A MULTI-STATE COMPARISON OF TEACHERS' BELIEFS ABOUT TEACHING ENGLISH LANGUAGE LEARNERS MATHEMATICS

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What mathematics teachers believe about teaching ELLs affects which mathematics teaching practices they employ (Sztajn, 2003). This study compares beliefs of mathematics teachers from Illinois, Texas, and Wisconsin. Surveys and quantitative analysis methods are used to compare beliefs of teachers by district demographics (high ELL population vs. low ELL population) and region (Midwestern school districts vs. Southwestern school districts). It was found that teachers' beliefs about teaching ELLs mathematics were mostly similar regardless of comparison made. One main difference was that districts with low ELL populations looked for outside help to address challenges in teaching ELLs mathematics while high population ELL school districts relied more on their own teachers' expertise to address challenges.

Since teachers provide ELL students access to mathematics, it is essential to understand how teachers implement curricula with these students. Research studies suggest the manner in which teachers interpret and implement curricula is influenced by their knowledge and beliefs (see Thompson, 1992). Thompson (1984, 1992) reports that teachers frequently treat their beliefs as knowledge. Sztajn (2003) noted that teachers' practices were based on their conception of students' needs. A teacher may implement problem solving with students from upper socioeconomic backgrounds, while using repetitive instruction and memorization with students from lower socioeconomic backgrounds. This variation in teaching strategies and activities based on teachers' perceptions is important, because teachers may perceive that ELL students would be more successful with memorization and lecture when the opposite is true (Winsor, 2007). Creating innovative, high quality lessons for students is most likely to occur when teachers are part of a collaborative learning community supporting such experiences (McLaughlin, 1993).

In order to be equitable, it is essential that ELLs receive a high quality mathematical education (NCTM, 2000) therefore, the present study focuses on mathematics teachers' beliefs about teaching ELLs in three states, Illinois, Wisconsin, and Texas (González, 2009). The comparison of different regions allowed the researchers to compare beliefs between teachers who teach in highly and sparsely Latino-populated areas. The hypothesis of the study was that teachers in regions with large Latino populations would hold similar beliefs. It was also hypothesized that teachers in regions with small Latino populations would hold beliefs that were quite different than the regions with relatively large Latino populations.

Literature Review

Teachers' practice affects ELL students' success in the classroom (Boaler, 2002). Two factors that affect teacher practice are their attitudes towards teaching ELLs and knowledge and

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beliefs that motivate attitudes towards teaching ELLs (e.g. Batt, 2008; Byrnes, Kiger, & Manning, 1997).

Boaler (2002) states that teachers do not hold malicious beliefs toward teaching ELL students; they just have misconceptions about how ELL students learn. One such misconception is that teachers believe ELL students' linguistic backgrounds keep them from participating in activities requiring a higher level of cognitive demand, such as problem solving (Hansen-Thomas & Cavagnetto, 2010; Sztajn, 2003). Hansen-Thomas and Cavagnetto (2010) found that teachers from all academic fields believe mathematics is the easiest course for ELLs to study because it uses only numbers and symbols. Reeves (2006) reports that teachers believe it takes two years or less to learn English, which leads them to believe ELL students' academic difficulties are due to ability and not fluency. Cummins (1999) proposed that in fact it takes ELLs four to seven years to gain sufficient fluency that allows them to negotiate academic situations.

There are two other teacher beliefs that seem to be systemic challenges. First, teachers feel unprepared to teach ELLs (Batt, 2008; Reeves, 2006), which often makes them reticent to teach such students; however, the vast majority want to learn effective teaching techniques to use with ELLs (Hansen-Thomas & Cavagnetto, 2010). Teachers also face added responsibilities that come with teaching ELLs (Batt, 2008), such as paper work and additional meetings outside of class.

Byrnes, Kiger, and Manning (1997) and Youngs and Youngs (2001) describe several factors that affect teachers' attitudes towards teaching ELL students. Both studies found that training specific to linguistic diversity had a positive impact on attitudes towards teaching ELLs. Training such as taking a foreign language class or a multicultural class (Youngs & Youngs, 2001) are examples of training that focused on linguistic diversity. Moreover, teachers that had ELL specific training in an in-service setting had positive attitudes towards teaching ELLs.

Another factor that had a positive effect on attitudes towards teaching ELLs was more direct experiences with linguistic diversity. Experiences such as living or teaching in a foreign country are examples of direct experiences with linguistic diversity (Youngs & Youngs, 2001). Byrnes, Kiger and Manning (1997) found that the region teachers live in affected their attitudes towards teaching ELLs. Youngs and Youngs (2001) found that teachers who had students from multiple language backgrounds were more positive towards teaching ELLs. Taken together, these studies suggest that if teachers have experiences that help them better understand and relate to ELL students, then they may be more likely to have positive attitudes towards teaching ELLs.

