

# STUDENT VIEWS OF DIVERSITY A MULTICULTURAL MATHEMATICS ACTIVITY

## Viewing Transformation during the Middle School Years



### Introduction

Multicultural education connects social change and transformation to the classroom (Banks, 2004; Sleeter, 2001). Within the field of multicultural education exists the prospect of transformative learning, defined as the process of moving beyond factual knowledge to developing greater awareness (metacognition) through the curriculum (Mezirow, 2000), growing and developing in a meaningful manner. Transformative learning highlights these factors within the personal context and societal context. With the changing face of today's classrooms, both in K-12 and higher education, there is a growing need to address multiculturalism and diversity awareness in the United States.

Of particular importance are the middle school years, which is the developmental period when students are concerned with how others perceive them and their culture (Manning, 1989). To the middle school student, their self worth and self image are at stake, and Manning suggests that the middle school classroom should be an

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environment that promotes cultural awareness, experiences, and opportunities.

Banks (1989) has proposed four major goals in multicultural education:

- (1) To increase the academic achievement of all students.
- (2) To aid students in developing a more positive attitude toward different cultural, racial, ethnic, and religious groups.
- (3) To assist students from victimized groups develop confidence in their academic ability and influence upon societal institutions.
- (4) To encourage all students to consider the perspectives of other groups.

Within the middle school classroom, multicultural education would act to positively enhance student awareness, develop understanding of diversity, and promote student self-confidence. It is a method to cultivate perspective and nurture diversity through cognition and action to achieve clarity in our societal mores and practices (Phillips, 1998). Hill (1992) suggests that the foundation for optimal child development is an understanding and appreciation of self, community, cooperation, purpose, creativity, and spirituality encouraged during the transition into adulthood, all of which can be achieved through multicultural activities during the middle school years.

An important aspect of multicultural education involves questioning assumptions, paradigms, values, and beliefs (Grabov, 1997; Mezirow, 1997). Mezirow (1990) states that learning is changing the way one thinks, but not all learning is transformative. Defining differences between transmissional, transactional, and transformational education, Miller and Seller (1990) state that transmission knowledge is lectured from teacher to student, while transactional knowledge is experienced, such as in practices of inquiry and interaction with others. Transformative knowledge goes beyond transactional knowledge, making learning not just behaviorally active, but cognitively active, through questioning one's own thoughts and beliefs (Mezirow, 1997).

O'Sullivan (2003) described transformative learning as:

[Experiencing] a deep, structural shift in the basic premises of thought, feelings, and actions. It is a shift of consciousness that dramatically and irreversibly alters our way of being in the world...[involving] our understanding of ourselves and our self-locations; our relationships with other humans and with the natural world; our understanding of relations of power in interlocking structures of class, race and gender; our body awarenesses, our visions of alternative approaches to living; and our sense of possibilities for social justice and peace and personal joy.

Multicultural education does not simply teach students about other cultural



*student*

*mathematics*

*middle school*

*transformation*

*video*

*village*

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or demographic groups but nurtures the cohesion of these groups. It goes beyond showing that there are many lifestyles, languages, cultures, or perspectives by embracing the differences between others to provide a platform for growth and unity, helping students to become respectful and understanding (Dimidjian, 1989).

Addressing the commonalities among those who may seem different helps to dispel stereotypes and encourage cohesion (Dixon & Fraser, 1986). Teaching with this perspective promotes the students' sense of uniqueness within their culture as a positive characteristic and enables the student to accept the uniqueness of other cultures (e.g., Tajfel & Turner, 1986; Tsue & Egan, 1992).

In today's diverse classrooms and society, multicultural education and transformative learning are imperative. However, also of importance to U.S. K-12 administrators are the growing necessities of meeting state and national curriculum standards. To combine these two practices, educators seek to teach common concepts through a multicultural framework.

For example, combining the national standards for mathematics education that promote data analysis and interpretation (NCTM, 2000) with the National Research Council (NRC) (1996) content standard of 'science in personal and social perspectives' that encourages systematic and critical thinking skills, may act to integrate cultural awareness and mathematics in

a culturally-responsive manner. Integrating these two cross-disciplinary standards may encourage students to explore and investigate their beliefs and surroundings—transforming their understanding of the world around them.

The 100 People Village research project explores world statistics and seeks to "educate, entertain, and inspire participants to learn more about world geography, culture, language, religion, music, and our shared resources" (100 People Foundation, ND). This foundational mission would encompass the three learning styles: transmissional, transactional, and transformational education.

For the multicultural activity used in this research study, students would focus on 'their world' as simply the school environment, and they would survey their school to learn about its cultural and background. With the results of the survey, the students would create a video that portrayed their school as 100 students. The instructors intended the video to be thought-provoking at a human level, and this message was repeated throughout the unit.

The goal was similar to the 100 People Foundation's mission to develop a video that shared information and explored the students of the school. This type of activity sought to transcend the traditional transmissional learning of mathematics to develop a more complete understanding of the students' society and culture in addition to mathematical concepts.

The purpose of our research was twofold: to explore students' thoughts of diversity in the U.S. and to determine how participation in a mathematics multicultural education activity affects student metacognition. Thus, the specific research questions for this study were:

- (1) How does participation in a multicultural education activity change middle students' metacognition and their view of diversity?
- (2) How do middle school students' conceptual understandings of diversity differ by gender, race/ethnicity, and socio-economic class following their participation in multicultural education activity?

### **Theoretical Framework**

Over the years there have been conversations examining the appropriate pedagogies and learning processes for mathematics at all levels, from K-12 (e.g., Fennema & Romberg, 1999) through higher education (e.g., Ganter, 2001, 2002). The fact is that most students fail to recognize mathematical material in relation to their world and their life (Gellert, 2004). Thus, there is a need to show students the relevancy and necessity of the discipline as it relates to their interests and future.

Further, in addition to multicultural understanding, societal needs require students to be versed in the science,

technology, engineering, and mathematics (STEM) disciplines. As such, the unit developed for this study built upon work from the 100 People Village by integrating the statistics curriculum with an activity where students explored their thoughts on diversity and multicultural awareness.

For the class project, students were to create a video showing their school as 100 students (Riskowski et al., 2010). Though the salient feature of this project was the development of the video production, it was the student dialogue and conversations that would be the most significant in developing the students' understanding of diversity and cultural awareness.

