What Motivates Students to Learn More Math?

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Background Information/Context

This year I have had the pleasure of completing a yearlong internship as part of the Professional Development School (PDS) internship at The Pennsylvania State University. As an intern in a fourth grade classroom at Corl Street Elementary School, I have noticed that math is an important content area for many students and their families. The State College Area School District has many high-achieving students and supportive parents, which creates an academically competitive environment. In addition to completing various activities during the day as part of the math curriculum, I have also noticed that some students complete additional math activities outside of math class, whether it is because they enjoy it, they want more practice, or they are expected to by their parents. While some students excel in general fourth-grade math skills such as multiplying and dividing, other students seem to struggle with these concepts.

At Corl Street Elementary School, there are two fourth grade classes. The students in both classes have a wide range of math skills, which can make it difficult to both adapt and enrich for all of the students. For this reason, my mentor and the other fourth grade teacher have chosen to group students together according to their ability as one fourth grade class. My mentor has the faster-paced math class, while the other fourth grade teacher has the students who move at a slower pace. As I refer to the students, I will refer to my original fourth grade class as my homeroom, and I will refer to my math class as my math class.

My homeroom consists of students at various math levels, ranging from Title I math students to advanced level math students. My math class, however, consists of students who are in the average range of math learners through the more advanced math

learners. All of the students in the fourth grade, no matter what their math levels may be, are expected to follow the same math curriculum throughout the year. The higher-level students tend to work at a quicker pace, which creates the need for enrichment activities. The other students, however, follow the curriculum at a slower pace and may need activities to support their learning.

The students in both of my classes, homeroom and math, work together quite well and have a great sense of community. These students can be put into groups with any other students in the class and get their work done in an efficient manner, even if they are grouped with students they would not normally work with. This makes group work in the classroom, especially during math, much easier on both my mentor and I. The students have the ambition to learn as much as they can, as long as the topic keeps them interested. With their ambition and the effort and energy from the teachers, the students are able to achieve a high level of math learning.

Rationale

While the students in my class are expected to reach high standards in math, there are many struggles along the way. The math investigations lessons that are new to my fourth grade classroom seem to contain some gaps that need to be filled for students to succeed. Some of those gaps include enrichment opportunities for the students and an easily noticeable connection to the algorithms. In addition, the curriculum is repetitive, which is not as necessary for my students as it is for a slower-paced group of students. With these things in mind, I wanted to create some type of math enrichment for my students to help them with the PSSAs and also with math in general. Since there are so

many subject areas to be covered in a day and limited time to do it, finding time to add math enrichment that is of interest to the students is a challenge. I wanted to find the time and the resources needed to help my students grow as math learners. I also wanted to create activity centers that are appealing to the students. I wanted students to have the chance to practice skills that they have already learned in school, such as reflections and patterns. In addition, I wanted to introduce new activities to the students that would challenge them, such as games that involve discovering strategies that would help them solve problems.

Wonderings

After thinking of what I could do to add math enrichment for my students, I began to think of questions to help me with my task. The main wondering that summarizes all of my questions is:

-How can a teacher provide math enrichment for students in an appealing way when there is little time during the day and little space in the room?

There were many other questions that followed as I began to really think about my inquiry. These were questions that could be incorporated into the main question and would be answered throughout the process of my explorations and research. These sub-questions include:

-Which students will choose to do math enrichment activities when they are given a choice?

-Which types of math enrichment activities will students participate in when given the choice?

-Do students choose to complete activities alone or in groups?

-Do students enjoy the enrichment activities that are available to them?

Inquiry Versus Project

This topic could be a project or an inquiry, depending on how it is carried out. If this topic were carried out in a different way, it could be a project. This topic for me, however, is an inquiry, because I am looking at how the enrichment can be added into my classroom, where it fits during the day, and how it can be added to a busy day in a way that is appealing to the students. It is also an inquiry, because I need to find the resources for the enrichment in my classroom, which are not immediately available and ready to use. I need to talk to the math department to find out what resources are available, and I also need to look for my own information as well. All of this information is not information that I knew before beginning this inquiry. I wanted to find out if it is possible to fit math enrichment into a busy day, because it has not been done thus far during this school year. Because I had never seen all of the available resources, I wanted to find out if there were resources available for enrichment within the district or in easily accessible locations.

