

# Factors that Influence the Beliefs of First Year Teachers Regarding Reform-based Mathematics Instruction

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This survey-based study reported how the intensity of the beliefs of novice in-service teachers about reform-based mathematics instruction changed as they crossed the threshold into their first year of teaching. It also investigated the relationship between the influence of school-based mentors, or “transitional faculty,” including mentor teachers, instructional coaches, and administrators, along with curriculum materials, and the changes in belief intensity. Results obtained indicated belief changes were highly influenced by transitional faculty and curriculum materials. This study highlights the importance of creating systems to improve mentor selection and training, so the work of university personnel is not undone during the novice’s first year of teaching.

**Keywords** • mathematics teacher education research • belief change • reform-based mathematics instruction • mentoring • novice in-service teachers

The purpose of the study reported in this paper was to investigate how the intensity of the beliefs of novice in-service teachers about reform-based mathematics instruction changed as they crossed the threshold into their first year of teaching. It also investigated the relationship between changes in belief intensity and the influence of school-based mentors, or “transitional faculty,” including mentor teachers, instructional coaches, and administrators, along with curriculum materials. We begin with a literature review that places the study in the context of the current mathematics education reform movement and that justifies our use of teacher beliefs as the lens through which the study was conducted. We continue the review by arguing for a focus on the belief changes of first year in-service teachers by pointing out the similarity between them and preservice teachers, then further argue for the examination of the influence of transitional faculty and curriculum materials on those changes.

## Literature Review

Mathematics education reform has long been a topic of interest and importance. Although defined in multiple ways, many mathematics educators as early as the 1950s were describing the “*New Math*” as a teaching practice focused on problem-solving, investigation, and discovery in contrast to the rote memorization of facts and algorithms (Petronia, 1966). More recently, in an effort to instigate a second wave of reform, several organizations such as The National Council of Teachers of Mathematics (NCTM, 1980, 1989, 1991, 1995, 2000, 2006, 2014); the National Research Council (NRC, 1989, 2001); the Australian Curriculum, Assessment and Reporting Authority (ACARA, 2022); the Australian Association of Mathematics Teachers (AAMT, 2017); and the Association of Mathematics Teachers (AMT, 2006) in Britain have continued to focus on problem-solving, investigation, and discovery, as well as reasoning, constructing mathematical representations, engaging in meaningful discourse, and building conceptual understanding.



Teachers have been described as gatekeepers of curriculum and instruction because they “are normally the primary determinant of content, sequence and instructional strategy” (Thornton, 1989, p. 5). Fullan and Hargreaves (1992) added that transforming educational institutions was dependent on the development of teachers. This fact is relevant to the implementation of reform-based mathematics instruction (RBMI) because regardless of whether new standards have been provided, those standards will not benefit students unless teachers possess beliefs that align with RBMI. Teachers’ beliefs have been identified as a central aspect in the implementation of RBMI, as teacher beliefs are connected to teacher practice (Battista, 1994; Muijs & Reynolds, 2002). Thus, unless a teacher’s beliefs align with RBMI, her or his practice won’t either. The same is true for the use of reform-oriented curriculum materials (Collopy, 2003). Without aligning beliefs, teachers will not utilize those materials in a manner that supports RBMI.

Constructing or changing teachers’ beliefs is a challenging process and has not always been well understood or interpreted by researchers (Leatham, 2006; Pajares, 1992). Despite the challenge, it is well accepted that attending to teacher beliefs, broadly conceived, is a valuable component of effective teacher preparation and professional development (Sanger & Osguthorpe, 2011). Indeed, in relation to the study of teaching, some scholars maintain that beliefs can be the single most important construct in educational research (Pajares, 1992, p. 329). Thus, understanding the role teachers’ beliefs play in influencing teacher practice can lead to better results for applying research, including the application of RBMI. Moreover, rather than being thought of as a dichotomous construct—either people believe something or they do not—beliefs can be held with varying degrees of intensity (Rokeach, 1968, as cited in Pajares, 1992), so the measurement of beliefs places belief intensity on a continuum.