Castina (1996) suggests that behind the word diversity "lie[s] the basic underlying assumptions about the people who make up this nation, how they get along with each other, and how well they are living up to ideals of equality." She further states that there is an urgency in the U.S. to understand the cultural make up and diversity belief system of the country in order to understand the educational and awareness needs of its citizens. From the social constructivist viewpoint, it is only by understanding what students believe and think that instructors and institutions can appropriately meet the needs of the students (Wertsch & Polman, 2001).

From this viewpoint, student learning is improved through a common understanding between instructor and student knowledge, and this common understanding leads to open conversations and progresses student learning and transformation. This open approach breaks down resistance, and underscores the importance of investigating students' preconceived notions of diversity to augment learning while curtailing resistance to change (Rodriguez, 2002). Throughout the student project, small group, classroom discussion, and reflexive activities helped enable students to explore their own beliefs and ideas.

This approach enables students who are interested in learning how they relate to the world (Romberg, 1992; Romberg & Kaput, 1999). The value and applicability of a multicultural mathematics activity adds to student interest and understanding of mathematical techniques to explore and solve real-world problems (Meaney, 2002; Nichol & Robinson, 2000). Assimilating social and contextual learning with student interest in their world provides a platform for transformative learning alongside contextual learning. In attempting to understand others ideas, beliefs, and lifestyle, individuals may be encouraged to reflect on their own internal and external

models (Apple, 1979; Berlak, 1992), which encourages metacognitive development (Brown, 1987). Developing metacognition will encourage individuals to regulate their own cognition to enhance the potential to think, learn, and evaluate proper ethical and moral practices (Brown, 1987; Swanson & Hill, 1993).

Transformative learning can be seen as derivative from social constructivist theory (Mezirow, 1991; Cooke, 2001). Social constructivism structures student learning as a dynamic, iterative process developed through social interaction with members of the community and culture (Vygotsky, 1986). From this perspective, students construct their knowledge independently, not in isolation, but through a socially-negotiated practice of understanding (Bishop, 1985; Rogoff 1990; Vygotsky, 1986). They develop understanding based on prior ideas and experiences (Driver & Bell, 1986; Duit, 1991) and through physical and mental manipulation of objects (Piaget, 1970).

Thus, one key to facilitating learning is to enable students to successfully accommodate new information and to effectively interact and discuss with their peers their perspective of the topic at hand (Driver & Bell, 1986). However, in addition to simply developing meaning from knowledge, transformative learning relies on critical thinking and analysis (Brookfield, 1987). In this project, students were asked to develop meaning based on the surveying and statistical analysis, while critically analyzing and reflecting on their beliefs and assumptions of the school environment (i.e., their world).

Transformative learning pushes beyond gaining cultural knowledge to developing cultural awareness and consideration (Miller & Seller, 1990; O'Sullivan, 2003). In this curricular unit, social awareness is developed through new perspectives and voices within the current knowledge domain to provide new levels of understanding. The instructors and students explore these new and various perspectives to bring to the forefront a new level of understanding and appreciation. Within this framework, the learning environment consists of:

- ◆ *Instructors:* Providing a classroom environment that fosters trust and respect for all students and cultures (Taylor, 1998) and encourages a willingness to learn, change, and reflect (Cranton, 1994) on experiences, beliefs and ideas. (Taylor, 1998)
- ◆ *Learners:* Actively participating in the dialog to create the learning environment and reflecting on their

own experiences, beliefs and ideas. (Taylor, 1998)

◆ *Transformative Learning Curriculum:* Developing the cognitive, rational, and objective skills of the student, while fostering the development of the students' intuition and imagination (Grabov, 1997) and enabling the development of metacognitive skills, using critical analysis and self-reflection to help students use their own thoughts and feelings as a means of reflections and growth. (Taylor, 1998)

With this project, Our School as 100 Students (Riskowski et al., 2010), students created their own videos that highlighted the school culture; the main objective was to recognize and understand the commonalities and similarities amongst all students regardless of background. This aligns with a model of meta-learning procedures (Puk, 1996), and in planning the activity, the instructors used the four part procedure for meta-learning to promote student development.

- ◆ *Developing a focus:* Student survey activity provides students the opportunity to determine what would be relevant for the project.
- ◆ *Developing a framework:* The critical analysis and reflection of the survey results allows students to engage in discourse with their peers and instructors.
- ◆ *Developing a resulting product:* The video production of the survey results offers students a creative method for showcasing their thoughts on diversity at their school.
- ◆ *Reflecting:* Student assessment of their video and the underlying message developed through the production provides students opportunities to reflect. The explicit and mindful communication of their thoughts, beliefs and experiences allows students to create their own mental model of diversity awareness.

The student project of developing a video production based on their survey results enables students to utilize extrarational sources (i.e., symbols, images, and archetypes) to create their own personal vision of their world (the school) (Boyd, 1989; Taylor, 1998). Boyd (1989) posits that the fundamental change through transformative education from these artistic sources helps students to integrate and expand their consciousness, bringing metacognition to the forefront. These artistic models are

also representative of an active, deliberate meaning-making process; they are embodied with and carry meaning for the student (Kress et al., 2001) as an expression of their mental model (Glynn & Duit, 1995). The artistic approach “reveal[s] qualities of understanding that are hidden from other procedures” (White & Gunstone, 1992), while allowing students the opportunity express their thoughts and clarify their own understanding (Rennie & Jarvis, 1995).

This holistic approach of discussion, cultural awareness, creative arts, and mathematics can be a model of meta-learning procedures (Puk, 1996). The activity, grounded in mathematics and statistics with an emphasis on the video production, may integrate both the rational and extrarational processing of the student. As such, neither the mathematics nor the video production can stand alone in this transformative activity; it is through developing the aesthetic appreciation of the video and learning statistics that would enable students to integrate their “conscious and unconscious worlds” (Puk, 1996).

As students bridge their conscious and unconscious worlds, they are examining their old ways and habits and discussing their thoughts and beliefs, all to examine how they connect, a practice that aligns with the theories of social constructivism. In this manner, students discuss and negotiate to reach a common and viable conclusion (Bishop, 1985; Driver & Bell, 1986; Rogoff, 1990; Vygotsky, 1986) concerning diversity awareness and issues facing different populations.

This also supports Boyd and Myers’ (1998) position that the most critical phase of the discernment process takes place when an individual realizes old patterns or ways of perceiving are no longer relevant and moves to adopt or establish new ways, ultimately integrating old and new patterns. Though social constructivism is often associated with STEM education, the socially-negotiated strategies involved in transformative learning parallel this learning theory. Student discussion is paramount to understanding what the student thinks, believes, and understands. The open discussion allows students to reflect on their past experiences and then seek to integrate their new and old knowledge to gain a more complete level of understanding. In this context, each student develops his or her own understanding of diversity, and because each student has a unique framework of prior knowledge, beliefs, and understanding, the student’s resulting knowledge set is different.

