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Abstract

Elementary teachers' lack of conceptual knowledge negatively affects their confidence, beliefs and teaching ability. The implementation of earlier exposure to teaching mathematics in the undergraduate career can benefit the pre-service teacher's future career by giving them the opportunity to examine their beliefs and attitudes towards math and gain confidence in their teaching. Interviews were conducted with teachers at California State University Monterey Bay who instruct Math 308 and Math 309 as well as a professor at the credential program. These interviews gave insight into the goals of the classes, the effectiveness of the classes and the teachers' thoughts and opinions on a service-learning component in the classroom. Preliminary data analyses indicated that the curriculum and class structure help students experience math in a different way that develops a deeper understanding of the content. All teachers interviewed agree early exposure to teaching math is beneficial in developing student's confidence and skills as a teacher.

Setting the Stage

Kate had an amazing journey because of an opportunity to be part of a university study that looked at changes in teacher's instructional patterns when her and her colleagues collaborate. The purpose of the study was to look at what drives motivation of instruction of mathematics. Kate met monthly with five other teachers in her school along with the researcher and worked through the following areas over the course of a school year: focus on their student's competence, autonomy, belongingness, and meaningfulness of mathematics. Kate, with seven years of teaching experience, was ready for a change. She had become very focused on teaching to the test and knew there was a better way to teach mathematics.

Through instruction from the researcher, Kate quickly discovered the joys and challenges of teaching in a more constructivist model. On the one hand, her students responded well to having more of a voice in class. However, Kate quickly realized she did not know the concepts as well as she thought she did and therefore was at times not able to cinch the lesson. For example, when teaching order of operations she had her students experiment with the equations and attempt the problem in different orders to explore if different orders produced different answers. When the students computed different answers depending on the order of operations, Kate was unable to explain why the order of operations she was teaching and had been taught was the correct way. She was very fortunate to have her peers along with the researcher to talk to and gain clarification and support. Kate learned through this experience to stay attuned to her student's responses and change her instruction accordingly. Kate's story is a meaningful example because through support of her peers and the researcher, along with practice in her classroom, she was able to improve the learning experience for her students and herself.

What is the Problem and Why is it an Issue?

Some of the common factors in elementary math teachers that have affected the success of their teaching are unchanging views of mathematics, lack of self reflection, understanding of the traditional method of teaching content, lack of confidence in teaching math, and lack of content knowledge (Hill, 1997; Raymond, 1997; Turner et al., 2011; Wilkins, 2008). These reasons have perpetuated the view of math as hard, unattainable and a series of definitions and procedures that is static and unchanging. Teachers who are intimidated by math or believe they are not competent at math often do not understand that these beliefs have stemmed from their past experiences in learning math (Hill, 1997; Grootenboer, 2008; Raymond, 1997; Wilkins, 2008). These negative assumptions are then brought into their classroom and can deeply affect their teaching practices. Often teachers resort to a traditional method of instruction, which presents math as merely tasks involving numbers rather than an engaging experience. If students do not respond well to this style of instruction, some teachers choose to blame this on the students instead of critically looking at how their teaching affects this. This is a problem because as these students move into higher more complex levels of math they start to suffer because they do not have the core concepts and problem solving skills needed to achieve the next level of math. The students then feel disappointed and believe it is their fault they cannot learn math rather than understanding their lack of knowledge often stems from how they were taught (Hill, 1997, p.3).

Old Beliefs of Mathematics and Self Reflection

It has been seen that a person's beliefs are developed from past experiences (Hill, 1997, p. 3; Wilkins, 2008, p. 143; Raymond, 1997, p.552). When it comes to beliefs around math, negative views are often stubborn and hard to change. Many pre-service teachers and practicing teachers believe they are not good at math. When examined closer, these teachers often find their lack of math skills is from the way math was taught to them. When they are shown in a different way or encouraged to ask questions and make mistakes, mathematics can become an engaging and fulfilling subject. The challenge arises in the amount of time it takes to change someone's old beliefs. This is a long process that involves introspection and looking at one's own fears and inadequacies. A lot of support from teachers and peers is helpful in this process. Some year long credential programs may have a hard time fitting this into curriculum. Pre service teachers need time to deeply and thoroughly explore how their past experiences affect their teaching beliefs and practices and may not be able to because of lack of time.

Traditional Teaching and Content Knowledge

The traditional model of teaching involves memorization and the use of worksheets and repetition for the majority of learning. This model is troubling because the dynamics of what is happening with the concepts is often lost. Teachers may be well versed in the algorithms and facts but not in the concepts behind the facts and algorithms (Wilkins, 2008, p. 142). Teaching in the traditional model serves as a safe spot for teachers because knowledge is only surface deep. The traditional method opens up questions of how something is supposed to work, but often lacks the understanding of why something works. The why part is usually the core concept of the activity and is the part the teacher may not feel confident in teaching or may not fully understand themselves. As demonstrated by Turner, Warzon, and Christensen, (2011), the desire to teach in a non traditional way may be harder than anticipated with the discovery that the concepts the teacher is teaching are not fully understood by themselves (p. 739).

Confidence

The amount of anxiety a teacher has stems from their past experiences with math and how well they know the content. Many elementary teachers have less confidence in math than in other subjects (Turner et al., 2011, p. 733). As Wilkins (2008) states, “teachers who have increased mathematics anxiety may be less willing to engage in the teaching of mathematics and avoid it whenever possible” (p. 5). It then follows that the students receive an inadequate lesson and their confidence could lessen as well. For many teachers, the only time they had practice teaching math was through a methods course in their credential program. This short amount of time proves not sufficient for pre service teachers to understand their own beliefs about math and start to gain confidence and knowledge in how to learn it and how to teach it.

Are there ways to support the learning of how to teach math?

The literature has many examples of why some elementary teachers are not able to teach math in a way that is more conducive to a student’s learning. Many offer suggestions on how to help, as well as their own research of what some have down to help teachers gain confidence in their mathematical ability. The three main themes that spanned all the research are being involved in a community that discusses the struggles and successes in teaching math, working in groups to work out problems together and gain insight, and lastly getting practice in the field.