Ma (1999) suggested the place to begin the reform movement is among preservice teachers (PSTs), and preservice teacher education is enhanced through off-campus field, or clinical, experiences in schools that “create expanded learning opportunities for prospective teachers ... to be successful in enacting complex teaching practices” (Zeichner, 2010, p. 89). Numerous studies evidence the critical role clinical faculty—mentor or cooperating teachers and field supervisors—play in shaping the beliefs of preservice teachers (Vacc & Bright, 1999). Clinical faculty assist preservice teachers to integrate “theory and practice through guiding and supervising their practicum experience” (Holmes Group, 1995, p. 62). Therefore, field experiences are especially helpful to PSTs when there exists a conceptual alignment, or “conceptual interweaving” (Bahr et al., 2014), between the perspectives that undergird on-campus mathematics education courses and those possessed by the clinical faculty or support PSTs’ field experiences. In fact, beliefs favourable to RBMI that PSTs construct on campus can be “washed out” (Zeichner, 2010) by clinical faculty who espouse more traditional approaches to mathematics teaching and learning.

As Bahr (2013) asserted, it takes a village of preservice teacher mentors to assist in the development of strong reform oriented preservice teachers. The members of this mentoring group acted as boundary spanners (Osguthorpe et al., 1995) from university to school and were “both knowledgeable about and comfortable with the cultures of the collaborating institutions,” thus enabling them to guide preservice teachers (Sandholtz & Finan, 1998, p. 14). Brigham Young University (BYU), which has long been involved in university-district partnerships, has established the positions of Clinical Faculty Associate (CFA) and Partnership Facilitator (PF) to operate as boundary spanners. CFAs are “highly respected teachers” who work for two years supervising, teaching, and mentoring preservice teachers with the aim of “narrowing the gap between” teacher preparation programs and schools (Bullough et al., 2004, p. 506–507). PFs are on-site teacher educators who have the responsibility to “supervise and mentor” preservice teachers during field experiences (Bullough et al., 2004, p. 506).

The CFA and PF, along with the mentor teachers who work with preservice teachers in their classrooms are the clinical faculty that form a supporting village at BYU. When all three members of the clinical faculty are perceived by the preservice teacher to be supportive of RBMI, research suggests the belief intensity of the preservice teacher is favourably influenced (Bahr, 2013).

Another key influence on beginning teacher beliefs, along with the mentoring provided by clinical faculty members, are curriculum materials. Firestone and Schorr (2004) listed both the development of teachers and curriculum as drivers of change in teacher beliefs. While the reception of reform curriculum



is not a given, having one in place can be both educative and influential for teachers (Collopy, 2003; Remillard, 2000; Remillard & Bryans, 2004).

### *Research Questions*

After the work has gone into the preparation of PSTs, arming them with beliefs aligned with RBMI, what happens to these same PSTs when they leave the safety of their closely guarded teacher education programs? What if they gain employment at a school where those charged with supporting early career or novice in-service teachers (ISTs) are indifferent or negative toward RBMI? Franke et al. (2001) detailed the challenge of recidivism following the professional development of ISTs. While their study dealt with experienced ISTs, it is not unreasonable to infer that similar recidivism might occur with teachers who are in the beginning years of their career. The purpose of this study was to research the effects of the presence or absence of supportive guides such as a mentor teachers, instructional coaches, and school administrators, who will be referred to as "transitional faculty," on the belief intensity of early career educators regarding RBMI. Every newly minted novice IST will fight a battle against the recidivism that would drag them back to outdated and ineffective teaching practices. The supportive mentoring of these early career teachers may be just as crucial in promoting reform as the mentoring that supports PSTs.

While there is research describing the influence of clinical faculty on the mathematics teaching beliefs of PSTs, the same cannot be said for beginning career ISTs, specifically for novice ISTs who have come through a teacher preparation program which specializes in preparing preservice teachers in RBMI. This gap in existing knowledge means that preparing teachers who have a strong belief in RBMI doesn't necessarily mean that they will continue in that belief. Recidivism is a reality for many teachers (Franke et al., 2001), including those in their first year of teaching, and addressing the factors that play a role in whether their beliefs wax or wane is worthwhile.