Methods

Research Hypotheses

1) Teachers from a district sparsely populated with Latino/ELL students will have different beliefs about teaching ELLs mathematics than teachers from districts densely populated with Latino/ELL students.

2) Teachers from Midwestern districts densely populated with Latino/ELL students will have similar beliefs about teaching ELLs mathematics to teachers from a southwestern district densely populated with Latino/ELL students.

Research Participants and Settings

Eighty-six secondary mathematics teachers from school districts in Illinois, Texas and Wisconsin participated in this study. Participants were recruited from school districts meeting criteria for (high vs. low) proportion of ELLs and that had established working relationships with

the researchers. The four school districts will be referred to as follows: a high-ELL urban school district in the Southwestern United States (HUs); a high-ELL urban school district in the Midwest (HUm); a high-ELL rural school district in the Midwest (HRm); and a low-ELL suburban school district in the Midwest (LSm).

School District	Study participant demographics	District population that is Latino	District population classified as ELL
HUs	76% Hispanic	92%	24%
HUm	79% Caucasian (total participants from the Midwest)	20% total population, individual schools range from 40 – 97% Latino	5 % total, individual schools range from 20% to 47% ELL
HRm		71%	52.%
LSm		5%	3%

Table 1: Description of participant and school district demographics.

Forty-two secondary mathematics teachers taught at HUs. HUs school district was chosen because it was recognized as an urban district that is succeeding in educating their students (see Kitchen, DePree, Celedón-Pattichis, & Brinkerhoff, 2006). Twenty-three participants taught at HUm and HRm school districts, which were chosen because they had similar student demographics as HUs but were located in the Midwest. Twenty-one participants came from LSm school district, chosen for comparison purposes because of the scarcity of Latino students in the district.

Instrument

Researchers generated questions for a survey that focused on teachers' beliefs about teaching ELLs mathematics. The foundation for the questions came from research conducted on teaching ELLs mathematics (see González, 2009 for details). At an authors' university, the survey was piloted with a class of preservice middle school mathematics teachers. The results from the pilot helped researchers to refine questions based on preliminary responses. Data for this study was collected using a paper-pencil or an online version of the survey, depending on the preference of the school administrators and convenience for their teachers.

The data analyzed for this report came from two different sections of the survey. One section of the survey asks, "How effective are the following strategies in helping ELLs succeed in school?" Examples of these strategies are: grouping students by language proficiency level, hiring more Bilingual Education Assistants, hiring more ESL or Bilingual Ed certified teachers, etc. Rating categories were: "Strong Positive Impact", Weak Positive Impact", "No Impact", "Weak Negative Impact", "Strong Negative Impact" or "N/A".

The other section asks teachers to share their level of agreement (on a seven-point Likert scale) on statements about teaching ELLs mathematics. Two examples of statements are, "I use the same teaching methods with English Language Learners (ELLs) as I do with Native English Speakers (NESs)" and "Technology can help ELLs learn mathematics."

Data Analysis

For each survey item, one-way ANOVAs were conducted in Minitab to evaluate the relationship between a secondary mathematics teacher's beliefs and each of the two independent variables in the research hypotheses: (1) teachers' geographic region (either Midwest or Southwest) and (2) the ELL proportion of the district's student population. The latter was

categorized into two groups -- a district predominantly Caucasian (70%), and less than 3% ELLs, and districts with at least 20% ELLs. A Bonferroni correction was applied to the simultaneous tests to guard against Type I error.

Findings

The first research hypotheses that LSm School district teachers would have different beliefs than those of teachers from the HUs, HUm, and HRm school districts might be seen as true. There are several responses where LSm teachers' beliefs are significantly different than those of teachers in HUs, HUm, and HRm (see table 2). LSm teachers also gave responses that were not significantly different than the teachers in HUs, HUm, and HRm. An example of two questions where there was no significant difference are: a) ELLs can be taught to problem solve as well as Native English Speakers (NESs) can and b) ELLs have the skills and content knowledge to contribute to my class that NESs do. All teachers in the study held positive beliefs towards both of the previous statements.

The second null hypotheses that HUm and HRm school district teachers would hold similar beliefs to those of teachers from HUs school district might be seen as false. Teachers from HUm and HRm held several beliefs that were significantly different than the beliefs of teachers from HUs (See table 1). There are multiple questions from the survey where there were no significant differences between the responses of the school districts.