Community

The most common theme throughout the literature is building a community of teachers. Community is important because teaching is a solo experience the majority of the time. Teaching requires juggling curriculum, classroom management and class structure. A community of teachers supporting and encouraging professional growth creates a situation where teachers can be heard and they can help each other (Featherstone et al., 1995; Turner et al., 2001).

As established already, math is a subject that is often challenging and difficult. Harper (1998) suggests the college classroom setting as a place for pre-service teachers to discuss their anxiety and past experiences of mathematics (p. 35). By pre-service teachers talking about their fears and anxieties towards mathematics they find many other people share their feelings. Once credentialed, teachers no longer have the classroom structure they did in their undergraduate or graduate experience. By teachers meeting and talking on a regular basis about their teaching challenges and successes, it can help build confidence and improve teaching practices. Teachers have the opportunity to learn from each other and help each other problem solve in areas they may be struggling in (Turner et al., 2011). Featherstone, Smith, Beasley, Corbin and Shank (1995) give an example of a bi-weekly meeting over an entire school year which provided the teachers with "learning of the content, a better understanding of the nature of mathematics, and a changed attitude towards the subject" (p. 3). The teachers formed a deeper working relationship and gained the trust to start to work through the challenges of teaching mathematics.

Group Work

Having students work in groups is a tactic that was shown in studies concerning pre-service teachers. Working in a group makes the student express his or her ideas and be given criticism and a chance for his or her ideas to grow and change (Featherstone et al., 1995). Like building a community, group work gives students a chance to open up and take the risk of being wrong and working through it. By doing this, the student has less anxiety associated with math (Harper, 1998, p.33). Students also have the chance to teach each other further deepening both of their knowledges of a concept (Harper, 1998, p. 33). Harkens, D'ambrosio, and Morrone (2007) explain that, "In mathematics classrooms, students co-construct their knowledge through collaboration on meaningful tasks…they make connections to previous mathematical understanding and refine their thinking…" (p. 237).

Fieldwork

Fieldwork was a common thread through most of the literature. In Featherstone et al. (1995), Turner et al. (2011), and Raymond (1997), the focus was on in-service teachers. Therefore the fieldwork applied to the participating teachers' respective classrooms. Featherstone et al. (1995) studied a group of teachers who met bi-weekly throughout an entire school year (p. 3). These teachers met to discuss different content areas of mathematics, such as negative numbers and fractions. These meetings built a community through the group and field work. The group offered support for the teachers to try new approaches to teaching mathematics by offering suggestions and listening to their struggles and successes. Three women in the study focused on building a friendship and working relationship where they had the trust and safety to talk about their struggles in the classroom (Featherstone et al., 1995, p. 4).

Similarly, over the course of a year Turner et al., (2001) met with teachers monthly to work on their mathematical knowledge and attitudes. In studies that focused on pre-service teachers, the need to apply theory and practice was important. The chance to teach mathematics gave the teachers, in-service and pre-service, the chance to teach. The teachers also had the chance to learn from the students they taught. Many studies found that by teachers focusing on the process of the students discovering the answer and learning to listen to their students, the teachers' practices improved.

The research shows that gaining real life experience in the undergraduate experience can be beneficial to future teachers. I decided to next ask those who teach the two required math courses for Liberal Studies what their opinions were on the topic.

Method

Context

All interviews took place on the California State University Monterey Bay campus. The scope of the project is of the Math 308 and Math 309 classes required for Liberal Studies students. These classes teach the concepts needed in order to teach K-8th grade mathematics.

Participants and Participant Selection

A total of six teachers were asked to participate. Five are female teachers and one male. Of the five female teachers, four teach either Math 308 or Math 309. One female works in the credential program on campus and the male teacher works in the math department on campus. In total all four teachers from Math 308 and Math 309 as well as the teacher from the credentialing program participated.

Researcher

I am a Liberal Studies major with a minor in Mathematics. I have been attending the University where the interviews were held for three years. I have completed both math classes required for the Liberal Studies major with the same teacher. I have completed my service-learning component in a seventh and eighth grade math classroom.

Semi-Structured Interview/or Survey Questions

The following questions will be asked at the interview:

1. What do you see as the problem with having no opportunity to practice the skills learned in Math 308/Math 309 and then reflect on them; or What are you concerned about when it comes to the students lack of opportunity and reflection?
2. What is currently being done to improve reflection on real life experience - by whom - and do you think this is good, bad, or indifferent? Why?
3. What do you think should be done about how Math 308/Math 309 is structured with regard to service learning or volunteer options?

4. What do you think are the obstacles/drawbacks/disadvantages to changing the curriculum to incorporate a service learning and reflection component?
5. Is there anything else that you would like to say about the incorporation of a service learning/reflection component and/or the improvement of a service learning component?

Procedure

Through email correspondence, interviews were scheduled over the span of four weeks. The interviews were all recorded with the interviewee's consent. The interviews spanned from 20-40 minutes. Most interviews occurred in the participant's office with one happening over lunch. Clarifying questions were asked as needed. All interviews were transcribed and analyzed for themes. These themes influenced my action plan.

Results

The interviews conducted gave great insight into how Math 308 and Math 309 were formed, the purpose of the classes, the opinions of those who teach them as well as where the areas for growth are. Math 308 and Math 309 are the two required mathematic courses for Liberal Studies Majors. The purpose of these classes is outlined here in the syllabus for Math 309:

> The purpose of the Mathematics 308 and 309 sequence of courses is to provide you (prospective elementary teachers) with an in-depth understanding of key concepts in K-8 mathematics by further developing your own facility in thinking mathematically, and to develop insight into how these concepts, mathematical content, and processes are learned (Math 309 Syllabus, Fall 2011).

Each teacher had their own opinion on whether an outside of class activity was something worth applying in their class. In asking about a personal reflection portion of class, the opinions ranged from very interested to not at all. All teachers also gave me suggestions and obstacles in implementing an outside of class activity into their class curriculum, which was a great help in organizing my project.

Opinions of an Out of Class Math Activity

Having the opportunity to practice teaching was a point made by all interviewed. All teachers spoke to the complexities of learning math and then to the complexities of teaching it. The two required service-learning classes for Liberal Studies are ways for Undergraduates to start experiencing the classroom setting. Being that Math 308 and Math 309 are content and not methods courses, there was some concern of overloading the class' content and purpose. The teacher's opinions and suggestions spoke to finding a balance between offering a real life experience while still learning the concepts on a deeper level.