The purpose of the study reported in this paper was to examine the extent to which the belief intensity of novice ISTs towards RBMI changed during the first year of teaching. This study also examined how novice ISTs' beliefs were influenced by various factors including their perception of their mentors' beliefs, the quality of support that they received from their mentors, and their district's curriculum. Therefore, we sought to answer the following research questions:

- 1. To what extent did the belief intensity of novice ISTs change regarding RBMI during their first year of teaching?*
- 2. What was the relationship between the changes in the beliefs of novice ISTs during their first year of teaching and their perceptions of the beliefs of transitional faculty members who mentored them as well as the quality of support those faculty provided?*
- 3. In instances in which the ISTs perceived all three transitional faculty and their curriculum materials to be RBMI friendly and received high quality support, how did their changes in belief compare to those whose perceptions were otherwise?*

## Methodology

### *Research Design*

A survey research design (McMillan & Schumacher, 2001) was utilized for the study reported in this paper. The survey assessed the intensity of the participants' beliefs regarding RBMI, their perception of the beliefs of their transitional faculty and the quality of support received from their transitional faculty, and their perception of the curriculum materials at their disposal. Once data were collected, respondents were grouped on the basis of their responses. These groupings enabled the exploration of relationships among the data, such as how the belief intensity of the transitional faculty members, as perceived by the novice ISTs, influenced the belief intensity of those novice ISTs. Inasmuch as this study reflected a



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continuation of Bahr's (2013) village study, much of the study's methodology mirrored that of the village study.

### *Participants*

Participants in this study were teachers in their first year of teaching, who had attended BYU, and were currently working in one of the five districts that form the previously discussed public school partnership with BYU—Alpine, Jordan, Nebo, Provo, and Wasatch. The reason for including only BYU graduates as participants was three-fold. First, it is an institution that focuses its mathematics content and methods courses on the principles of RBMI. Second, all participants had received the same courses from the same teacher preparation program, limiting variation in their preparation. Third, this study aimed to build off existing research, which studied the impact that those who act in the role of clinical faculty at BYU have on the belief intensity of preservice teachers, by studying the impact that a corresponding group, termed the transitional faculty, might have on the RBMI beliefs of recent graduates who also previously experienced mentoring from a clinical faculty at BYU.

There were two categories of participants that were surveyed for this study. BYU allowed preservice teachers to choose to do traditional student teaching at the end of the teacher preparation program but also offers the option to forego student teaching to complete a year-long internship. As an intern, the teacher benefits from the support of clinical faculty as do student teachers. However, because interns are also full-time classroom teachers, they benefit and receive support from transitional faculty and make use of curriculum materials. Indeed, interns function as and consider themselves first year teachers. With that in mind, the first category of participants was comprised of those who were in their first year of teaching as interns. The second category was comprised of first year teachers who completed traditional student teaching prior to their first year of in-service teaching and who were no longer supported by clinical faculty. Distinguishing among the participants according to this categorisation allowed controlling for possible differences in the experience and nature of the participants' first year.

### *Instrument*

In order to obtain data for the study, a selected-response, self-report survey was created that has eleven sections and appears in the Appendix. As seen in Table 1, the first section consists of 20 items drawn from *A Survey Measuring Elementary Teachers' Implementation of Standards-based Mathematics Teaching* (Ross et al., 2003) that was created to measure belief intensity regarding nine dimensions of RBMI. Each dimension is represented with one, two, or three items. Results obtained from the survey have shown to highly correlate with observations of classroom practice and evidence of its reliability and validity is presented in Ross et al. (2003; see also Rino et al., [2021]). The same 20-item survey made up the second section, but the participants were asked to respond to it retrospectively, as if they were responding to it at the time immediately preceding their first year of teaching. The validity of retrospective pre-measures in assessing the dispositions of PSTs was demonstrated by Cantrell (2003) and ISTs by Allen and Nimon (2007). Response-shift bias, which occurs when a participant's understanding or frame of reference about what is being measured changes from the time of the pre-measure to the time of the post-measure, is addressed by the use of a retrospective measure, as responses on the pre- and post-measure occur at the same time (Aiken & West, 1990; Cronbach & Furby, 1970). Consequently, greater validity and statistical power tend to be produced by retrospective measures in comparison to traditional pre-measures (Bray et al., 1984; Howard et al., 1979).