This inquiry began as an issue that my mentor and I wanted to address in the current classroom I am in, but I also wanted to pursue an inquiry topic that would help me in my future career, even if I taught in a completely different context. As I began thinking, I realized that finding the time for math enrichment and incorporating it into a

classroom would be something helpful for me in any classroom that I teach in. Every student needs to learn math and continue to learn math to be successful in school and in life. The lessons that I learn through this inquiry will follow me throughout my teaching career.

Inquiry Plan Description

Before I was able to begin collecting data, I had to think about how exactly I would carry out this inquiry. What would I do to figure out how to fit math enrichment into a busy day? Where would I find available space in my already content-filled classroom? What activities would I use? How would I introduce these activities to the students? These questions and many more ran through my mind, and I had to sort through them all to get myself organized and ready to begin my research.

I began my inquiry by getting organized and making a plan to carry out the inquiry. Appendix A contains my data collection timeline. Once I had a general idea of the steps I was going to take, I did my research to find information on different enrichment activities that would be beneficial for my students. I spoke with my mentor to find out what resources she had available in her classroom. I spoke with a representative from the Math department to get an idea of what resources they had available for teachers to borrow. I also searched on the Internet to find out what types of things other teachers were doing with their students outside of the general math curriculum. I found that there are many resources readily available for teachers to use, but in order to get those resources, a teacher would need to either search for them or ask someone from the Math department in the State College Area School District.

I gathered all of my materials and sorted through them to get an idea of which activities I wanted to use with my students. I also needed to decide how I would present these activities to my students in an appealing way. With the help of my PDA, I decided to create three different centers that I would have available to my students throughout the day, especially during their regularly scheduled math class. I decided to designate one of those centers as the computer station, which would have math computer games that could easily be accessed through the Internet. I found an assortment of games that would be enjoyable for the students, yet would encourage the learning of math skills. Then I decided on a games center for the second station, which would offer both individual and partner games. The students could choose a game to play by themselves, or they could choose a game to play with a partner. All of the games available would pertain to math skills, skills learned as a part of the math curriculum for extra practice and skills that would enhance students' learning. For the third center, I created a worksheet station. From personal experience, I know that some students would prefer to complete a worksheet, rather than playing games. I, myself, was one of these students, so I knew that the center would be appealing to at least a few of the students in my classroom. Appendices B-E contain examples of the worksheets available to the students.

The next step of the process was to find a place to keep these centers in the room. After talking with my mentor, we decided to create centers that were easy to place in the hallway or around the room, then clean up and store at the end of the day. I created three different signs, one for each center, to display around the room to let the students know where the centers were located and what they contained. The signs were each decorated in a way to draw students so they would try the activities available there. The first sign

was for the computer center. The sign let the students know what games were available to play at the computer center. According to Ediger (1998), "the order of learning opportunities continues when computer use follows other kinds of stimulating experiences" (P. 2). I think that stimulating the students to play the math activities on the computer helps the students learn computer skills as well as math skills.

The sign for the games center was divided into two parts: the first part contained information about the games that students could play individually, and on the other side of the sign information about what games were available for partners to play was displayed. A third sign contained information about the worksheets available for students to complete. The signs were displayed in the hallway and around the room to let students know these centers were available during free time and when students completed their assignments.

After sorting through all of the activities and deciding the activities I wanted to have available to my students, I gathered the information and presented the centers to my students. I showed the students each of the activities that were available, and I explained that they could visit the centers during free time and when they have completed their work. The students appeared interested in the new activities available to them, which was apparent by their facial expressions and conversations, and I had high expectations for what the students' reactions would be. The centers were made available to the students, and they began to explore after they had completed their math assignments.