When asked about incorporating a service-learning component to the classes, none of the teachers believed that would be beneficial. The two required service-learning classes already required were sufficient enough given it is an Undergraduate program. Also, Math 308 and Math 309 are both three-unit classes. The teachers have condensed their curriculum as much as possible and do not believe the amount of work required for service learning should be fit into the course. However, when asked about incorporating an activity or two of real life experience, all teachers responded positively.

Two of the teachers explained how many of the students in their classes' were also enrolled in a service learning class. One teacher commented that "if there was a way to coordinate [the service learning class with the math class]…then we could build in some assignments that could really take advantage of [the service learning class] and I think it would be great" (C. Reed[1], personal communication, November 16, 2011). The teachers saw the benefit of starting to tie the concepts and the methods at this stage in the students learning.

Opinions of Reflection in the Classroom

The topic of personal reflection was met with some hesitation and confusion. A survey is given at the beginning of the semester in each class. This survey serves as an opportunity for the teacher to understand the student's opinion of math and what the students history is around math. This is the only time during the classes that students have the chance to personally reflect on their attitudes and beliefs towards math. A component of both classes is having the ability to dissect a problem, comprehend the multiple ways to write a problem as well as the vocabulary that is unique to math. In this respect, Math 308 and Math 309 do require a fair amount of writing to analyze problems. Student must also analyze children's work and find where the children are missing the concepts. This makes Math 308 and Math 309 different from other math courses because of the conceptual knowledge the students are gaining. But the required form writing is different than personal reflection because it is all external work. The teacher at the credential program had some very interesting insight. She mentioned, "You give them opportunities, you probe for it, and they go, 'Eh, we're ok'" (M. Shaeffer, personal communication, October 25, 2011). This quote goes against some of the research I have found. Raymond (1997) found that examining one's beliefs about math and how it relates to their pedagogy is an important process that is better started early in a teachers preparation work. A Math 308 and Math 309 instructor responded well to the question and thought it would be beneficial to check in more often during the semester to see how her students are responding and if their views of math change at all. When asked the teachers' opinions of having a project

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[1] All names of people have been replaced with pseudonyms.

including a reflection component, time was the biggest concern. None feel as if they have enough time to teach the amount of content they would like so all where hesitant about agreeing to add anything else to the curriculum. This is only one example of the concerns and hesitations about incorporating reflection and an out of class activity.

Concerns of Out of Class Activity

MPUSD guidelines. Currently, MPUSD requires Tuberculosis tests as well as background tests for students participating in service learning. Regarding asking students to coordinate an outside of class activity, one teacher commented "…it's a very good thought but you have to understand the background to do it" (S. Collins, personal communication, November 8, 2011). The guidelines currently in place are for those planning a semester long visits. It is not clear whether a one-time visit would require the same amount of paperwork. A different possibility to work around the current requirements in Monterey County is to coordinate with a school in Salinas. Because it is a different district, the requirements are different. Another option is to ask a private or charter school if they are open to having the student visit. A different venue could also be at an afterschool program or at the Boys and Girls Club. Being able to interact with the student outside of the classroom environment about an educational topic could be beneficial for the CSUMB student to see the children in a different setting and the children seeing their schoolwork in a different setting as well.

Volunteer or mandatory. Due to time constraints as well as required curriculum some teachers were concerned of overloading the students with work. Whether this activity is volunteer or mandatory is up to the instructor's discretion. The project could be a fun end of the semester project, which included a reflection component on the entire semester as well as the math activity. It can also be set up as an extra credit option for those to do at any point in the semester.

Unit restrictions. Math 308 and Math 309 used to each be four units. After being cut down to three units all instructors were faced with squeezing as much as they could into a smaller time frame. It is very important that the students have enough time to learn and process the information. By adding a service-learning component, I understand that the time restriction would hinder the students from focusing on the content of the class. However, including a project that happens once a semester into a three-unit class is done in a variety of other required classes for the major in a variety of subjects. In my personal experience, having a project to help sum the semesters has always been productive and meaningful for me.

Location of School or After School Program. As touched on in the MPUSD guideline section, there are a variety of different schools that can accommodate CSUMB students without entrance requirements. Another option is to find a school to partner specifically with the courses. An example of this is in KIN 374L: Physical Education for Elementary School Children Lab where the class has a partnership with McKinnon Elementary in Salinas. By doing this it saves time for the students so they do not have to find a school, the teachers can work on building a relationship with a school who most aligns with the practices Math 308 and Math 309 teach and that particular school is able to reap the benefits of college students participating in the school and helping educate the children.

Service-learning logistics. A thought was quoted earlier about coordinating the student's pathways in such a way where a service-learning class would need to be taken in the same semester the students take Math 308 and Math 309. I went and discussed this option with the Chair of the Liberal Studies Department and she agreed with the idea. Liberal Studies students have a lower division service-learning class, LS 298S, which Math 308 could be paired with. The department head mentioned that Math 308 is normally taken earlier in the course pathway so they could be easily paired together. Not all who come to CSUMB are required to take LS 298S. Transfer students who have documentation of prior service learning hours can waive taking the course. Fortunately, Liberal Studies also offers LS 398S and LS 394S. This would open the option for all Liberal Studies students, transfers and non-transfers to take both of their math classes with a service learning class. This opens up the opportunity for the Math 308 and Math 309 instructors to assign smaller tutoring assignments if the student's service-learning hours were during math instruction.

Description and Justification of Action

The teachers of Math 308 and Math 309 are aware of the benefits of real life experience in teaching mathematics. They were supportive in having an option to incorporate a fun activity for the students of Math 308 and Math 309 to apply what they had been learning. After addressing the concerns and logistics of the teachers, my action serves as an example of how they could execute an outside of class math activity without overwhelming the students. What I am presenting to the instructors is a mock activity of what I would do for the project. Being that I have taken both classes, I feel my experience will give a realistic example of what a student could produce.

The Math Activity also involves the community and school that participate. The school is able to have volunteers (Liberal Studies students) host an educational event at their school. Depending on when it would work best for the CSUMB students to execute their project, parents could have the opportunity to visit the school and gain resources to help with their children's learning. The children get the chance to experience math outside of the classroom and engage in activities their normal classroom may not be able to accommodate.