Table 1  
*Summary of Survey Contents by Section*

Section	Description	Number of items ( <i>n</i> )
Section 1	Current teacher beliefs	20
Section 2	Retrospective beliefs from before first year of teaching	20
Section 3	Perception of mentor teacher's RBMI beliefs	9
Section 4	Perception of instructional coach's RBMI beliefs	9
Section 5	Perception of administrator's RBMI beliefs	9
Section 6	Perception of facilitator's RBMI beliefs (intern only)	9
Section 7	Curriculum alignment with RBMI	9
Section 8	Rapport/support from mentor teacher	6
Section 9	Rapport/support from instructional coach	6
Section 10	Rapport/support from administrator	6
Section 11	Rapport/support from facilitator (intern only)	6

Following Section 2, the survey assessed the perceptions that participants had regarding the RBMI belief intensity of the members of their transitional faculty. This comprised Sections 4–5, and the items were based on the same nine dimensions as the first two sections. Section 6 was for participants who were interns and assessed their perceptions regarding the RBMI belief intensity of their facilitator owing to the fact that they received support from clinical as well as transitional faculty. Unlike the previous sections, however, Sections 3–7 assessed each dimension with only one item per dimension, due to concerns about survey length. The reliability and validity of these items were established through three procedures. First, one of the original creators of the survey, reviewed and found the items to represent the meaning and intent of the nine dimensions. Second, a think-aloud protocol was used to provide evidence of response process validation in a 2009 study (Bahr et al., 2009). Finally, in a later study that used the same instrument, Bahr (2013) stated that the 2009 study also found a “high degree of clustering among the responses to these nine items by using item-to-adjusted total correlation” (p. 523). The purpose of this item-total correlation was to ensure that no items had responses that vary dramatically across the population in comparison to other item responses yet varied enough to indicate that responses obtained from them provide unique contributions to the overall constructs being assessed. The items, created for PSTs, were adapted only for the purpose of use with ISTs.

Section 7 assessed the same nine dimensions related to reform-based practice as the previous sections, but items in this section asked respondents to assess the extent to which the curriculum materials that they were provided reflect a reform-based perspective. The items within the first seven sections had six bi-directional response categories, as items in these sections measured varying degrees of agreement, which can be positive or negative, ranging from *strongly disagree* to *strongly agree*.

Section 8 through to Section 11 were made up of the same six items that were designed to assess the participants' perceptions of the support provided by each of the transitional faculty—mentor teacher, instructional coach, and school administrator. Similar to Section 6, Section 11 was completed by participants who were interns, because as mentioned previously, they also received support from a clinical faculty, their school facilitator. The items for these sections were validated using the same procedures as were used for items in Section 3–7 as detailed above. The Sections 8–11 each had five uni-directional response categories because the items in the survey inquired about the presence or absence of certain types of support, ranging from *never* to *consistently*.

## *Analysis*

Four preliminary analyses were performed. First, in order to determine the degree of homogeneity among items in the first two survey sections regarding participants' current and prior beliefs, an item-test correlation analysis was performed, and items found to have low correlation were omitted from subsequent statistical analysis. Second, to determine if the participants' own dispositions influenced their perceptions of their transitional faculty, Pearson *r* correlations were computed between the overall



variables obtained from participant responses in the first two sections of the survey and the items that measured the perceptions they had of their transitional faculty and curriculum material. Third, descriptive statistics—minimum score, maximum score, mean, median, and standard deviation—for all variables assessed by the survey were computed. Fourth, when data collection began there was interest in looking at the two types of novice ISTs as subgroups—interns and those that completed traditional student teaching who were in their first year of teaching—to investigate if there were statistically significant differences in their responses to items in the third through eleventh survey sections. However, there was an insufficient number of first year teachers who completed student teaching to conduct such an analysis. Rather, an analysis comparing the current and prior beliefs of the two groups was performed in order to determine whether combining responses would be advisable.

A *t*-test was used to test for whether the difference between participants' current belief intensity to the intensity of their beliefs before their first year of teaching, which will hereafter be referred to as prior beliefs, was statistically significant. Next, effect size was calculated by computing the ratio between the difference between the current and prior belief means and the pooled standard deviation of the current and prior distributions. An effect size corresponding to 0.2 may be considered small, one of 0.5 may be considered moderate, and one of 0.8 large (Cohen, 1977).

