TSG 33: A MULTICULTURAL LOOK AT MATHEMATICS

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Abstract:

The effects of using Turkish cultural motifs to improve attitudes toward mathematics was examined by implementing a standards based multicultural mathematics unit. This was performed with middle level students and preservice teachers from Turkey and the United States. Preliminary findings indicate a statistically significant improvement in attitude toward mathematics due to the cultural experiences.

Introduction:

Mathematics and culture are often seen as separate areas that have no connection. Yet, mathematics education should reinforce and feed the cultural identities of students and should provide a broad perspective that makes them tolerant of and knowledgeable about different cultures (D'Ambrosio, 2001). We believe that the selection of cultural themes or motifs that have implications for the study of mathematics is key to giving students this perspective. In Turkey, handloom weaving is an art that has had an important place in the culture as it evolves differently in different regions. Providing an awareness about this culture through the mathematical study of Turkish rugs and carpets will both enrich and enliven students' mathematics education, and this is why we have designed a program for students and preservice teachers on two continents focusing on Turkish rug design which is presented in this paper. There are people that define mathematics as a science of patterns, which we observe in an abstract sense in rugs and carpets –(Bier, 2004) so it seems fitting to focus on such patterns in the cultural exercises described herein.

The integration of cultural themes into the standard mathematics curriculum is an accepted way of offering students a broader view of mathematics. D'Ambrosio (1994) emphasizes how ethnomathematics helps with contextualizing the process of generating, organizing, transmitting, and disseminating mathematics. In the view of Adam, Alangui and Barton (2003), benefits of ethnomathematics include treating mathematics as a cultural response to human needs and providing a non-traditional form of mathematics (e.g., though use of decorative forms found in weaving or architecture). In their view, a child's mathematical learning first takes place in the mathematical world of the child's culture, which then matures as the child encounters the global mathematical world. Thus ethnomathematics works into a natural stage in the development of the mathematical thinking of a child. Adam *et al* also note that all classrooms are (of course) situated in a cultural context which includes values and beliefs about learning, aims of education, culturally-specific learning theories and practices, and the classroom environment. Mathematical experiences from the learner's culture are thus used to understand how mathematical ideas are formulated and applied. Using a cultural context for mathematical learning could motivate students to recognize mathematics as part of their everyday life, enhance students' ability to make meaningful mathematical connections and deepen their understanding of all forms of mathematics (Adam (2002)). This is all the more important these days, with the increased level of global communication and cultural information provided to students all over the world by the internet. We therefore believe that the introduction of cultural studies into mathematics can motivate students tremendously.

Teachers can realize the mathematical potential of their students by helping them acknowledge the importance of culture in their students' identities, as well as how this culture affects students' thinking and learning of mathematics. For this to be done, we must find ways to teach teachers the value of diversity in the mathematics classroom and to understand both the influences culture has on mathematics and how this influence leads to different ways in which mathematics is used and communicated. Thus ethnomathematics has an important role in teacher education.

Our program is very much in line with the National Council of Teachers of Mathematics (NCTM) Principles and Standards for School Mathematics K-12 (2000) in the United States, as it promotes equity, one of NCTM's underlying principles, by providing all students with the opportunity to learn about diverse cultures. This further develops their mathematical understanding and develops a more positive perception of mathematics. Content standards addressed in this multicultural unit include the

number and operations, geometry, measurement, data analysis and probability, problem solving, communication, connections and representation. This program is being presented in both English and Turkish, with the results communicated in English.

The aim of this project is simple. It is to provide students at the middle school level and pre-service teachers in both elementary and middle school preparation programs with a mathematics program that will acquaint them with cultural motifs, particularly with Turkish handloom weavings. For the teachers, our goal is to show them how they can include their culture and different cultures in the educational process of mathematics, and for all of them our goal is to show them that math is a culture that will always exist in our lives. This project was piloted in Istanbul in 2007, and continues there and in Rhode Island (USA) at present. Sixth graders at two schools in Istanbul and in one school in the USA are involved in the program, and preservice teachers in Providence, RI (USA) and at Ankara University (Turkey) are also involved. Some studies are completed and some are underway. In this paper we will present our program and our preliminary results.