My action to design a "Math Activity" in a box is for the math classes to have an activity they could do in an elementary school. The research brought up the need for teachers to have enough time to learn the procedures and be able to practice their skills with the students. Liberal Studies students already have two requirements to participate in a school with their lower and upper division service learning. The math activity is an opportunity to experience math specifically. From the research and interviews, trying to incorporate a service-learning component into a content course was not something that seemed to serve the students in the class. Therefore having only one activity instead of a weekly expectation was my focus for the action. I have heard throughout my career at CSUMB the importance of practice. In order to understand if one is going to be happy and enjoy teaching and be an effective teacher, they need to experience it. Math is a subject that is often seen as intimidating. The Math 308 and Math 309 teachers are not only up against the task of re-teaching many of the math concepts, but also helping the students believe in their own ability to do math. The option of having a math activity gives the students of Math 308 and Math 309 the opportunity to have fun with math and watch children struggle with the same concepts they did and hopefully the students of Math 308 and Math 309 come to an even deeper understanding of what they have been taught.

Action Documentation

I made two math activities, one for the Math 308 class and one for the Math 309 class. Each activity involves group work, manipulatives, and time for the students to explore the problems in groups. Each activity box includes the outline for the CSUMB student to follow, construction paper manipulatives for the students to use during the activity as well as their own set of manipulatives to take home for further exploration. The boxes will also include parental instructions in both English and Spanish. I chose to include this so the parents can have the opportunity to learn a different way to approach a subject they already know, or learn something new and offer help to their child.

The activity for Math 308 is about fractions. The activity starts with the children in groups of 4 or 5 freely playing with the manipulatives and starting to find associations between the sizes and shapes. Next the CSUMB student will guide them through the different associations using mathematical terms such as “whole” and “parts.” As part of this the CSUMB student will give the children problems to solve such as “How many triangles are in a hexagon?” After that the children will be given a set of problems to try to solve together in their groups. One example is to combine three triangles and one trapezoid. In each question the children establish what one whole is and represent their answer in those terms. At this point in the activity it can be summed up and finished. But, depending on the age’s present and the amount of time, the activity can transition to associating written numbers with the shapes. The CSUMB student guides the children through the parts of a fraction and has them explore how each shape would be represented if the hexagon was whole. Then the children work through the same problems they did in the first section of the activity, but now associating the fraction numbers. The activity ends with the children having time to freely play with the manipulatives.

The Math 309 activity is learning about geometry through tessellations. Tessellations are patterns of shapes that do not overlap or have gaps. Using pattern blocks along with adding a square, regular pentagon and a regular octagon the children are broken up into groups and given time to explore which pieces form tessellations. After the children discovery which regular polygons form tessellations the CSUMB student will lead a discussion about the association found between the measurements of the angles at any vertex and which regular polygons form tessellations. From that information the children brainstorm and try to figure out how to find the measurement of the interior angles of each shape. Next, the children are given time to explore forming tessellations with more than one shape and finding the angle measurements with those vertices. The activity ends with the children having the option of drawing out the tessellations they formed.

After the CSUMB student has completed their activity they will complete an online survey that asks them to reflect on their feelings, beliefs and attitudes about how their math activity went and how they view their ability to teach math at this stage in their learning career.

Each Math Activity Box has been presented to the instructors of Math 308 and Math 309. I included a letter thanking them for their participation in my capstone project. I also included my results section with my suggestions towards their concerns about incorporating a math activity. Lastly, I included my contact information and offered any help I could if this was an activity they would like to try to add to the class next semester.

Critical Reflection

I have gained a lot of knowledge and growth through the capstone process. Being able to devote an entire semester to an area I am very passionate about really cemented my commitment to become a teacher and work towards the changes I wish to see. The LS 400 class was constructed in such a way that I felt supported and guided in my pursuit while still having ample room to grow and experience the research process at my own pace. While there are things I would do differently if I had to chance to do the project again, I am happy with the knowledge I have gained and the focus I have developed.

I have experienced the difficulties and rewards in conducting research. One of my biggest struggles was maintaining a manageable scope for the semester time frame. This whole process has provided more questions that I have had time to answer and I would at times find it difficult to not get sidetracked. Interviewing different people helped me learn to be open to adjusting my research. My project has evolved and changed through the semester and I learning to really listen to what I was being told and use it in a way that was both beneficial to my research topic and those affected by it. One of the biggest rewards I gained is discovering that my opinion about teacher's mathematical beliefs and attitudes is reflected in the peer-reviewed literature. I felt a large sense of belongingness and validation to have those in the field of education agree with what I believed. My research also showed all the different programs that are available in being a math teacher and what is being done currently to explore my research topic.

My action offered me practice in designing a math activity and exploring what my feelings and beliefs currently are. I felt excited to be designing a project I would really enjoy teaching, but also concerned about being confident enough to explain and teach the concepts correctly. While I trust my knowledge in fractions and geometry, I do not know everything. As one of the interviewee's said, "…they don't know what they don't know" (L. Walters, personal communication, November 1, 2011). Having the opportunity in the undergraduate process to start to explore what I don't know is very important. Due to time constraints I was unable to execute my action to the extent I would have like too. My original plan was to have a group of Liberal Studies student conduct the activity with a group of children and reflect on the experience. If this is a project the instructors of Math 308 and Math 309 try to implement next semester I hope to be a part of it.

I feel fortunate to be graduating from the Liberal Studies department. Through my coursework I have been able to grow and develop and gain a clear goal of what I want to pursue in the educational field. I have started to learn the importance, challenges, and rewards in being a teacher. I believe I have a real life view of how our educational system is set up and where I as a teacher can cause change. My understanding of myself as a white female choosing to enter a position of power over the next generation is not something I take for granted. My classes have taught me the depth and complexities of multiculturalism way beyond cuisine and clothes. That knowledge is something I will take and use to continue learning and implement in my own classroom to humanize my students. The life I have been given as a middle class white female has many unspoken privileges. In being aware, understanding and humbled to those privileges, I have the opportunity to give this power back to the students.