## Methods

### Subjects

A sample population of 81 students drawn from five 6th to 8th grade mathematics classes (total population of approximately 150 students) in a rural middle school in Indiana participated in this study. With project approval from the administrators and teachers, student selection criteria was: (1) signed consent and assent forms by the legal guardian and by the student and (2) responses to both the pre- and post-evaluation. All parties were informed of their rights as study participants, and consent and assent forms were approved by the Institutional Review Board.

This population of students was chosen as they were already taking part in a larger grant, and two of the co-investigators were regularly involved in classroom activities through the U.S. National Science Foundation (NSF) GK-12 program.

The racial and ethnic background of the total enrollment of the school, based on 2007-08 data, was 73% Caucasian, 16% Hispanic, 6% African American, 3% Multiracial/Other, and 1% Asian, with 31% of the total student population receiving free or reduced lunches (Indiana Department of Education, 2007). Table 1 shows the grade, gender, race/ethnicity, primary language, and socio-economic class (free/reduced lunch status) for the students participating in the research study.

All subjects were informed that they would undergo a pre- and post-evaluation concerning their views of diversity. The evaluations were conducted approximately one week before and after the unit exploring the diversity of their school. Students also took part in a reflexive writing activity and classroom discussion as part of their assessment.

### Curriculum & Instruction

The entirety of the project is detailed in a separate work (Riskowski et al, 2010).

The goal of the student project was to encourage students to explore their world and to create a video that disseminates the composition of the school as 100 students. Delving into statistics and how it can be applied to surveying and analysis was a forthright goal of the project and assessment agenda. The project was designed as a project-based task and was based on the work previously disseminated by Miniature-Earth (The Miniature-Earth, 2001) and the 100 people project (100 People Foundation, ND).

This project provided students with a nontraditional, open-ended manner in which to express their ideas and beliefs, with an overarching goal of enhancing student understanding of fundamental statistics concepts. The project culminated with students creating and developing a video production displaying the results of a survey study they design and conduct in their school. The activity was intended to be thought-provoking, not just in developing statistics concepts, but at a human level. The underlying goal was to illustrate to students how their world (i.e., the middle school) encompasses students from different backgrounds and up-bringsings that all share common features and characteristics.

To develop critical thinking skills and promote inquiry learning in the classroom, the students were responsible for creating the survey questions and determining the survey procedures. In small groups, students generated questions they felt were appropriate for the school survey and discussed survey methods. As the students formulated and developed their questions for the survey, they were encouraged to ask meaningful questions and to ask the things they cared about and wanted to understand about their peers. Using this as prompt, most student groups were able to devise insightful and significant questions, such as “Do you judge others by their appearance?” and “Do you ever worry about

**Table 1.**  
Student Demographics of Study

Grade	Gender	Race/Ethnicity	Primary Language Spoken at Home	Socio-Economic Status (free/reduced lunch)
6th 24%	Male 46%	Caucasian 70%	English 86%	Ineligible 68%
7th 40%	Female 54%	Hispanic/Latino 17%	Non-English 14% (Primarily Spanish)	Free/reduced eligible 32%
8th 37%		African-American 5%		
		2 or more Racial/Ethnic Identities 7%		
		Do Not Know, Did Not Answer 1%		

your parents/guardians not being able to support you?"

After surveying the school, students collected and amalgamated the data, and delved into the meaning of the results. Instructors encouraged students to state their results efficiently, which meant stating the outcomes they felt were most relevant. For the student video, each student group was responsible for expressing their results in a manner of their choosing, either through a skit or picture. All video clips from the groups were combined and edited into one class video. The class video was viewed by the students and used as a prompt for a group discussion.

The video viewing and subsequent discussion of the activity was less about statistics and more about life. To facilitate the discussion, students were prompted to write their thoughts discussing the meaning of the activity and video (Table 2). The reflexive writing prompt enabled students to explore their own thoughts, beliefs and ideas through a reflexive writing prompt and discussion. The dialog focused on how they viewed themselves, their peers and

their school prior to the activity compared to post-activity.

### Statistical Analysis

Students were asked to respond to a 7-question pre-post-evaluation designed to elicit their conceptual understanding and personal thoughts on diversity (Table 3). The open-ended questions were developed to understand how students viewed diversity, both at a metacognitive level in assessing how students thought of themselves and at a more national level in assessing how students viewed diversity in the US. In addition, the students also responded to a 36-point Likert Scale pre-post assessment of their comfort level with individuals from different backgrounds (Table 4).

The Likert-Scale assessment was used to understand how students viewed their peers from backgrounds other than their own. At the end of the project students also responded to several reflexive questions designed to provide a safe outlet for students to express their understanding of the meaning of the activity and to elucidate

the changes they experienced as a result of the activity. Additionally, there were interviews and discussions to promote self-reflection (Table 2). The final reflexive activity was a method for uncovering the level of growth the students experienced through the project.

The Likert Scale was assessed via ANCOVA, with the covariate the pre-evaluation value, to determine how students' views changed as a result of the curriculum), with a Tukey post-hoc analysis to understand the effects of racial/ethnic, socioeconomic status, gender and grade level of the student's response. The threshold for statistical significance was set at  $p=0.05$ , however, actual p-values are reported in the following section for clarity. Evaluations that were left blank or that scored a zero were not included in the statistical comparison. SPSS 15.0 (SPSS Inc, Chicago, IL, USA) was used for all quantitative analyses.

To answer the open-ended and reflexive questions, students were able to use drawings, word, or phrases to explain their understanding of diversity. All responses to these questions were initially reviewed to develop codes associated with recurring themes. The open-ended questions allowed the students to convey a level of understanding of concepts and ideas of diversity as well as to gauge the students' beliefs on diversity in the U.S. The only pre-established coding was for the final open-ended question on conflict resolution. This coding scheme followed work by Jensen et al. (1996). All other open-ended responses were initially reviewed to develop codes associated with recurring themes. The codes were scored for use with statistical analysis.

Additionally, interviews and group discussions were recorded during a conversation led by the authors' to delve into the reflexive questions at a deeper level. The group discussion were transcribed and coded to reveal the common themes of the discussion.

