16)
3. What does this part mean (circle the 6)?
4. Could you show me with the chips what this part means (pointing to the 6)?
5. What does this part mean (circle the 1)?
6. Could you show me with the chips what this part means (pointing to the 1)?
7. (If ten chips are shown for the numeral one) Can you explain what this means?
8. You showed this many chips (pointing to all shown for 16) for this numeral (pointing to 16). Then you showed this many chips (pointing to pile shown for 6) for this numeral (pointing to 6). Next you showed this many chips (pointing to pile shown for 1) for this numeral (pointing to 1). What about the rest of these (pointing to unused chips counted out for the original 16)? Is something strange here?

(Kamii, 1989)

Appendix D  
Analysis of Data

Level of Kumon Mathematex Completed

		Grade			
		First	Second	Third	Fourth
Ross' Place Value Stages	Stage				
	1				
	2				
	3				
	4				
5					

TABLE I

## Appendix E

## Script for verbal consent

Hi (child's name), I'm Amy. I would like for you to do this math activity with me. Your parents have given me permission to work with you. Would you like to help me with my math project? There are no right or wrong answers. If you do not know the answer that is fine, and you can quit at any time. The activity will only take about ten to fifteen minutes. When we are finished you may return to your classroom.



Appendix F  
OKLAHOMA STATE UNIVERSITY  
INSTITUTIONAL REVIEW BOARD  
HUMAN SUBJECTS REVIEW

Date: February 27, 1998

IRB #: ED-98-071

Proposal Title: THE UNDERSTANDING OF PLACE VALUE BY ELEMENTARY SCHOOL CHILDREN TAUGHT WITH THE KUMON METHOD

Principal Investigator(s): Kathryn Castle, Amy Beath Johnson

Reviewed and Processed as: Expedited/Special Population


Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.

APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.

ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

=====  
Comments, Modifications/Conditions for Approval or Disapproval are as follows:

Signature:   
\_\_\_\_\_  
Chair of Institutional Review Board

Date: March 2, 1998

cc: Amy Beath Johnson

VITA  
Amy Beath Johnson  
Candidate for the Degree of  
Master of Science

Thesis: THE UNDERSTANDING OF PLACE VALUE BY ELEMENTARY  
SCHOOL CHILDREN TAUGHT WITH THE KUMON METHOD

Major Field: Curriculum and Instruction

Biographical:

Personal Data: Born in Vinita, Oklahoma, On  
September 12, 1972, the daughter of Wayne and  
Elsa Johnson.

Education: Graduated from Afton High School, Afton,  
Oklahoma in May 1990; received Associate of  
Arts degree from Northeastern Oklahoma A & M,  
Miami, Oklahoma in May 1992; received a  
Bachelor of Science degree in Elementary  
Education from Oklahoma State University,  
Stillwater in December 1994. Completed the  
requirements for the Master of Science degree  
with a major in Curriculum and Instruction in  
July 1998.

Experience: Raised on a family owned and operated  
farm in Afton, Oklahoma; student teaching,  
second grade, September 1994 through December  
1994, Stillwater Public Schools, Stillwater,  
Oklahoma; substitute teacher December 1994 to  
December 1996, Stillwater Public Schools,  
Stillwater, Oklahoma; teaching assistant, pre-  
kindergarten, December 1996 to present, Will  
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Professional Memberships: Student Oklahoma  
Education Association.