An area of study that greatly informed my project is mathematics. Math 308 and Math 309 along with the class work required for my Math Minor has helped me develop my problem solving skill set. I have also learned through the History of Mathematics as well as College Geometry how dynamic the history of math is. My appreciation for the minds that have contributed to what we know so far is a connection I want to make with my students. I also have learned that math is not a static endeavor. Mathematicians today are still working on gaining a deeper understanding of concepts and ideas.

Another area that has also informed my project is the integrated physical science course. As with my Math 308 and Math 309 courses, Phys 121 uses the constructivism model of teaching. This really impacted my project because these classes gave me more responsibility over how much I learned. Much of my learning was through trial and error and searching for the answer's myself instead of being told the answers. In my research for my project, I found myself becoming more and more drawn into the topic and excited to be a part of the discussion.

My project was informed through my experiences in learning the different schools of thought surrounding education. In Pro-seminar we explored what it meant to be well educated. By examining those who believed in E.D. Hirsh's Core Knowledge as well as those who disagreed, I gained a deeper knowledge into what it means to be well educated. I disagree with Hirsh's model and started to open myself up to the different types of knowledge that exists and what my opinion was on a person being "educated." These thoughts were further deepened in my Innovative Approaches to Schooling class. This class opened up a discussion of how we define proper education and how to prepare students to enter into society as productive members. These classes informed my project because they taught me that learning is not linear. I have learned to be open and receptive to styles of learning I was not aware of, and to plan the activity in a constructivist fashion so the children have the chance to experience math in a way they may not have seen before.

The last two classes that informed my project were Multicultural Children's Literature and Teaching for Social Justice. The impact these two classes had on my view on teaching and life has deeply changed how I view society and myself. For the first time I was open enough to get a glimpse of the world through someone else's eyes. My project in Teaching for Social Justice was also focused on math. The class was a struggle because I was trying to find the outlet of teaching math while being socially just. While I am still learning how to incorporate both of those, I know my mindset has changed. I want teachers to be able to teach math in a way that is accessible to all their students. My upbringing involved my mother working in my elementary school and me having an abundance of support and help from the adults around me. Many of the children I have met though service learning are leading a very different life. I had a quiet place to do homework and had two parents who were present every evening to help me. I have learned this is not the norm for most families, but that does not mean they are not capable of being productive learners. I wanted to incorporate a way to bring these math activities into the family setting. My take home kits are ways for the children to show and explain to their parents what they did. The kit also offers the parents a chance to explore the activity as well.

From here I am looking forward to following what is being done in the educational field concerning pre-service teachers beliefs, opinions and attitudes towards math. I plan to gain experience in my own classroom and then conduct my own research to contribute to pre-service teacher's attitudes, beliefs and confidence to teach math.

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Appendix

Fractions:

This activity is broken up into two sections the first is using pattern blocks only, and the second section is associating shapes with numerical fractions. The total time for this activity can easily extend longer than an hour. Therefore it may be a project that is broken into different sections.

Definitions:

- Triangles: 3 sides
- Parallelogram: 4 sides (opposite sides parallel)
- Trapezoid: 4 sides (Only one set of opposite sides parallel)
- Hexagon: 6 sides

Activity:

Break the kids into groups of 3 or 4 and give them each a few of each of the shapes. Have the kids explore the shapes and find associates between them. Ask them to share one thing they discovered

The kids should see how two trapezoids fit into one hexagon. Three parallelograms fit into one hexagon. Six triangles fit into one hexagon. Etc…

Give the following addition problems. With each problem the kids will have to say which piece is the "whole." Also, each answer will have to be given in terms of the least amount of shapes.

1) Combine one trapezoid and one parallelogram.

A: The hexagon is the whole. Because the shapes are not the same, the kids should use the triangle shape instead to show that the answer is five triangles. The reason for this is because in written fraction form this is $\frac{1}{2} + \frac{1}{3}$. We would then find the common denominator of 6.

2) Combine three triangles and one trapezoid.

A. The hexagon is the whole. The kids could replace the trapezoid with the triangles and show that six triangles or one whole hexagon is the answer. Or they could replace the three triangles with one trapezoid.

3) Combine two parallelograms, one trapezoid and four triangles.

A. The hexagon is the whole. There are a few different combinations for this one. One is one hexagon, one trapezoid and one parallelogram. But, this can be taken down to fewer shapes if they use the triangles instead of the trapezoid and parallelogram.

4) Take away one triangle and one trapezoid from two hexagons. One hexagon is whole.

A. They will have to break up a hexagon and represent it in terms of triangles and trapezoids. They should then come up with one hexagon and one parallelogram.

Next, transition the activity into written fractions. Establish the hexagon as one whole. Then put two trapezoids next the hexagon and show they are also one whole just shown with two equal shapes. So the number of equal shapes to make a whole goes in the denominator and the numerator counts how many of those shapes are shown. So if one trapezoid is shown it is ½. One meaning that only one trapezoid is shown and 2 is how many trapezoids it would take to make a whole.

Have the kids try to figure out how to write the parallelograms and triangles in fraction form.

Next, use the same questions from above, but have them work through their steps and write the number associations with each problem. Each problem answer can only have one fraction in it.

The goal is for the kids to start to understand that we had them show the answer in the least amount of shapes because their numerical answer can only be in one fraction.

1) Combine one trapezoid and one parallelogram.

A: The hexagon is the whole. Because the shapes are not the same, the kids should use the triangle shape instead to show that the answer is five triangles. The reason for this is because in written fraction form this is ½ + ⅓. We would then find the common denominator of 6.

N.A.: Hexagon is the whole. One trapezoid (½) and one parallelogram (⅓) can't be the final answer because that would mean two fractions. By changing the trapezoid into triangles (3/6) and the parallelogram into triangles (2/6) they can then combine the triangles and numbers. The big point here is the bottom number always refers to the whole.

2) Combine three triangles and one trapezoid.

A. The hexagon is the whole. The kids could replace the trapezoid with the triangles and show that six triangles or one whole hexagon is the answer. Or they could replace the three triangles with one trapezoid.

N.A.: Either way they chose they will have either 3/6 + 3/6 or 1/2+1/2. This may start a discussion of how three triangles is the same as one trapezoid. So 3/6 is the same as 1/2. This would be going into a different lesson but should be addressed. These two fractions are different ways of showing the same thing. The fraction 1/2 is a simpler way to write it because we only have to use one shape to explain it instead of 3. Depending on the age, you can also explain that 3 is half of 6.