Even though the math centers were initially created as activities for students to participate in once they completed their work, the centers proved to be beneficial during math class as well. One of the activities that my mentor created during class time

involved some one-on-one time with groups of students. Because she needed to meet one-on-one with students and needed something for the rest of the class to do, we opened up the centers for the students she was not meeting with. The centers proved to be effective. The students that my mentor was unable to meet with at the time were busy and involved in worthwhile activities. My mentor and I will continue to pull out the centers during times when extra activities are needed to keep students on-task.

Data Collection

Before I set up the centers, I created a survey for my students to complete in order to find out more about the types of math they enjoyed and whether or not they would prefer more activities in or out of school. The survey that I created for my students is in Appendix F. With this initial survey data, I set up the centers around the room and offered the opportunity for the students to visit.

Once the centers were available to the students, I needed a way to keep track of which students visited which centers. I also wanted to know how long students spent at these centers and what the students thought about the activities. Did the students enjoy these activities? Did the students dislike these activities? To get a better understanding of these topics, I created a chart for students to fill out when at each available activity. A sample of this sheet is available to view in Appendix G.

While the students were at the centers, I observed and took note of the students' conversations, listening and watching for specific things that gave me an idea of whether the students enjoyed these activities. I listened for the students to say things to their friends that indicated they enjoyed a game or not. I also listened to get an idea if the

students were learning from these centers. I watched for students to return to a game multiple times, indicating to me that they enjoyed the game. I was able to get a good idea of how students felt about the activities by listening to the things students said to me or to other students. Some of my notes are available in Appendix H.

To get a better understanding of the students' reactions to the centers, I created and passed out a survey at the conclusion of these centers. This survey helped me to understand whether or not the centers were successful. This survey is located in Appendix I.

Data Analysis

In order to analyze my data, I decided to review all of the initial surveys that the students filled out. This would give me an idea of what the students' initial impressions of math were before beginning the centers. I took this data and calculated the percentage of students that answered a particular answer on each question. This gave me the information that I needed to decide what the students' initial impressions of math were. In addition, I also looked at the areas of math that the students said they enjoyed doing, and this showed me whether the activities at the centers were activities that the students' responses indicated they enjoyed doing. About 50% of the students indicated that they enjoy playing math games or completing worksheets. About one-fourth of the students indicated that they enjoy completing the math extra credit worksheets that are available to the students. Two students out of the twenty-four students in the class stated on the survey that they enjoy all types of math. About 10% of the students in the class stated that they enjoy practicing multiplication and division facts.

The next step I took to analyze my data was to look over all of the information sheets from each activity that the students filled out. I needed to look at each worksheet individually to understand what the students thought of each particular activity. I calculated percentages for each of four responses the students could have on a particular activity. I did this for each of the activity worksheets to get a better understanding of how students reacted to each of the activities I provided for them to do in their free time. 90% of the time, students indicated on the worksheets that they loved the center they participated in. Students indicated that they did not enjoy the activities 2% of the time. 8% of the time, students indicated that they either liked the activities "a lot" or "a little bit".

I also had to analyze the notes that I took while observing students at the stations. I needed to look closely at the students' responses to find out whether these responses were the same as the information they provided on the feedback sheets. The student conversations helped me to understand what students were thinking as they participated in the activities and whether or not the students were taking anything away from the activities.

Finally, I analyzed the surveys I had given to the students at the end of the centers. I had to carefully look over the surveys to find out whether students' perceptions of math changed or stayed the same since the initial survey. If the students were more positive about math experiences that would mean that the centers I created seemed to be effective.

The Kanter (1992) article discusses "the importance of continuous evaluation in a variety of ways" (Page 16). By evaluating the students' responses to the activities in a

variety of ways, I was able to get a better understanding of the students' reactions to the math centers and the activities provided for them.

Claims

Claim 1- Most students in the fourth grade enjoy math to some extent, while many adults lose interest in math due to its increasing complexity.

After analyzing the data from my initial student surveys, I noticed that all of the students indicated that they liked math either a little, a lot, or loved it. There were no students that indicated on the survey that they did not like math at all. From the surveys, I know my students enjoyed math enough to participate in math activities during school without hesitation.