All coding analyses followed a content-driven systematic iterative process of text interpretation and categorization to establish patterns of importance (Miller & Crabtree, 1992). First, the data was independently reviewed to identify meaningful descriptions or noteworthy statements related to the research questions. After a discussion on preliminary findings and interpretations, a code was developed, and themes were subsequently derived from the series of coded statements to establish the main findings. The reliability of the analysis was strengthened by the diversity

**Table 2.**

#### Reflexive Writing Prompt for Students To Explore Their Thoughts and Encourage Self-Reflection

1. What specific statistics surprised you from the survey results in your class video?
2. How did the video change your thoughts about your peers?
3. a. How do you think other students will perceive the video?  
b. Teachers?  
c. Your parents?
4. a. What do you think some of the benefits are that can come from this video?  
b. What do you think some of the negatives are that can come from this video?
5. Explain what you learned about yourself and other students during this project.
6. What did you like about doing this project?
7. What didn't you like or what would you change about this project if you could?
8. Any other thoughts?

**Table 3.**

#### Open-ended questions

1. When someone uses the word of diversity, what does that mean or what does "diversity" mean to you?
2. Students are different from one another. Can you think of some ways in which students may be different from each other? List as many as you know.
3. Do you see yourself as different from others? If so, how?
4. Explain your thoughts to the question: Do you think diversity is good or bad thing to have:  
In School?  
In the Community?  
In the U.S.?
5. What kind of difficulties or challenges do you think people from a background different than your own may face in their lives? Explain your response.
6. What kind of privileges or benefits do you think people from a background different than your own may experience in their lives? Explain your response.
7. How do you deal with situations when someone has a different point of view or differs from you in some way, yet you still have to interact with them?

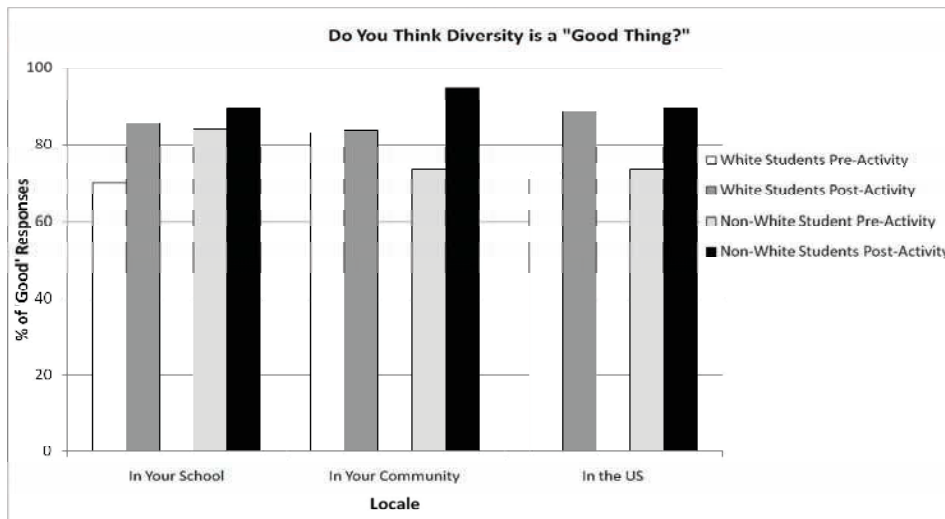
**Table 4. Likert Scale for Students To Determine Comfort Level with Individuals from a Different Background**

Response options were: 1 – Strongly Disagree, 2 – Disagree, 3 – No Preference, 4 – Agree, 5 – Strongly Agree. NS was provided for 'Not Sure' and was not included as part of the data analysis. Data reported as Mean (Standard Deviation). \* = p value < 0.05 between pre-post-evaluations scores; † = p value < 0.05 between pre-evaluation scores between White and non-White students.