An integrated curriculum based upon Turkish rugs was devised by the project team. Activities are designed to both enrich and reinforce the mathematics curriculum. Some activities will investigate handloom weaving and its relationship to mathematics to support the cultural look at mathematics. The various themes include instruction in number patterns, fractions, rate & ratio, area, similarity, polygons and transformational geometry. The number pattern strand is aligned with the National Council of Teacher's of Mathematics strand for problem solving, since students are using pattern recognition strategy to identify and generalize the pattern. The weavings, based on rug designs, are transformed into number patterns. Lessons will be embellished by including information and questions about handloom weaving and intercultural mathematical notation. In the fraction strand, part to whole relationships based on color are studied. For instance, students will investigate various rug patterns and the proportion of colors in differing patterns and their corresponding areas. A comparison of rug designs can be made by comparing color proportionality in the various weave designs. In addition, area, perimeter, price, size and shape of rugs and rug designs are examined for various types of regional patterns. The geometric designs of the rugs are examined using both the symmetrical and asymmetrical polygons used in the designs. By repeating different polygons using transformational geometry, samples of rugs are formed by students. Using clay, samples of rugs that contain motifs of polygons are visualized three dimensionally. For the middle school students, their work creating sample rug motifs is brought together in an exhibition where mini-workshops take place and are presented by the students.

In this study, we collaborated with the Plastic Arts and Turkish Language Departments of various universities. These departments contributed to the examination of rugs with different weaving patterns and the creating of designs that contain new motifs. They also contributed by providing texts that tell the meanings of the motifs used in these rugs and the emotions that they evoke. All of this information was shared with participants in the program in the United States.

In this "first pass" with our program, we have delineated three specific hypotheses, given here:

(1) Preservice teacher attitudes toward mathematics will significantly improve based on the multicultural program.

(2) Preservice teacher attitudes toward mathematics will show a statistically greater improvement at a college in the United States than at a Turkish University, due to increased interest in a multicultural program from a different culture.
(3) Middle level students' mathematical attitudes will increase significantly after the multicultural program.

In our current study, middle school students and preservice teachers took a 20-item survey of mathematics attitude and the relationship between math and culture (with 10 positive and 10 negative questions) on a 5-point Likert scale (Askar, 1986), with responses ranging from 5="strongly agree" to 1="strongly disagree." Students completed the survey questionnaire twice: once prior to the program, and again after the program. Differences in the responses of preservice teachers and middle school students before and after participating in the program identified any change in attitude toward mathematics as a result of the program.

The five sites in the USA and Turkey were given attitudinal scales and posttests on mathematical knowledge at the beginning and end of the study. Data was analyzed using the Wilicoxon signed-rank test for matched pairs for the attitudinal data. Comparisons will be made between US and Turkish students at both the middle school and preservice teacher levels. Student comments relating to the approach of learning mathematics will be noted. Pre-service teachers thoughts on implementing multicultural lessons and its usefulness will be collected.

Preliminary findings:
When we compare post-program and pre-program results there is an increase in most of the students' perceptions about the relationship between mathematics and culture. According to Wilcoxon paired-samples-analysis, this increase is found to be significant at 0.011 level for Turkish middle school students. The instruction presented to them had, for the most part, the same content that was presented to other students in the same grade level. However, the context of the instruction was different, including more cultural themes from real life as previously described. Besides doing exercises with fractions or patterns, students also discussed the meanings of different motifs and patterns and various carpet types. In this way, the rich material that exists in their culture became an integral part of their mathematics course.

At the end of the questionnaire students are asked to state their opinions related the relationship with mathematics and culture. Some students emphasized the positive contributions of cultural figures to mathematics courses. On the other hand, some students did not find a correlation between culture and mathematics. Here are some excerpts: (1)"*Math and culture together… would be good."(2)"They are close things to each other."*

In this study the problems were presented to students in a context enriched with cultural figures. In one of the studies the effects of the contextualized problems on students mathematics performance was investigated and a statistical significant increase was found. One of the student's evaluative commands in that study is worth mentioning. She said that school mathematics did not make sense to her and served no useful purpose. However, the contextualized problems did not look like mathematics (Bottge, 1999). In our study, we did not look for an increase in student achievement but one of the student's

thoughts on the instruction was close, "*We would have an instruction which is more entertaining and more informative (Turkish middle school student).*"

Site	N	p-value
USA Preservice teachers	17	0.000
Turkey Preservice teachers	53	0.000
Turkey Middle school site 1	45	0.011
Turkey Middle school site 2	*	
USA Middle school site 1	*	

The Wilicoxon signed-rank test for matched pairs on data for preservice teachers at a college that has a history of training teachers in the United States demonstrated statistically significant results in favor of an increase in mathematical attitude due to the program with p=0.0000. The null hypothesis of no difference between pre and post attitude scores is rejected in favor of a significant increase between the pre and post mathematics attitude scores. *Data for the other subgroups will be calculated upon completion of their curricula program. The data will be reported at the ICME-11 conference to be held in Monterrey, Mexico in July 2008.