	Strategy teachers were asked to rate effectiveness of	Comparison	
1.	Group students by same language proficiency.		(b)
2.	Hire more Bilingual Education Assistants.	(a)	(b)
3.	Hire more ESL or Bilingual Ed certified teachers.	(a)	(b)
4.	Create an ESL consulting teachers position to help teachers in math.	(a)	(b)
5.	Use a different education model.	(a)	(b)
6.	Change the ESL curriculum.		(b)
7.	Create a sheltered English academy within the school for ELLs.		(b)
8.	ELLs can be taught to problem solve as NES can.		(b)
9.	I use a variety of teaching methods with ELLs as I do with NES.	(a)	
10.	I collaborate with my colleagues to plan lessons for my ELLs	(a)	
11.	Technology can help ELLs learn math.	(a)	
12.	I feel adequately trained to teach ELLs math	(a)	

Table 2: Statements with significant differences by comparison (a) LSm vs. HUs, HUm, & HRm (b) HUm & HRm vs. HUs.

Comparison by Districts' ELL Population

The first section's statements related to strategies in helping ELLs succeed in schools. Statements that had significant differences, with $p < 0.05$, between LSm teachers' responses and HUs, HUm, and HRm teachers' responses were 2, 3, 4, and 5. The responses were in a Likert-type scale, in which 0 meant strong negative impact; 1, weak negative impact; 2, no impact; 3, weak positive impact; and 4, strong positive impact. (see table 3)

Statement	$F(df_w,df_b)=F$	M (SD) of LSm	M (SD) of HUs, HUm, HRm	p-value
2	$F(1,69) = 18.92$	3.36 (0.63)	1.53 (1.54)	0.000
3	$F(1,69) = 33.09$	3.71 (0.47)	1.30 (1.55)	0.000
4	$F(1,68) = 21.66$	3.31 (0.63)	1.25 (1.57)	0.000
5	$F(1,58) = 5.70$	2.55 (0.69)	1.68 (1.62)	0.020

Table 3: Means, standard deviations and ANOVA results of the statements' of the two groups of districts classified by ELL population.

The second section of the survey used a scale from 1 (strongly disagree) to 7 (strongly agree), with 4 being neutral. Statements 9-12 had significant ($p < 0.05$) results (see table 4).

Statement	$F(df_w,df_b)=F$	M (SD) of LSm	M (SD) of HUs, HUm, HRm	p-value
9	F(1,77) = 9.00	5.00 (1.73)	6.00 (1.0)	0.004
10	F(1,76) = 4.90	2.64 (1.90)	3.89 (1.91)	0.030
11	F(1,79) = 5.72	5.44 (1.03)	6.08 (0.94)	0.019
12	F(1,80) = 6.25	3.00 (1.97)	4.22 (1.74)	0.014

Table 4: Means, standard deviations and ANOVA results of the statements of the two groups of districts classified by ELL population.

Comparison by Region

In the comparison between regions, all statements in the first section had significant ($p < 0.05$) results (see table 5).

Statement	$F(df_w,df_b)=F$	M (SD) of HUm, HRm	M (SD) of HUs	p-value
1	F(1,58) = 23.54	3.35 (0.99)	1.55 (1.50)	0.000
2	F(1,55) = 123.95	3.77 (0.80)	0.70 (0.88)	0.000
3	F(1,55) = 177.68	3.35 (0.86)	0.43 (0.71)	0.000
4	F(1,55) = 135.27	3.17 (1.10)	0.36 (0.71)	0.000
5	F(1,47) = 18.87	2.60 (1.06)	1.27 (0.96)	0.000
6	F(1,47) = 16.67	2.57 (1.22)	1.20 (1.00)	0.000
7	F(1,52) = 5.90	2.19 (1.38)	1.21 (1.34)	0.019

Table 5: Means, standard deviations and ANOVA results for the statements of the two groups of the two regions.

Only the statement #8, "ELLs can be taught to problem solve as NES can," had a significant difference, with $p = 0.37 < 0.05$.

Discussion

LSm vs. HUs, HUm, and HRm School Districts

The researchers hypothesized that LSm teachers would have different beliefs than the other school districts because LSm teachers and students were predominantly Caucasian. There are certain factors that promote a positive attitude towards teaching ELLs (Byrnes, Kiger, & Manning, 1997; Youngs & Youngs, 2001) and few of these are present in LSm.

For the most part, there was not a significant difference between the responses that LSm teachers provided and responses from teachers in the other three school districts. Responses to two particular questions are especially intriguing. The first question where teachers in LSm gave similar responses as teachers in the other three school districts is "ELLs can be taught to problem solve as well as NESs can." In both the literature (e.g. Hansen-Thomas & Cavagnetto, 2010; Sztajn, 2003) and in the researchers' experience working with teachers in in-service settings, mathematics teachers tend to believe that ELLs cannot engage in mathematics that require higher levels of cognitive demand. However, both LSm and the other three school districts had a positive response to the question.