	All Students Pre	Post	Non-White Students Pre	Post	White Students Pre	Post	Female Students Pre	Post	Male Students Pre	Post
I am comfortable being in the same school with someone from a different gender.	4.38(0.35)	4.55(0.15)	4.72(0.12)*†	4.42(0.31)*	4.28(0.33)†	4.59(0.10)	4.37(0.27)	4.69(0.12)	4.39(0.31)	4.39(0.27)
I am comfortable playing with someone from a different gender.	4.23(0.45)	4.26(0.20)	4.43(0.28)	4.25(0.38)	4.18(0.23)	4.27(0.35)	4.28(0.34)	4.29(0.37)	4.17(0.31)	4.24(0.24)
I am comfortable being in the same class with someone from a different gender.	4.38(0.22)	4.64(0.25)	4.72(0.21)†	4.68(0.19)	4.18(0.34)†	4.63(0.34)	4.37(0.33)	4.71(0.33)	4.39(0.29)	4.56(0.24)
I am comfortable sitting next to someone from a different gender at school.	4.26(0.30)	4.28(0.19)	4.35(0.22)	4.10(0.27)	4.24(0.29)	4.33(0.28)	4.33(0.30)	4.33(0.27)	4.19(0.27)	4.21(0.20)
I am comfortable doing homework with someone from a different gender.	4.19(0.19)	4.31(0.19)	4.02(0.15)*	4.55(0.17)*	4.22(0.22)	4.22(0.29)	4.17(0.22)	4.40(0.21)	4.21(0.20)	4.19(0.20)
I think someone from a different gender is or can be as smart as me.	4.33(0.33)	4.62(0.27)	4.47(0.23)	4.49(0.28)	4.31(0.29)	4.68(0.30)	4.24(0.25)	4.62(0.25)	4.43(0.28)	4.63(0.29)
<b>Total value for gender comfort level.</b>	25.80(0.83)	26.67(0.69)	26.65(0.70)	26.42(0.59)	25.54(0.90)	26.74(0.73)	25.80(0.67)	27.04(0.60)†	25.80(0.69)	26.24(0.73)†
I am comfortable being in the same school with someone from a different economic class.	4.29(0.26)	4.50(0.35)	4.65(0.23)†	4.62(0.27)	4.18(0.29)†	4.49(0.31)	4.28(0.33)	4.60(0.28)	4.29(0.30)	4.39(0.29)
I am comfortable playing with someone from a different economic class.	4.20(0.29)	4.35(0.26)	4.45(0.29)	4.65(0.30)	4.12(0.30)	4.25(0.28)	4.26(0.26)	4.40(0.22)	4.12(0.30)	4.29(0.28)
I am comfortable being in the same class with someone from a different economic class.	4.26(0.25)	4.53(0.26)	4.73(0.26)†	4.72(0.29)	4.13(0.33)†	4.48(0.32)	4.28(0.33)	4.56(0.30)	4.24(0.37)	4.51(0.31)
I am comfortable sitting next to someone from a different economic class at school.	4.18(0.28)	4.47(0.27)	4.45(0.30)	4.66(0.29)	4.11(0.24)	4.40(0.33)	4.26(0.33)	4.58(0.28)	4.09(0.29)	4.34(0.27)
I am comfortable doing homework with someone from a different economic class.	4.18(0.29)	4.27(0.23)	4.47(0.31)	4.41(0.27)	4.12(0.33)	4.22(0.28)	4.24(0.30)	4.47(0.36)	4.12(0.31)	4.08(0.31)
I think someone from a different economic class is or can be as smart as me.	4.25(0.33)	4.49(0.25)	4.62(0.19)†	4.37(0.27)	4.15(0.35)†	4.54(0.29)	4.20(0.21)	4.53(0.30)	4.31(0.27)	4.44(0.21)
<b>Total value for socioeconomic comfort level.</b>	25.39(0.98)	26.62(0.85)	27.25(0.94)†	27.30(0.87)	24.81(0.89)*†	26.39(0.79)*	25.55(0.71)*	27.13(0.79)*	25.19(0.83)	26.02(0.69)
I am comfortable being in the same school with someone with a physical handicap.	3.93(0.23)*	4.42(0.41)*	3.55(0.27)*†	4.75(0.37)*	4.05(0.30)†	4.31(0.34)	3.97(0.39)	4.58(0.38)	3.87(0.41)	4.24(0.31)
I am comfortable playing with someone with a physical handicap.	3.67(0.28)	3.78(0.49)	3.31(0.27)	3.95(0.39)	3.78(0.33)	3.72(0.38)	3.73(0.31)	4.09(0.39)†	3.60(0.47)	3.44(0.51)†
I am comfortable being in the same class with a physical handicap.	3.78(0.25)*	4.34(0.43)*	3.45(0.31)	4.55(0.36)	3.87(0.33)*	4.27(0.40)*	3.82(0.24)*	4.51(0.24)*	3.73(0.31)	4.14(0.41)
I am comfortable sitting next to someone with a physical handicap.	3.75(0.34)	3.90(0.50)	3.42(0.29)	4.03(0.34)	3.86(0.37)	3.86(0.30)	3.82(0.27)*	4.22(0.29)†	3.68(0.33)	3.56(0.37)†
I am comfortable doing homework with someone with a physical handicap.	3.71(0.39)	3.75(0.42)	3.30(0.33)	3.75(0.36)	3.85(0.40)	3.74(0.37)	3.66(0.39)	4.09(0.41)†	3.78(0.29)	3.36(0.37)†
I think someone with a physical handicap is or can be as smart as me.	4.00(0.43)	4.30(0.51)	4.12(0.34)	4.23(0.37)	3.98(0.41)	4.31(0.41)	3.88(0.42)	4.44(0.38)	4.14(0.51)	4.12(0.34)
<b>Total value for physical handicap comfort level.</b>	22.87(1.15)*	24.51(1.03)*	21.08(0.99)*†	25.21(1.10)*	23.40(1.21)†	24.24(1.10)	22.91(1.01)*	25.91(1.05)*†	22.82(1.15)	22.87(1.09)†
I am comfortable being in the same school with someone with a mental handicap.	3.80(0.36)*	4.34(0.45)*	3.55(0.34)*	4.52(0.41)*	3.87(0.33)	4.29(0.37)	3.75(0.37)*	4.49(0.40)*	3.85(0.34)	4.17(0.32)
I am comfortable playing with someone with a mental handicap.	3.34(0.29)	3.33(0.47)	2.98(0.30)*	3.70(0.39)*	3.44(0.39)	3.20(0.37)	3.44(0.35)	3.71(0.28)	3.21(0.31)	2.87(0.34)
I am comfortable being in the same class with a mental handicap.	3.60(0.49)	3.98(0.53)	3.45(0.40)	4.15(0.48)	3.65(0.45)	3.92(0.43)	3.55(0.40)*	4.22(0.43)*†	3.65(0.41)	3.70(0.37)†
I am comfortable sitting next to someone with a mental handicap.	3.35(0.45)	3.65(0.36)	3.05(0.39)	3.75(0.33)	3.43(0.41)	3.60(0.41)	3.51(0.42)	3.96(0.45)	3.17(0.40)	3.29(0.42)
I am comfortable doing homework with someone with a mental handicap.	3.17(0.43)	3.27(0.49)	2.82(0.33)*†	3.75(0.40)*	3.28(0.43)†	3.12(0.43)†	3.24(0.37)	3.62(0.42)	3.09(0.41)	2.87(0.43)†
I think someone with a mental handicap is or can be as smart as me.	3.43(0.48)	3.84(0.58)	3.37(0.44)	4.15(0.49)	3.48(0.48)	3.74(0.45)	3.35(0.50)	3.93(0.45)	3.53(0.41)	3.73(0.40)
<b>Total value for mental handicap comfort level.</b>	20.71(1.14)*	22.42(1.01)*	19.15(1.11)*†	24.02(1.10)*†	21.18(1.19)†	21.87(1.18)†	20.86(1.06)*	23.93(0.93)*†	20.53(1.10)	20.65(1.23)*†
I am comfortable being in the same school with someone from a different race/ethnicity.	4.42(0.29)	4.68(0.39)	4.91(0.30)†	4.68(0.33)	4.27(0.31)†	4.68(0.28)	4.46(0.33)	4.84(0.10)	4.36(0.28)	4.48(0.26)
I am comfortable playing with someone from a different race/ethnicity.	4.39(0.37)	4.62(0.39)	4.85(0.38)†	4.82(0.41)	4.25(0.36)†	4.56(0.34)	4.46(0.37)	4.73(0.12)	4.31(0.29)	4.48(0.31)
I am comfortable being in the same class with someone from a different race/ethnicity.	4.39(0.36)	4.70(0.28)	4.92(0.33)†	4.96(0.30)	4.24(0.40)†	4.62(0.37)	4.48(0.37)	4.84(0.10)	4.29(0.31)	4.53(0.27)
I am comfortable sitting next to someone from a different race/ethnicity at school.	4.42(0.37)	4.59(0.35)	4.90(0.38)†	4.87(0.30)	4.27(0.30)†	4.52(0.38)	4.48(0.35)	4.77(0.12)†	4.34(0.30)	4.39(0.31)†
I am comfortable doing homework with someone from a different race/ethnicity.	4.40(0.29)	4.62(0.29)	4.82(0.34)†	4.92(0.27)	4.27(0.30)†	4.53(0.34)	4.46(0.22)	4.77(0.12)	4.34(0.20)	4.44(0.27)
I think someone from a different race/ethnicity is or can be as smart as me.	4.43(0.45)	4.71(0.29)	4.91(0.10)*†	4.66(0.30)*	4.17(0.26)*†	4.73(0.25)*	4.46(0.35)	4.76(0.10)	4.39(0.27)	4.66(0.29)
<b>Total value for racial/ethnic comfort level.</b>	26.48(0.89)*	27.94(0.78)*	29.35(0.91)†	28.83(0.77)	25.99(0.90)*†	27.64(0.92)*†	26.84(0.81)	28.73(0.56)†	26.04(0.79)	27.00(0.81)†
<b>Overall Total</b>	121.25(1.87)	128.17(1.58)	123.53(1.91)*†	131.7(12.61)*†	120.54(1.83)*†	126.89(1.47)*†	121.97(1.74)*	132.76(1.20)*†	120.41(1.91)	122.80(1.67)†