For each of the other sections, participant responses regarding their perceptions of the beliefs of their transitional faculty, of the extent to which the curriculum materials they were provided aligned with an RBMI perspective, and of the level of support provided were used to divide participants into two groups. The median response acted as the separator between the two groups. Then the overall current belief means, Section 1 of the survey, for the two groups were compared using analysis of covariance procedures with the means on the overall prior belief variable as a co-variant. For example, if the median for responses about the novice ISTs' perception of the beliefs of their mentor teachers was 3.5, ISTs were placed in two groups according to whether their responses were above or below that median. Then their overall response means on the current beliefs variable were compared. Therefore, in this analysis the separated groupings were independent variables and were used in analyses of covariance with the current belief overall variable as the dependent variable and the prior belief overall variable as the covariant.

Having participants grouped by the median also allowed for the testing of the research question regarding the village of mentors. Participants whose responses placed them in the above median group for each of the transitional faculty for transitional faculty beliefs, transitional faculty support, and curriculum were grouped together. All other participants were grouped together, and the current belief means of the two groups were compared using analysis of covariance. Doing so revealed how having curriculum materials supportive of RBMI and being supported by transitional faculty who all were also perceived to possess RBMI friendly beliefs influenced the RBMI beliefs of first year teachers.

In the course of analyzing the data, an additional question arose as to whether there were significant intensity differences across the perceived beliefs of transitional faculty. Therefore, a series of paired *t*-tests were performed comparing the mean beliefs score for each type of transitional faculty.

## Results

### *Preliminary Analyses*

An item-test correlation analysis was performed for Section 1 and Section 2, regarding participants' current and prior beliefs, and items found to have low correlation were omitted from subsequent statistical analysis—Items 6, 15, 18, 19, and 20. Interestingly, all of these items called for a negative response in order to show support for RBMI. For instance, Item 6 says, "It is not very productive for students to work together during math time," which someone would disagree with if their beliefs were aligned with RBMI.

Descriptive statistics for the perceived beliefs of the transitional faculty, curriculum material alignment, and intern facilitators are shown in Table 2. The lowest overall mean for beliefs came from



the ratings provided by participants for their mentor teachers, who typically spend the most time with the first-year teacher compared to other transitional faculty, and responses about them showed the greatest variability. The only lower overall mean provided by participants was the curriculum materials alignment with RBMI. While only interns responded for facilitators, the overall mean for their beliefs was the highest at 5.24.

Table 2  
*Descriptive Statistics for Beliefs*

Beliefs	<i>n</i>	Min	Max	Mean	Median	<i>SD</i>
Facilitator	50	2.44	6.00	5.24	5.33	.701
Coach	75	1.89	6.00	5.16	5.33	.796
Admin	76	1.67	6.00	5.00	5.17	.867
MT	76	1.89	6.00	4.88	5.00	.915
Curriculum	75	1.78	6.00	4.83	4.89	.898

Table 3 shows the descriptive statistics for the level of support provided to first year teachers from their transitional faculty and the facilitator for interns. As depicted in participant ratings for mentor teachers had the highest overall mean for support at 3.86, with the mean for facilitators at 3.79. Ratings for coach and administrator support were lower at 3.34 and 2.87, respectively.

Table 3  
*Descriptive Statistics for Support*

Support	<i>n</i>	Min	Max	Mean	Median	<i>SD</i>
MT	76	1.50	5.00	3.86	3.83	.942
Facilitator	50	1.50	5.00	3.79	4.00	.978
Admin	77	1.00	5.00	2.87	2.67	1.019
Coach	76	1.00	5.00	3.34	3.50	1.143

Due to concern that novice ISTs own dispositions towards RBMI might affect their perceptions of their transitional faculty's beliefs or curriculum's alignment, Pearson's *r* correlations were computed. The correlations were computed between the overall variables obtained from participant's responses to the prior and current beliefs items and the items that measured participants' perceptions of the transitional faculty's beliefs and the curriculum alignment. Had participants' dispositions coloured their perceptions, meaningful correlations would have been obtained. As shown in Table 4, there is a clear absence of such correlations between either prior or current measured beliefs and those perceptions.