3) Combine two parallelograms, one trapezoid and four triangles.

A. The hexagon is the whole. There are a few different combinations for this one. One is one hexagon, one trapezoid and one parallelogram. But, this can be taken down to fewer shapes if they use the triangles instead of the trapezoid and parallelogram.

N.A.: A few different ways of combing these shapes will get one whole. One way is to combine two parallelograms and two triangles. Then there is one trapezoid and one triangle left. After changing the trapezoid in to 3 triangles, the final answer is 1 5/6.
Another way is to combine one trapezoid and three triangles to make the whole. Then there are two parallelograms and one triangle. After changing the parallelograms into triangles, the final answer is 1 5/6.

4) Take away one triangle and one trapezoid from two hexagons. One hexagon is whole.
A. They will have to break up a hexagon and represent it in terms of triangles and trapezoids. They should then come up with one hexagon and one parallelogram.

N.A.: One hexagon stays the same and will be written as 1. The other hexagon will be broken up with one trapezoid (1/2) and three triangles (3/6). Then by taking away the 1/2 and 1/6 it is left with 2/6. Ask the children to see if there is a simpler way to show the answer instead of two triangles. They should come up with one parallelogram or 1/3.

With any remaining time let the kids free play and make shapes and patterns with the pattern blocks.

Parent's Reference:

Definitions:

- Triangles: 3 sides
- Parallelogram: 4 sides (opposite sides parallel)
- Trapezoid: 4 sides (Only one set of opposite sides parallel)
- Hexagon: 6 sides

Green Shape: Equilateral Triangle
Blue Shape: Square
Red Shape: Trapezoid
Orange Shape: Regular Pentagon

Have your child explore the shapes and find things that are alike between them. Ask them to share what they discovered.

The different shapes fit evenly into other shapes. Two trapezoids fit into one hexagon. Three parallelograms fit into one hexagon. Six triangles fit into one hexagon. Etc…

Give the following problems. With each problem the kids will have to say which piece is the "whole." The whole piece is a piece that all the others can fit into. For each problem the hexagon is the whole. Also, each answer should be show with the least amount of shapes. The child is trying to see how many shapes fit in the whole (hexagon).

1) Combine (add) one trapezoid and one parallelogram.

A: The hexagon is the whole. Because the trapezoid and parallelogram are different shapes, the child should use the triangle shape instead to show that the answer is five triangles. The reason for this is because in written fraction form this is ½ + ⅓. If we were writing it we would the find the common denominator of 6. They will learn how to do this later. So for now we only want one shape to show how many fit into the whole.

2) Combine three triangles and one trapezoid.

A. The hexagon is the whole. The kids could replace the trapezoid with the triangles and show that six triangles or one whole hexagon is the answer. Or they could replace the three triangles with one trapezoid. The final answer is one whole hexagon.

3) Combine two parallelograms, one trapezoid and four triangles.

A. The hexagon is the whole. There are a few different combinations. One is one hexagon, one trapezoid and one parallelogram. But, this can be taken down to fewer shapes if they use the triangles instead of the trapezoid and parallelogram. In the end they should have one whole hexagon and five triangles.

4) Take away one triangle and one trapezoid from two hexagons. One hexagon is whole.

A. Start out with two hexagons. Have them use a trapezoid and three triangles and take one of the hexagons away. They still have two wholes. We just broke one up. Then, take away one triangle and one trapezoid. They are left with two triangles. They can use a parallelogram instead of the two triangles so the final answer is one hexagon and one parallelogram.

Next, lets look at written fractions. The hexagon is still one whole. If you put two trapezoids next the hexagon, they are also make one whole just shown with two equal shapes. We write this fraction as 1/2. The number of equal shapes it takes to make a whole goes one the bottom (denominator) and how many pieces you have goes on the top (numerator). If one trapezoid is shown it is 1/2. One meaning that only one trapezoid is shown and 2 is how many trapezoids it would take to make a whole hexagon.

Have your child try to figure out how to write the parallelograms and triangles in fraction form.

It takes six triangles to make one hexagon. So a one is in the numerator (on top) because it shows one piece and a 6 is in the denominator (the bottom) because that's how many it take to make one hexagon. 1/6

Next, use the same questions from above, but have them work through their steps and write the number associations with each problem. Each problem answer can have a 1 if you make a whole hexagon and only have one fraction after that if you have more shapes.

1) Combine one trapezoid and one parallelogram.

A: The Hexagon is the whole. One trapezoid (½) and one parallelogram (⅓) can't be the final answer because that would mean two fractions. By changing the trapezoid into triangles (3/6) and the parallelogram into triangles (2/6) they can then combine the triangles and numbers. Three triangles fit evenly into the trapezoid. The child may write 3/3. But remember the denominator always means how many pieces it take to make one whole. And we already decided the hexagon was the whole. The correct answer is 5/6.

2) Combine three triangles and one trapezoid.

A: Either way they chose they will have either 3/6 + 3/6 or 1/2+1/2. This may start a discussion of how three triangles is the same as one trapezoid. So 3/6 is the same as 1/2. This would be going into a different lesson but should be addressed. These two fractions are different ways of showing the same thing. The fraction 1/2 is a simpler way to write it because we only have to use one shape to explain it instead of 3.

3) Combine two parallelograms, one trapezoid and four triangles.

A: A few different ways of combing these shapes will get one whole. One way is to combine two parallelograms and two triangles. Then there is one trapezoid and one triangle left. After changing the trapezoid in to 3 triangles, the final answer is 1 5/6.

Another way is to combine one trapezoid and three triangles to make the whole. Then there are two parallelograms and one triangle. After changing the parallelograms into triangles, the final answer is 1 5/6.

4) Take away one triangle and one trapezoid from two hexagons. One hexagon is whole.

A: One hexagon stays the same and will be written as 1. The other hexagon will be broken up with one trapezoid (1/2) and three triangles (3/6). Then by taking away the 1/2 and 1/6 it is left with 2/6. Ask the child to see if there is a simpler way to show the answer instead of two triangles. They should come up with one parallelogram or 1/3. The final answer is 1 1/3.