I analyzed the data that I collected from students as they completed the center activities. This data included worksheets at each center for students to complete and observations I collected. While analyzing this data, I noticed that there were very few students who did not enjoy some of the activities. All of the students participated in at least one of the activities provided at the centers. Most of the students participated in two or more of the activities at the centers. Out of all of the data I collected, there were only 7 out of 67 instances where a student did not enjoy an activity. That adds up to 10% of the time when a student did not enjoy an activity. Out of those 67 times, the students indicated 32 times that they loved the activity, which is 48% of the time. Students indicated that they either liked the activity a lot or a little 21% of the times they participated in one of the activities. From what I can tell from the data I collected,

students were more likely to enjoy one of the 3 available math centers created for free time than not.

Claim 2- Most students in the fourth grade would enjoy more time learning math during the school day.

On the initial survey that I gave to the students to fill out, 96% of students indicated that they either might or would like more math activities available to them during the school day. Out of those 96%, 8% of students indicated that they would love to have more math activities available during school, while 25% of the students indicated that they would like more math activities during the school day. This tells me that a majority of students would like to have more of some type of math activities available to them during the school day.

On the concluding survey that I gave students, I asked them whether or not they enjoyed the math centers. 22 out of 23 students, which is 96% of students, replied that they either loved the math centers or enjoyed that a lot. Only one student, 4% of the total, did not reply in this way. This student stated that he liked the math stations a little. No students answered that they did not like the math stations. This tells me that students enjoyed the extra math activities during the day. This leads me to believe that students did not look at the centers as "math" games, but merely as "games" that they could enjoy with their friends.

Claim 3- When given the opportunity, most students will choose to participate in math enrichment opportunities during the school day.

When the activities were made available to my students during their free time, there were only two times when three students chose to stay and work on an extra credit packet at their desks. For the most part, the students chose to play a game with a friend in the hallway or complete a worksheet that was available for them to complete at their desks. I had many students ask me if they could work at the math centers more often. When I observed the students, they appeared to be highly interested in the activities made available to them. I could tell that they were interested by their expressions and conversations. I did not have any students who did not participate in one of the activities at least one time. Although there were a few students who chose the same activity multiple times, most of the students chose to try out the different activities. I had many positive comments from the students about the stations, and the feedback was better than I expected. Some of these comments include "Where did you get this game from? I want to get it so I can play it at home. It's a lot of fun!", "Can we have more time to play the games instead of doing this math activity?", and "Can I play this game again? I think I know the strategy to win."

Kanter (1992) states "Math is a very important skill, one which we will all need for the future in our technological world" (Page 11). I believe that students and their parents see the need for math, which encourages students to work hard at math and partake in extra math opportunities when the opportunities are available to them. The results from the concluding survey that I gave to my students are evidence of this. When asked if they enjoyed the math centers, 22 out of 23 students, which is 96% of students, replied that they either loved the math centers or enjoyed them a lot. The one student that

did not respond with the majority of the students replied that he liked the math stations a little. No students answered that they did not like the math stations.

Claim 4-Most fourth grade students would enjoy spending at least a little more time on math activities at home.

According to the Kanter article (1992), parents should work with students at home to help them increase their math skills, and parents should "explore math with [their children]" (Page 19). Kanter (1992) believes that parent involvement helps students to achieve higher levels of math skills (Page 19). Although students need to learn math at school, I believe that they should also have math activities to work on at home with their parents.

When given an initial survey about math and math-related activities, 17 out of the 24 students responded that they would like to spend more time at home completing math activities. Only 7 students, or 29% of my students, responded that they would not like to spend more time at home working on math. 42% of the students stated that they would like to spend a little more time at home completing math activities. 25% of students surveyed stated that they would like to participate in more math activities at home. Only 1 student, which equals 4% of all of the students, responded that she would love to have more math activities available to her at home.

These results show me that a majority of the students in my fourth grade class would enjoy doing more math activities at home. Although most of the students indicated that they would only like some more time with math activities, these students stated that they would not mind doing more math activities at home.