**Figure 1.**  
Percentage of Student Responses to the Question of Whether Diversity Is a Good Thing or Bad Thing in the Varying Locales.

Initially, non-White students were more likely than White students to see diversity as a positive addition to the school environment; in the community, the roles reversed, with more White students seeing diversity positively compared to non-White students. Post-activity, scores in all three locales were similar between White and non-White students, with no significant differences seen.

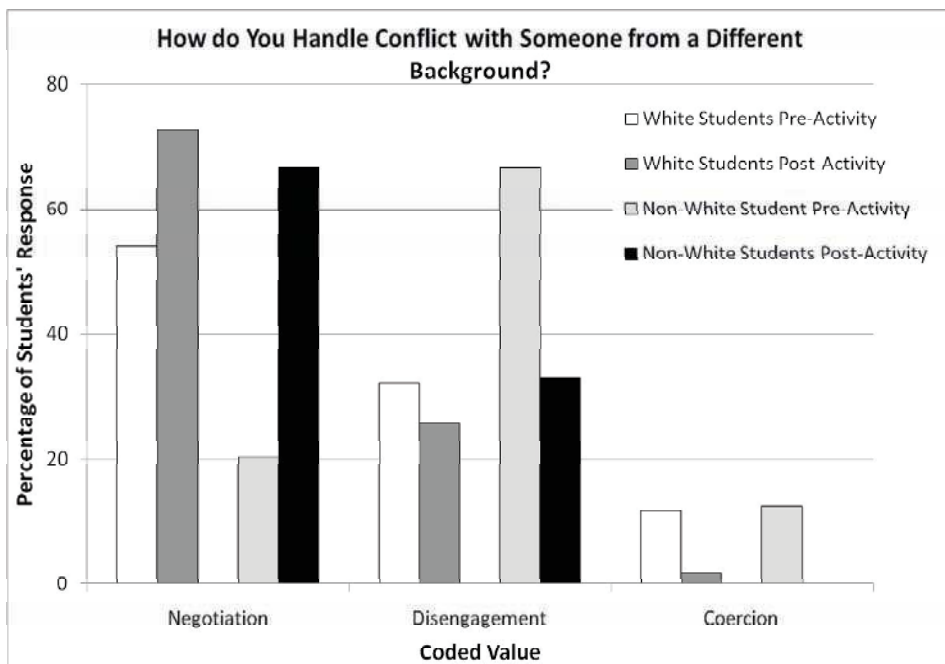


\* = p value < 0.05 between pre-post-evaluations scores

† = p value < 0.05 between pre-evaluation scores between white and non-white students

**Figure 2.**  
Open-ended Responses to the Question of How the Student Handles Conflict with Someone from a Different Background.

Statistically significant changes were made in student responses as more students were likely to use a discussion to solve conflict. Categories were based on work by Jensen-Campbell et al. (1996): Negotiation (compromise and third-party resolution), disengagement (withdrawal and standoff), and coercion (submission). Post-activity, scores in all three categories were similar between White and non-White students, with no significant differences seen.



\* = p value < 0.05 between pre-post-evaluations scores

† = p value < 0.05 between pre-evaluation scores between White and non-White students

of perspectives that functioned as checks and balances in the analytic process and through a post-analysis examination for conflicting or disconfirming evidence (Kuzel & Like, 1991). The threshold for statistical significance was set at  $p=0.05$ , and the qualitative analysis software used was NVivo 7.0 (QRS International, Melbourne, Australia).

## Results

The goal of the student project was to encourage exploration of their world (i.e., the school) and to create a video of what the school would look like with 100 students. For the research agenda, the goal was to assess student understanding of diversity and cultural awareness as well as to explore the changes that develop as a result of participating in a mathematics multicultural activity. Though all questions were noted, we chose to discuss and explore only the statistically significant results.

In the question concerning if diversity is a "good thing" in the school, community and nation, significant differences in the pre-evaluation were noted along racial lines. A significantly higher percentage ( $p=0.0121$ ) of self-identified non-White students responded that diversity was a "good thing" in the school compared to White students (Figure 1). The most common response (62%) non-White students provided for accepting diversity in the school was that it made school more fun with multiple perspectives. The common response by White students (45%) as to why diversity was "bad" in school was that it leads to student fights and hinders to learning. In asking about diversity in the community, the roles were reversed, with a significantly higher percentage ( $p=0.0315$ ) of White students stating that diversity was a "good thing." White students (51%) felt that diversity aided in providing multiple perspectives on community issues, whereas most non-White students (43%) felt that diversity in the community lead to discriminatory practices.

In examining their thoughts on diversity in the U.S. as nation, there was no statistical difference in their responses between pre-post evaluations. In light of the timing of the assessment (Spring of 2008), student thoughts on diversity as a positive aspect for the U.S. centered on the presidential race, with students responding "It makes you a good presidential candidate" and "People will think you are unique and cool and vote for you." Negative responses centered on issues of discrimination and racial or hate crimes. There was no significant difference seen

in student responses in this question by gender, grade or socioeconomic status.

Post-activity, both non-White and White students reached similar end points, with significant gains seen in White students viewing diversity as a positive aspect of their school and by non-Whites for their community. Post-evaluation responses by White and non-White students converged in all three locales, with 86% to 89% of students seeing diversity as a “good thing” in their school, community and nation.