Referencia de los padres:

Definiciones:

- Triángulos: 3 lados
- Paralelogramo: 4 lados (enfrente de lados paralelos)
- Trapezoide: 4 lados (un único conjunto de paralelismo de lados opuestos)
- Hexágono: 6 lados

Forma verde: Triángulo equilátero
Azul forma: cuadrado
Forma roja: trapezoide
Forma naranja: Pentágono Regular

Con su hijo explorar las formas y encontrar cosas que son iguales entre ellos. Pídales que compartan lo que descubrieron.

Las diferentes formas encajan uniformemente en otras formas. Dos trapezoides caben en un hexágono. Tres paralelogramos encajan en un hexágono. Seis triángulos encajan en un hexágono. Etc…

Dar los siguientes problemas. Con cada problema los niños tendrán que decir qué pieza es la "totalidad". Toda la pieza es una pieza que todos los demás encajan. Para cada problema el hexágono es todo. Además, cada respuesta debe mostrar con la menor cantidad de formas. El niño está tratando de ver cómo muchas formas caben en todo (hexágono).

1) Combinar (Agregar) un trapecio y un paralelogramo.
R: el hexágono es todo. Porque el trapecio y paralelogramo son formas diferentes, el niño debe utilizar la forma de triángulo para mostrar que la respuesta es cinco triángulos. La razón de esto es porque en fracción forma escrita es ½ + 6.585,32. Si estábamos escribiendo que lo haríamos el buscar el denominador común de 6. Aprenderán cómo hacerlo más tarde. Así que por ahora solo queremos una forma para mostrar cuántos caben en el conjunto.

2) Combinar tres triángulos y un trapecio.
R. el hexágono es todo. Los niños podrían reemplazar el trapecio con los triángulos y demostrar que seis triángulos o un hexágono toda es la respuesta. O pueden sustituir los tres triángulos con un trapezoide. La respuesta final es un hexágono todo.

3) Combinan dos paralelogramo, un trapecio y cuatro triángulos.
R. el hexágono es todo. Hay algunas combinaciones diferentes. Uno es un hexágono, un trapecio y un paralelogramo. Sin embargo, esto puede tomarse a formas menos si utilizan los triángulos en lugar del trapezoide y paralelogramo. Al final deben tener un hexágono todo y cinco triángulos.

4) Llevar un triángulo y un trapezoide de dos hexágonos. Un hexágono es todo.
A. comienza con dos hexágonos. Tienen un trapezoide y tres triángulos y llevar uno de los hexágonos. Tienen dos un todo. Nosotros sólo rompió uno. A continuación, llevar un triángulo y un trapezoide. Se quedan con dos triángulos. Pueden utilizar un paralelogramo en lugar de los dos triángulos por lo que la respuesta final es un hexágono y un paralelogramo.

A continuación, analicemos las fracciones escritas. El hexágono es uno todo. Si pones dos trapezoides a continuación el hexágono, son también hacer todo solo uno que se muestra con dos formas iguales. Escribimos esta fracción como 1/2. El número de formas iguales que se tarda en hacer un plenario uno va la parte inferior (denominador) y cuántos tienes va en la parte superior (numerador). Si se muestra un trapezoide es 1/2. Uno lo que significa sólo un trapezoide se muestra y 2 es cuántos trapezoides tomaría para hacer un hexágono todo.

Tener a su hijo intentar averiguar cómo escribir los paralelogramos y triángulos en forma de fracción.

Tarda seis triángulos para hacer un hexágono. Así que uno está en el numerador (en la parte superior) porque muestra una pieza y un 6 es el denominador (el fondo) porque es cuántos tarda en hacer un hexágono. 1/6

A continuación, utilice las mismas preguntas desde arriba, pero que funciona a través de sus pasos y escriben los números asociaciones con cada problema. La respuesta de cada problema puede tener un 1 si un hexágono todo y sólo tienen una fracción después de si tienes más formas.

1) Combinan un trapecio y un paralelogramo.
R: el hexágono es todo. Un trapezoide (½) y un paralelogramo (6.585,32) no puede ser la respuesta final, porque eso significaría dos fracciones. Cambiando el trapecio en triángulos (3/6) y el paralelogramo en triángulos (2/6) que, a continuación, pueden combinar los triángulos y los números. Tres triángulos encajan uniformemente en el trapecio. El niño puede escribir 3/3. Pero recuerde que el denominador siempre significa cuántas piezas tarda en hacer un todo. Y ya hemos decidido que el hexágono fue todo. La respuesta correcta es 5/6.

2) Combinar tres triángulos y un trapecio.
R: cualquier manera eligieron tendrán cada 3/6 + 3/6 o 1 / 2++ 1/2. Esto puede iniciar una discusión de cómo tres triángulos es lo mismo que un trapezoide. Por lo tanto 3/6 es igual a 1/2. Esto podría ir en una lección diferente pero debe abordarse. Estas dos fracciones son diferentes maneras de mostrar lo mismo. La fracción 1/2 es la forma más simple para escribirlo porque sólo tenemos que utilizar una forma de explicar en lugar de 3.
3) Combinan dos paralelogramo, un trapecio y cuatro triángulos.

R: unas maneras de peinar estas formas obtendrá un todo. Una forma es combinar dos paralelogramos y dos triángulos. Entonces es un trapecio y un triángulo izquierda. Después de cambiar el trapecio en 3 triángulos, la respuesta final es 1 5/6.
Otra forma es combinar un trapezoide y tres triángulos para hacer todo. Entonces hay dos paralelogramos y un triángulo. Después de cambiar los paralelogramos en triángulos, la respuesta final es 1 5/6.

4) Llevar un triángulo y un trapezoide de dos hexágonos. Un hexágono es todo.
R: un hexágono mantiene igual y se escribirá como 1. El otro hexágono ser desguazado con un trapezoide (parte 1 de 2) y tres triángulos (3/6). A continuación, quitándole el 1/2 y 1/6 TI se queda con 2/6. Pregunte al niño para ver si hay una manera más simple para mostrar la respuesta en lugar de dos triángulos. Se debe topar con un paralelogramo o 1/3. La respuesta final es 1 1/3.

Tessellations Activity

Definitions:

- Tessellation: A pattern where no pieces overlap and there are no gaps between pieces.
- Regular Geometric Shapes: Shapes (Polygons) where all the sides are the same length and all the angles are the same measurement.