Conclusions

After analyzing my data, I came to the conclusion that all of the students in my fourth grade classroom enjoy math, and many of the students would like to have more math activities available to them. I learned that students in elementary school still have an appreciation of math, as long as the teacher keeps the curiosity about math alive in the students. If students see that the teacher is interested in math, the students are more likely to enjoy math. According to the Jones article (1999), a teacher should "promote an interest in mathematics, raise the standards of achievement in mathematics, and assist the mathematical development of children" (P. 12).

From my inquiry, I have learned information that I can take with me in my future teaching, as well as information that will benefit me this year. No matter what they age or grade, students enjoy a variety of activities, including activities on the computer. Participating in math activities on the computer can help students with both technology and math skills. According to the article by Jones (1999), students should have the opportunity to participate in computer math activities. This helps to enhance their computer skills, which will help them in the future, as well as enrich their math skills. If students are only given one type of activity to participate in, they are less likely to stay engaged and more likely to get bored with that activity. If a variety of activities are available to students, they are more likely to stay engaged. The Jones article (1999) states that students should be given math strategies in a variety of ways, which is what the math centers provide for students. The students can move from one activity to the

next activity as they get bored. I noticed that my students will stay engaged and on-task when they can try a variety of activities and find the ones that are most appealing to them.

New Wonderings

As I began to carry out my research and look to find the answers to my initial wonderings, new questions arose about the topic. These wonderings include:

-Would students enjoy these math activities if they were available to them at home?

- How would making math activities available at home affect students' participation and enjoyment?

-Would students still enjoy the same activities if they were made available to them all year?

-What factors will keep the students interested in participating in math activities in their free time?

-What do students learn, if anything, through these activities?

-What motivates them and why are they interested in math/math activities?

-Which skills/what kinds of skills are most important to include in stations?

-How can stations be differentiated to appropriately challenge/support all learners?

References

1. Ediger, M. (1998). Computers in the Mathematics Curriculum. Retrieved Feb 20, 2007, from ERIC database.

2. Jones, K. (1999). Online Mathematics Enrichment: An Evaluation of the NRICH Project. Retrieved Feb 20, 2007, from ERIC database.

3. Kanter, P. F., & Dorfman, C. H. (1992). Helping Your Child Learn Math with Activities for Children Aged 5 through 13. Retrieved Feb 20, 2007, from ERIC database.

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Appendix A:

February:

-Prepare Inquiry Brief

-Search for various types of math enrichment activities

-Begin preparations to introduce math enrichment activities to the students

-Pass out student surveys to ask students if they would like to participate in math enrichment activities and what types of activities they would like to participate in

March:

-Complete background/context, annotated bibliography, inquiry vs. project paragraph, and wonderings

-Introduce math enrichment activities to students in an appealing way (one new activity per station per week)

-Begin analyzing data

April:

-Continue to rotate in new activities for each station

-Pass out student surveys to ask students how they enjoyed the activities and if they feel they benefited from them

-Analyze sign-in sheets to see which students participated in which activities and how often

-Complete data analysis

-Prepare papers for presentation

Appendix B:

Student Worksheet #1:

Name: _____

Find the rule for each of the following patterns. Find the next three numbers in the sequence.

1. 1, 1, 2, 3, 5, 8, 13, 21, ___, ___, ___
Rule: _____

2. 2, 4, 6, 10, 16, 26, 42, 68, ___, ___, ___
Rule: _____

3. 1, 3, 4, 7, 11, 18, 29, 47, ___, ___, ___
Rule: _____

4. 1, 4, 5, 9, 14, 23, 37, 60, ___, ___, ___
Rule: _____

Find the rule that gives the third number from the first two numbers. Fill in the blanks with the missing numbers.

5. 8, 3, 11

6. 9, 5, 14

7. 4, 8, __

8. 5, 2, 10

9. 7, 5, 35

10. 6, 4, __

11. 10, 4, 6

12. 15, 7, 8

13. 19, 9, __

Appendix C:

Student Worksheet #2:

Name: _____

When you put a number into the math machine, another number comes out. Do you see a pattern? Guess what the math machine is doing to the numbers.

1.