The second question where LSm teachers held the same beliefs as the other three school districts was, "ELLs have the skills and content knowledge to contribute to my class that NESs do." All of the school districts had positive beliefs towards the prompt. Once again, this conflicts

with the literature (Vollmer, 2000) and the researcher's experience with other mathematics teachers, school administrators, and counselors. It may be that because teachers at LSm have not had many opportunities to work with ELLs, the teachers are just hypothesizing that ELLs could contribute to their class.

One area where LSm teacher responses were significantly different than teachers' in the other school districts was mostly with the questions that addressed effective strategies that help ELLs succeed in school. The four questions where LSm teachers significantly differed from teachers in the other schools are #2-5 in table 1. In each of the four questions, LSm teachers believed that each strategy had a weak positive impact (mean ≈ 3) on helping ELLs succeed in school. Teachers in the other school districts believed that each strategy would have a weak negative impact (mean ≈ 1) on helping ELLs succeed in school. It seems that the teachers in LSm are looking for outside help with teaching ELLs. The other school districts seem to believe that they do not need outside help. Perhaps, since the HUs, HUm, and HRm teach more ELLs, their teachers believe that they are already successful and do not need external help.

There are two other questions where LSm teachers differ significantly from teachers in HUs, HUm, and HRm school districts. The first is "I collaborate with my colleagues to plan lessons for my ELLs." It is not so much that the school districts' responses to the question differ significantly that is interesting; it is that teachers' responses had means that fell in the disagree range (2.6 and 3.8 respectively, where 4 is neutral and 1 is strongly disagree). It is unsettling that all teachers in this study generally choose not to collaborate in planning lessons for ELLs. In order to ensure students, including ELLs, receive innovative, high quality instruction, the literature indicates that collaboration is essential, but is less likely when working independent of a teacher community that values such work (McLaughlin, 1993). It may be that the prevailing culture of mathematics teachers is to work independently on all lesson planning, but working to change that culture appears essential to improving the instruction of ELL students.

The other question where LSm teacher responses significantly differed from teachers' responses in the other three school districts is "I feel adequately trained to teach ELLs math." Once again, the means of the two groups raises questions. The mean for LSm is 3, meaning that they feel unprepared to teach ELLs. The mean of the other three school districts is 4.2, which is a neutral response. It seems that this finding points to the necessity of training teachers how to teach ELLs mathematics. It is not surprising that teachers from LSm do not feel prepared to teach ELLs given ELLs' scarcity. In Batt, 2008 and Reeves, 2006, it was found that teachers from districts similar to LSm did not feel prepared to teach ELLs. What is surprising is that teachers in school districts with higher proportions of ELLs did not voice feeling at least somewhat prepared as a group to teach ELLs mathematics.

HUm and HRm vs. HUs

For the majority of the questions in the survey, the HUm and HRm teachers gave responses similar to the Hus teachers. There were eight questions where HUm and HRm teachers' responses differed significantly from the responses of teachers from HUs (See table 2). Seven of the eight questions fell under the category of "strategies that help ELLs succeed in school." What is interesting is that for questions #1-4 (see table 2) HUm and HRm had means of roughly 3, which indicates that the teachers felt that the strategies would have a weak positive impact on ELL's success in school. The means for the HUs for the same questions range from 1.5 (Weak negative impact) to 0.42 (Strong negative impact). It would seem that the HUm and HRm are looking for someone to help them teach their ELLs where HUs teachers feel that they do not

need outside help. Perhaps many of the teachers at HUs had tried the different strategies and found them to be less effective. For questions 5-7, all three school districts responded on the negative end of the spectrum (Weak negative impact or Strong negative impact), with the HUs teachers answering more negatively on all there questions than the other two school districts' teachers.

Implications

Follow-up interviews with teachers would help researchers more fully understand participants' responses. Despite this limitation, the findings suggest several implications. First, teachers do not feel trained to teach ELLs mathematics. There is a need for specialized sustained training aimed at mathematics teachers in order for them to learn how to effectively teach mathematics to ELLs. Next, mathematics teachers need to cultivate a culture of collaboration within their community. Regardless of the students mathematics teachers are teaching, they should collaboration dramatically increases the likelihood of planning effective mathematics lessons that engage students (McLaughlin, 1997). Finally, further research needs to be conducted to understand teachers' beliefs with respect to teaching ELLs mathematics. Once researchers more completely understand the beliefs of teachers, training can be organized to effectively address teachers' misconceptions and reinforce positive beliefs and practices.

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