Activity:

Break the kids into groups of 4 or 5. Each group will be given a variety of regular geometric shapes ranging from equilateral triangles (3 sides) to octagons (8 sides).

Have the kids explore which shapes form tessellations with shapes of the same, and which shapes form tessellations with different shapes.

They should discover that equilateral triangles, squares and regular hexagons are the only 3 regular polygons that form tessellations.

Then, explain there is a relation between the total measurement of the angles and which shapes will form tessellations. Have the kids use the equilateral triangles, squares, and hexagons to see if they can find the association between the angle sum and pattern.

What they are trying to find is that at every vertex, the angles add up to 360°. Since all the shapes are regular polygons, all angles will have the same measurement.

For the last part of the lesson give each kid a piece of paper, some different colored markers and let them trace the shapes and draw out different tessellation patterns.

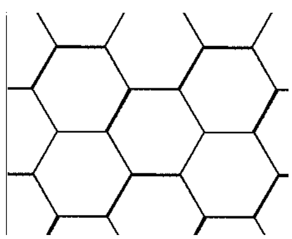
Parent's Reference:

Definitions:

- Tessellation: A pattern where no pieces overlap and there are no gaps between pieces.
- Regular Geometric Shapes: Shapes (Polygons) where all the sides are the same length and all the angles are the same measurement.
- Vertex: Is the point where two sides of a shape meet. A triangle has 3 vertices and a square has 4.
- Angle: The two sides and the vertex form an angle. Each angle can be measured in degrees (symbol: °)

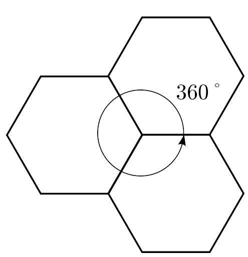
Green Shape: Equilateral Triangle
Blue Shape: Square
Orange Shape: Regular Pentagon
Yellow Shape: Regular Hexagon
Brown Shape: Regular Octagon

Have your child explore which shapes can form a pattern like the ones below:



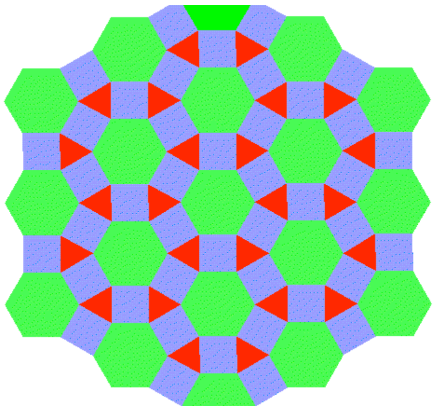
By placing the shapes together, some shapes will make patterns where no pieces overlap and there are no gaps between the pieces. The three shapes that will form Tessellations are the Equilateral Triangles, Squares and Regular Hexagons.

These three shapes have one thing in common that makes them all form Tessellations. Adding up the measurement of the angles where the vertices meet will always equal 360°.



Equilateral Triangles: 60°+60°+60°+60°+60°+60°=360°
Square: 90°+90°+90°+90°=360°
Regular Hexagon: 120°+120°+120°=360°

Now, see if they can find other Tessellation patterns by combining different shapes! And they check to see what the vertices add up to be!



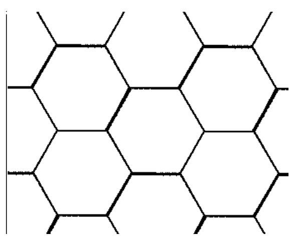
Referencia de los padres:

Definiciones:

- Mosaico: Un patrón donde se superponen sin piezas y hay no hay huecos entre piezas.
- Formas geométricas regulares: Formas (polígonos) donde todos los lados son la misma longitud y todos los ángulos son la misma medición.
- Vértice: Es el punto donde se unen dos caras de una forma. Un triángulo tiene 3 vértices y un cuadrado tiene 4.
- Ángulo: Los dos lados y el vértice forman un ángulo. Cada ángulo puede medirse en grados (símbolo: °)

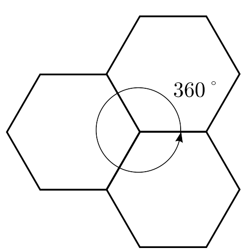
Forma verde: Triángulo equilátero
Azul forma: cuadrado
Forma naranja: Pentágono Regular
Forma amarillo: Hexágono Regular
Forma marrón: Octágono Regular

Tener a su hijo explorar qué formas puede formar un patrón como los que a continuación:



Colocando las formas juntos, algunas formas harán patrones donde no hay piezas se superponen y hay no hay huecos entre las piezas. Las tres formas que van a formar teselaciones son el equilátero triángulos, cuadrados y hexágonos regulares.

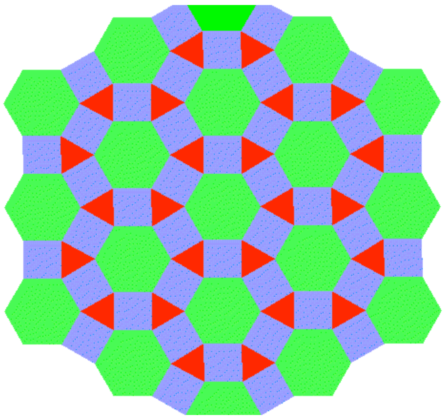
Estas tres formas tienen una cosa en común que les hace todo de teselaciones de forma. Adición de la medición de los ángulos donde se unen los vértices siempre será igual a 360 °.



Equilátero: 60 ° + 60 ° + 60 ° + 60 ° + 60 ° + 60 = 360 °
Plaza: 90 ° + 90 º + 90 º + 90 º = 360 º

Hexágono regular: 120 + 120 ° + 120 = 360 °

Ahora, ver si pueden encontrar otros patrones de mosaico combinando diferentes formas!
Y comprueban para ver lo que los vértices suman a ser!



After Activity CSUMB student Reflection:

1) Describe why you chose to teach the topic you did in your activity.

2) What kind of emotions did you experience before, during and after the activity?

3) How well prepared did you feel for the activity?

4) What went well?

5) What would you change?

6) What was one success in this activity?

7) What was one challenge in this activity?

8) How has this experience changed your view of your ability to teach math thus far?