In	Out
0	2
1	5
2	8
3	11
4	14
5	17

Rule: _____

2.

In	Out
0	3
1	4
2	5
3	6
4	7
5	8
6	9

Rule: _____

3.

In	Out
1	7
2	14
3	21
4	28
5	35

Rule: _____

Appendix D:

Initial Math Survey:

Math Survey
Name_____

1. I like math: (Please circle one)

1	2	3	4
Not at all	A little	A lot	I love math!

2. If you had the opportunity to participate in math activities outside of math class, would you? (Please circle one)

1	2	3	4
No	Maybe	Yes	I'd love more math activities!

3. Would you like to spend more time <u>in school</u> learning math? (Please circle one)

1	2	3	4
No	Maybe a little more time	Yes	I'd love to spend more time on math!

4. Would you like to spend more time <u>at home</u> learning math? (Please circle one)

1	2	3	4
No	Maybe a little more time	Yes	I'd love to spend more time on math!

5. What types of math activities do you enjoy? (Please circle all that you like)

worksheets with problems to solve
games I can play alone
computer games
worksheets with math facts
games I can play with a friend
helping others learn math

Others: _____
_____
_____

6. What kinds of math activities do you like to do best? Please name some of those things.

_____
_____
_____

Appendix E:

Activity Sign-In Sheet

Name	**Start Time**	**End Time**	**Did you like this activity?** **No-** **A little-** **A lot-** **I loved it-**
BC			
BW			
BM			
BR			
BI			
BH			
CB			
FC			
GS			
JR			
KS			
KJ			
MJ			
MC			
MB			
OR			
PS			
PE			
RA			
RJ			
SM			
SA			
ST			
SD			
TD			

Appendix F:

Samples of Notes:

Student 1: "Where did you get this game from? I want to get it so I can play it at home. It's a lot of fun!"

Student 2: "I really didn't like the computer game. Not to sound mean, but I just didn't enjoy it."

Student 3: "The computer game wasn't interesting to me."

Student 4: "Can I play this game again? I think I know the strategy to win."

Student 5: "Can we have more time to play the games instead of doing this math activity?"

Student 6: "I figured out the strategy to win every time! She is still trying to beat me at the game!"

Appendix G:

Concluding Survey:

Name: _____

1. I like math: (Please circle one)

1	2	3	4
Not at all	A little	A lot	I love math!

2. Would you like to spend more time <u>in school</u> learning math? (Please circle one)

1	2	3	4
No	Maybe a little more time	Yes	I'd love to spend more time on math!

3. Did you enjoy the math stations?

1	2	3	4
Not at all	A little	A lot	I loved them!

4. What was your favorite math station and what did you like best about it?

_____
_____
_____
_____

5. What was your least favorite math station? Why?

_____
_____
_____
_____

6. Would you like to visit the math stations during your free time in school? Why or why not?

_____
_____
_____
_____

Appendix H:

Students working at centers:

Appendix I:

Examples of Centers

Appendix J:

Results of Activities:

Activity	Students Did Not Like	Students Liked a little	Students Liked a Lot	Students Loved it!	Total Students Who Participated in the Activity
Pattern Blocks	0	2	3	3	8
24	1	3	4	11	19
Calculator Path	2	2	1	1	6
Izzi	0	2	4	1	7
Tessera	1	3	1	1	6
Balloon Ride	0	0	1	10	11
Cubits	1	2	0	3	6
Computer	2	0	0	1	4
Worksheets	7	14	14	32	67

Appendix K:

Results of Initial Survey:

Question	Rating of 1 out of 4	Rating of 2 out of 4	Rating of 3 out of 4	Rating of 4 out of 4
I like Math:	0	5	11	8
Would you like to participate in more math outside of class?	1	16	5	2
Would you like to spend more time in school learning math?	4	12	6	2
Would you like to spend more time at home learning math?	7	10	6	1

Appendix L:

Results of Concluding Survey:

Did students enjoy the math centers? Here are the results.

Not at all	A little	A lot	Loved them!	Total Students
0	1	4	18	23

As you can see, the majority of students loved the math centers and the activities they participated in.