Table 4  
*Belief-Perception Correlations for Transitional Faculty Beliefs*

Belief Measure	MT Beliefs	Coach Beliefs	Admin Beliefs	Facilitator Beliefs	Curriculum
Prior	-0.125	-0.108	-0.141	-0.053	-0.176
Current	0.277	0.278	0.231	0.149	0.202

An analysis comparing the current and prior beliefs of interns and first year teachers was performed in order to determine combining responses would be advisable. The overall prior belief mean and current belief mean for interns were 4.89 and 4.62, respectively, showing a negative difference of 0.27. The overall prior belief mean and current belief mean for those who had completed a student teaching experience were 5.00 and 4.52, respectively, showing a negative difference of 0.48. When compared, the *p*-value was 0.623 and the *F* was 0.246, showing that the difference between the two groups was not statistically significant. Therefore, the two subgroups were combined into one group for the rest of the analyses.



### *Research Question 1: Changes in Belief Intensity*

The first research question that guided this study was, "To what extent did the belief intensity of novice ISTs change regarding RBMI during their first year of teaching?" As can be observed in Table 5, the RBMI belief intensity of novice ISTs decreased during their first year of teaching to a statistically significant degree. Despite the overall mean belief score decreasing, 18 of the participants showed positive growth in their belief intensity towards RBMI, with the rest showed their belief intensity wane.

Table 5  
*Overall Prior and Current Belief Means*

Overall Mean	<i>n</i>	Mean	<i>SD</i>	Std. Error Mean
Prior	73	4.93	0.572	0.06691
Current	75	4.58	0.434	0.05014
Effect Size			0.695	

### *Research Question 2: Groups Based on Perceived Beliefs and Support*

Next, participant responses related to their perceptions of transitional faculty beliefs and curriculum and the level of support provided by the transitional faculty were used to split participants into two groups. For novice ISTs who were interns, participants were also split on the basis of the survey sections relating to their perceptions of the beliefs and support provided by their facilitators. This division was accomplished by determining the median response of the perceptions related to one set of perceptions regarding the transitional faculty, curriculum alignment, and facilitator, then placing those participants whose responses were above the median in one group and participants whose responses were below the median in the second group. This resulted in two roughly equal-sized groups for each analysis. This made two groups for each of the nine separate analyses of covariance which used the current belief measure as the dependent variable and the prior belief measure as a covariate.

As shown in Table 6, the difference in the current mean beliefs between the above median group and below median group was statistically significant for all transitional faculty beliefs, support, and curriculum alignment. The largest mean difference between the above and below median groups for current beliefs occurred with coach support as the independent variable, the difference being 0.33. The smallest mean difference between the above and below median groups for current beliefs was 0.12 for facilitators. Additionally, the effect sizes for each variable for beliefs, curriculum, and support were in the moderate range. These results indicate those participants who perceived that their respective traditional faculty possessed beliefs that aligned with RBMI also reported greater belief intensity in relation to RBMI.





Table 6  
*Analysis of Covariance: Individual Groupings Based on Transitional Faculty, Facilitators, and Curriculum Materials*

Perceptions	Group	<i>n</i>	Mean Current Novice IST Beliefs (6 pt scale)	<i>F</i>	<i>p</i>	Effect Size
MT Beliefs	Above median	39	4.67	99.32	< 0.001	0.35
	Below median	33	4.52			
Coach Beliefs	Above median	34	4.70	106.23	< 0.001	0.39
	Below median	37	4.53			
Admin Beliefs	Above median	36	4.67	100.14	< 0.001	0.33
	Below median	36	4.53			
Facilitator Beliefs	Above median	24	4.69	60.66	< 0.001	0.28
	Below median	23	4.56			
Curriculum Alignment	Above median	43	4.67	94.77	< 0.001	0.41
	Below median	28	4.49			
MT Support	Above median	38	4.68	94.13	< 0.001	0.40
	Below median	34	4.51			
Coach Support	Above median	39	4.73	116.07	< 0.001	0.75
	Below median	33	4.40			
Administrator Support	Above median	36	4.69	86.88	< 0.001	0.50
	Below median	29	4.48			
Facilitator Support	Above median	27	4.71	61.94	< 0.001	0.38
	Below median	20	4.54			