Another area that made strong gains was in how students said they would handle conflict with an individual from a different background. Again, in assessing the data in terms of racial lines, there were significant differences in the response, and no significant differences were seen by gender, grade or socioeconomic status. Initially, White students were almost two times more likely to negotiate or compromise with someone from a different background, whereas non-White students were more likely to disengage or withdraw from the situation. Post-activity, responses from both White and non-White students were similar, with 72% of White students and 65% of non-White students stating they would negotiate. There was also a significant drop in the number of non-White students stating they would disengage or use coercion when in conflict with someone from a different background.

Post-activity, there were significant changes noted in how students viewed themselves. Pre-activity, a significantly smaller percentage ( $p=0.0224$ ) of White students viewed themselves as “different from others” in comparison to non-White students (Figure 3). Post-activity, the number of white students seeing themselves as different increased approximately 30%, with no significant difference seen between white and non-white students at this juncture.

There were also significant changes seen with the student’s comfort level with individuals from backgrounds different than their own (Table 4). Changes in comfort level were most significant in the student’s comfort level with individuals who have a different mental or physical handicap or who are from a different race/ethnicity. Non-White students were significantly more likely to feel more comfortable working with students with a physical or mental handicap after the activity, whereas their white counterparts noted no significant changes in their comfort in working with these students. In exploring race and ethnic feelings, White students significantly increased their comfort level in working with others from a different

race/ethnicity, whereas non-White students noted a decreased in their comfort level. The final question explored students thoughts of the intelligence level of students from a different race or ethnicity, and post-activity White students tended to see non-White students as intellectually capable as them, whereas non-White students tended see White students as less intelligent.

### Voices from the Classroom: What Students Have To Say

In the interviews and class discussions, a common theme among the students was how they identified with the results relating to their demographic or cultural group. Most Hispanic, African American, and White students felt that the reported statistics of their racial or ethnic group were low. This same phenomenon crossed gender lines, as female student thought there were more female students than male students in the school and vice versa. Statistically, the survey results reported 52% male and 48% female; school data show the student body as 54% male and 46% female (Indiana Department of Education, 2006). This is highlighted in a discussion with a female student:

*Interviewer 1:* Is there any statistic in particular that surprised you?

*6th grade female student:* I thought there were going to be more girls than boys. There is like 60 [sic] more boys than girls in the school. It doesn’t seem right.

...Break with discussion on how to calculate number of boys and girls in the school based on percentages. Based on the provided survey results there should be 20 more boys than girls in the school, and actual school data suggest 40 more boys than girls.

*6th grade female student:* It just seems though, you know, in the classes, in the hallways, that there are more girls around than boys.

*Interviewer 1:* Do you think a lot of your classes have more females than male students?

*6th grade female student:* Well, I don’t know, but I think most do, and it seems like there just are more girls in the school than boys when you look around and stuff. Well, I think what I see is that, you know, there are more girls in this class, and there are more girls are in most of my classes. In the hallways there are always more girls than guys, so I just don’t think that boys outnumber girls in the school.

Likewise, in a separate class discussion, with the same prompt to students of

which statistic was surprising, once again students saw their ‘world’ differently; however this time the focus centered on racial and ethnic divisions. With this class discussion, students were able to articulate that individuals’ see their ‘world’ differently based on who they identify with in the population.

*7th grade African American male student:* I was surprised by the number of Black people, 6 or, you know, 6% or whatever.

*Interviewer 1:* Did you think there would be more or less Black students?

*7th grade African American male student:* I thought more. I mean, that shows that there are only like 30 Black students in the whole school, that’s it. I think there is more than that here. I mean there are 6 or something in this class.

*Interviewer 1:* Well, can you always tell optically, or by how people look, especially given the survey? The survey gave options like White, African American, Hispanic, Native American, etc and two or more races. How do you think people responded?

*7th grade African American male student:* Well, they could have lied or they could have not filled it in right. But I’m saying there just are more than 6% Black in the school that’s all.

*Interviewer 1:* Was anyone else surprised by any of the statistics?

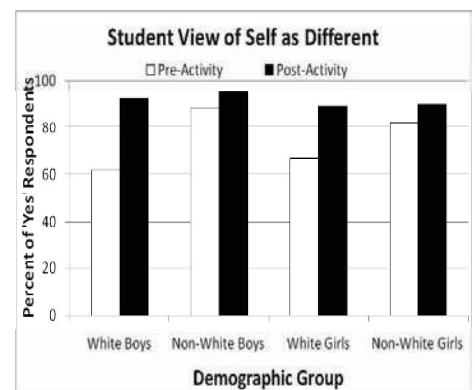
*7th grade White male student 1:* I was surprised by the 69% of the students being White.

*Interviewer 1:* Do you think that number should be higher or lower?

*7th grade White male student 1:* I think

**Figure 3.**  
Responses to the Questions:  
“If Students Viewed Themselves  
as Different in Their School.”

Post-activity, there were no significant differences between the demographic groups.



\* =  $p$  value < 0.05 between pre-post-evaluations scores.  
† =  $p$  value < 0.05 between pre-evaluation scores between White and non-White students.



that number should be higher. I think there are more White students than that, percentage-wise, in the school.

*Interviewer 1:* Why do you think that?

*7th grade White male student 1:* When you look around, there are a lot more White students than Black, so I think that the numbers are wrong.

*Interviewer 1:* So on one hand some students think percentage-wise there are more Black students than is reported and some think there are more White students than is reported. Is that correct? Why do you think that is?

*7th grade White male student 2:* Everybody sees things differently, and I think that may be why. What some students look for and what other students look for might not be the same. I think that we're all looking for what we want to see. Maybe then we see differently. I don't know, or maybe the statistics are wrong or something.

*Interviewer 2:* I think you're on to something.

*7th grade White female student:* I think that maybe we all are seeing things differently. We hang out with our friends and stuff that are like us, and we maybe just see then our own race. And that might be why. And, too, some people might not have taken the survey or might have lied on it. Especially, like with doing things illegal and stuff, but I don't think people lied on this.

*Interviewer 2:* So do you think people lied?

*7th grade White female student:* I think they could have, and probably did, I got things like people had an ostrich as a pet or a wolf, but I think people wouldn't lie about this? Who would care?

*Interviewer 1:* Could you explain that?

*7th grade White female student:* I think that people wouldn't lie about this, just because you know, you're not getting in trouble for it. I think the main things people lie about are the things like, you know, having stuff or doing illegal things. I'm just saying this isn't big enough to lie about. Nobody would care what you put on here; they would just care if you put down bad stuff. I think people would want to see this stuff. They'd be looking at who's like them; they'd be seeing what groups they fit into and stuff. But, people did lie on the survey, just maybe not here. You can't just believe it.