Preliminary conclusions:
A program of mathematical study involving multicultural aspects will improve the mathematics attitudes of preservice teachers. This has implications for the design and implementation of curricula for mathematics courses directed at this population. Further study is needed to support the hypotheses. Conclusions with Turkish students need to calculated at the end of the program implementation and cross cultural analyses will be done.

The relationship between culture and mathematics and the place of culture in mathematics classrooms is discussed in Nasir et. al (2008). One of the possible ways of relating mathematics to culture is creating authentic mathematics problems. Making students think mathematically with cultural knowledge. One of the concerns in this study was to increase students' cultural awareness, improve their attitude toward mathematics along with increasing their mathematical skills.

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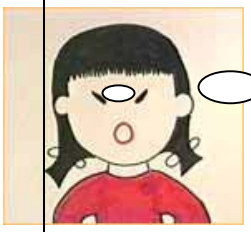
Appendix A: A SCALE FOR ATTITUDE TOWARDS MATHEMATICS COURSE

Name : _____

		Completely agree	Agree	Undecided	Disagree	Completely Disagree
1	Mathematics is a course I love.					
2	I dread going to mathematics class.					
3	Students' life would be more enjoyable without math class.					
4	I enjoy discussing mathematics with my friends.					
5	I wish we had more mathematics class hours.					
6	I am bored when I study mathematics.					
7	Mathematics class is a chore for me.					
8	I like mathematics.					
9	Time seems to drag when I am in mathematics class.					
10	I am apprehensive of mathematics exams.					
11	Mathematics is interesting for me.					
12	Mathematics is the course that scares me the most.					
13	I would never tire of studying math.					
14	I prefer studying mathematics to studying for other courses.					
15	Mathematics makes me uncomfortable.					
16	Mathematics scares me.					
17	Mathematics is a fun class.					
18	I feel joyful in mathematics classes.					
19	My least favorite class is mathematics.					
20	I would like to spend most of my study time doing math.					

DARÜŞŞAFAKA EĞİTİM KURUMLARI 1863 DŞ	**2007-2008 ÖĞRETİM YILI** **İLKÖĞRETİM 6. SINIF** MATEMATİK **ÇALIŞMA KAĞIDI** **AREA CALCULATION 1**	**Date** **…/…/……**

Name-surname: _____ **Class:** _____ **Number:** _____



Buhara Carpets! Buhar is "steam" in Turkish. Do you think they are called "Buhara" since they vapor?

Of course not. These rugs are done by Turkmenistan immigrants. The common point in these rugs are „bad eye". In a way people believe that these carpets protect people from troubles.

1) Width: 1.50 m length : 3 m are given for above rectangular carpet. Find the area of the carpet. Round it to the nearest integer.

2) The above Buhara carpet has 5 m^2 of area. If the area of the circular motives in the carpet are 2 m^2 , what is the ratio of circle shapes to total area of the carpet?

3) Write the result in question 2 as decimal number.

4) If the area of the circular motives in a similar carpet is 1,88 m^2, find the total area of the carpet.

5) You decided to buy a carpet for your room. There are several types of carpet and rug motifs in the catalog. You like four of them. The sizes of the rugs are given below.

a) Calculate the area of the each rug and write it in the table.

Rugs/carpets		Size (m x m)	Area (m^2)
	Turkmen Carpet	1,91 x 1,31	
	Kurds Carpet	1,75 x 0,9	
	Usak Carpet	1,85 x 1,45	
	Yahyalı Carpet	1,65 x 1,03	

b) Arrange the carpets according to their area in descending order.

c) Your room size is 2 m. x 1,26 m..Find the probability of choosing a carpet that fits into your room. Write it as a ratio and percentage.

d) Choose the most suitable one. Give your reasons.

e) If you place the rug on your floor, how much empty area is left in cm^2 ?

f) The rug I will buy according to the size of my room should not be smaller than…… meter square, bigger than ……. meter square.