The discussion diverged at this point to discussing student truthfulness on the survey. However, in analyzing the student reflective responses, many students stated that the demographic group that they self-identified as their own was surprising or

incorrect. A majority of students (76%) that responded to this question in light of the demographic statistics reported did so in terms of their own racial, ethnic, or gender group, with most (57%) stating the reported number was incorrect and too low. Written responses included comments such as, "I was surprised that only 6% of the students were Black. I guess what I look for and see doesn't always match what [sic] out there in the classroom."

This discussion provided a gateway into discussing relations with other students and how students assess or judge their peers. These comments align with Mezirow (1991) thoughts on transformation: "Transformation is the process of becoming critically aware of how and why our assumptions have come to constrain the way we perceive, understand and feel about our world." Post-activity, students were able to explicate this view, recognizing that what is seen and what is do not always match, and the realization that perception and reality may be different is an important breakthrough for the student as they become more critically aware of their surroundings and environment.

## Discussion

Our aim was to investigate students' thoughts of diversity in the U.S. and to determine how participation in a mathematics multicultural education affects student conceptual understanding of diversity and metacognition differ based on race/ethnic identity, gender, and socioeconomic status. Through the work and project, there were several important findings in the changes in student metacognition, behavior, and critical thinking.

First, post-activity, we found White students were more likely to state that they would handle conflict through a discussion rather than arguing or ignoring the situation. Second, after the multicultural activity, students were more likely to view diversity as an important aspect of their school, community, and nation. Post-activity students also stated they felt more comfortable working with students from a background different than their own. Therefore, the data suggest that a multicultural activity in the mathematics classroom can positively enhance confidence and improve diversity awareness, which in turn could encourage students to aware and proactive in pursuing equity for everyone, regardless of background.

An objective of the project was to enable students to look beyond the physical differences to see the commonalities they share with others. Post-activity, students were more likely to state that the one thing

they share with others is that they are all unique in their own way. In answering the question of "Do you see yourself as different? If yes, explain," the most common answer post-activity (62%) was that all students are different. Students further stated that no two students, whether they have the same or different skin color or background, have experienced the same things, but their differences are what unite them.

Along those same lines, the students noted that having different perspectives allows for them to grow and learn new things in the school, community and US, benefitting all parts of their world. This idea that working with individuals from different backgrounds is beneficial and rewarding has been documented by others as well, as Light (2001) noted collegiate students felt that the greatest benefit in life is working with individuals from significantly different backgrounds.

From the classroom dialog, students also focused on critically reflecting on their beliefs and experiences. Engaging in this reflective discussion allows for the transformation of perspective within the group as well as changing meaning structures (Mezirow, 1991). The student's written responses in their final reflection exposed the changes made by the students. Student comments included:

I learned that we all have a place in this world, and there [is] a lot of things that we have to fix in ourselves before we fix the world; I think I need to work through some things.

[I learned] that we're all different. We all have different beliefs, values, and thoughts, but that doesn't mean we can't talk to one another because we're all human. We need to make sure we always remember this—we all are living, breathing human beings.

As the project was designed to encourage student reflection, their responses in the discussion and reflexive writing provided evidence of this.

This activity provided both a logical and creative outlet (i.e., using statistics and creating a video) to encourage student reflection, and utilized culturally-relevant teaching strategies to develop metacognition. This pedagogical approach would empower "students intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills, and attitudes" (Ladson-Billings, 1994).

This strategy is also thought to bring greater confidence and comfort to the student (Banks, 1985; Sleeter & Grant, 1987; Verkuyten & Thijs, 2004), which is in agreement with our work. Post-activity, students stated they were more comfortable and

willing to work with others from a different background. Students also reported they were more likely to discuss and compromise with others in conflict, which could reflect that students felt more confident in conflict resolution and in sharing power (Laursen et al., 2001). The necessity of examining conflict resolution provides insight into the students' view of social justice (Ross, 1996) and understanding cause and effect in peer relationships (Fabes & Eisenberg, 1992), while delineating personal autonomy (Nucci et al., 1996).

Thus, these findings support the use of transformative education to promote conflict resolution and metacognitive development. Moreover, as this culturally responsive activity highlights the different cultures and beliefs held by students, it encourages a deeper study, knowledge and celebration of own culture, connecting home-life to school, a motivating factor for the student (Ladson-Billings, 1994; Macedo, 1994; Zeichner & Liston, 1996). Without this type of pedagogy, students from minority or traditionally-disadvantaged backgrounds may have traits of lack of self confidence, lack of emotional security, distrustfulness, and decreased self worth (Garrison et al., 1967; Woodson, 2000).

In order to evaluate the present study results and to give some suggestions for further study, two restrictions on our study will be considered. First, the project and study was conducted only at a rural middle school in Indiana. This school in particular had experienced racial issues during the school year, and as such, students may have been more sensitized to racial/ethnic issues and concerns.

Further, Dunham et al. (2006) noted that during the middle years, individuals will deny their prejudices and biases, but experimental conditions will show children tending to favor their own ethnic/racial group. As students stated in examining their survey results, it is impossible to know if the student responds to the surveys were what they students believed or if they were what they thought they should believe. However, with the multiple assessments, including a pre-post evaluation, interviews, discussions and reflexive activities, it does appear that the students gained in their understanding of diversity awareness and metacognition.

Despite these limitations, the present research makes a contribution to the literature concerning the effect of a multicultural activity in the middle school classroom. Future studies in other schools in Indiana and throughout the U.S. will further examine the reliability and generality of the findings of how student

metacognition and diversity awareness is affected through a mathematics multicultural activity as well as to understand how self-confidence or self-efficacy changes through this activity.

### Conclusion

This study provides support for the inclusion of a multicultural activity in middle school mathematics and promotes culturally-responsive pedagogies. The work shows that students involved in a mathematics based multicultural activity were able to develop metacognition and diversity awareness, and through the activity, students developed a greater appreciation for working with others from a different background. From this data, we conclude that the use of mathematics multicultural activities enhances the confidence of the student, while developing greater cultural awareness.

The middle grades are a time for growth and change in several domains, not just physical, but cognitive and emotional as well. Therefore, exposing students to multicultural education and nurturing student reflection in a transformation learning practice may provide a meaningful experience that promotes social justice. However, additional studies are needed to evaluate the lasting effects of exposure and participation in multicultural projects, as well as the optimal timing and frequency of such activities and curricular units.

Nonetheless, the goal of the K-12 curriculum is not only to increase the academic achievement, but to promote a positive attitude towards others and develop student metacognition, and this research shows that culturally-responsive activities can support these objectives.

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