### *Research Question 3: The Influence of a Unified Village*

In order to test the hypothesis regarding a village of mentors whose beliefs and support are positive towards RBMI, along with curriculum materials that align with RBMI, another analysis of covariance was performed. Participants whose responses placed them in the above-median groups in each separate analysis were placed in one group and their overall current belief means were compared to the overall current belief means of all other participants using analysis of covariance procedures. As shown in Table 7, there were 13 participants in the above-median group for all separate analyses, and their group belief mean was found to be greater than the below-median group to a statistically significant degree. The effect size was 0.57, placing it in the moderate range. Thus, when participants perceived that all their respective transitional faculty possessed beliefs that aligned with RBMI and reported a high level of support from those faculty, they also reported greater belief intensity in relation to RBMI.

Table 7  
*Analysis of Covariance: The Village Hypothesis*

Perceptions	Group	<i>n</i>	Mean Current Novice IST Beliefs (6 pt scale)	<i>F</i>	<i>p</i>	Effect size
MT Beliefs	Above median	13	4.79	99.32	< 0.001	0.57
	Below median	62	4.54			

An additional question arose in the course of analyzing the data as to whether there were significant intensity differences across the perceived beliefs of transitional faculty. Therefore, a series of paired *t*-tests were performed comparing the mean beliefs score for each type of transitional faculty and the results appear in Table 8. Significant differences were found across all comparisons except the administrator and facilitator pairing. All the effect sizes, with the exception of that pairing were moderate.



Table 8  
*Paired t-tests of the Transitional Faculty Beliefs*

Transitional Faculty Pairing	<i>n</i>	Mean difference	<i>SD</i>	Standard error	<i>t</i>	<i>p</i>	Effect size
Mentor/ Coach	75	0.28	0.624	0.072	3.925	< .001	0.45
Mentor/ Admin	76	0.12	0.619	0.071	1.749	.042	0.20
Mentor/ Facilitator	50	0.20	0.651	0.092	2.147	.018	0.30
Coach/ Admin	75	0.16	0.471	0.054	2.913	.002	0.34
Coach/ Facilitator	50	0.14	0.464	0.066	2.066	.022	0.29
Admin/ Facilitator	50	0.004	0.411	0.058	0.076	.470	0.01

## Discussion and Conclusion

The purpose of this study was to examine the extent to which the belief intensity of novice ISTs towards RBMI changed during their first year of teaching. It also examined whether novice IST belief intensity was influenced by their perceptions of the beliefs of their transitional faculty and curriculum, and the quality of support provided by those mentors. The beliefs and perceptions of novice ISTs were obtained through a survey that was administered near the end of ISTs' first year of teaching. There were four research questions that guided this study, and the results obtained from each will be addressed in this section accompanied by links to other pertinent research previously conducted in order to provide context for the findings of this study.

### *Research Question 1*

This study's first research question was: To what extent did the belief intensity of novice ISTs change regarding RBMI during their first year of teaching? There was a statistically significant drop in belief intensity toward RBMI during the ISTs' first year of teaching, similar to the recidivism observed by Franke et al. (2001) among more experienced teachers. This finding, while not positive for those that work in the field of preservice teacher education and preparation, is one that must be addressed if stronger university-district partnerships are being sought. These findings contrast what Bahr (2013) found regarding RBMI beliefs of PSTs before and after practicum field experiences, where beliefs significantly increased. Despite the opposite direction of belief change from the participants of that study and the participants of this study, the findings from both studies can lead those that work with PSTs and ISTs to draw similar conclusions about the role that the perceptions of belief and support play in the evolution of their mentee's beliefs. Those findings and conclusions will be addressed further in this section.

While not specifically addressed in the original research questions, there was interest in examining if any difference existed in belief changes between novice ISTs who had completed traditional student teaching and those that were interns, as interns still have access to mentoring from clinical faculty that are more connected to university during their first year of teaching in addition to their transitional faculty. Somewhat surprisingly, while the drop for former student teachers was slightly larger than it was for interns, the difference was not statistically significant. We conjecture that while interns still interact with their clinical faculty mentors, they might feel more connected to their transitional faculty. Their transitional faculty might represent mentors that are seen as more long-term comparative to the clinical faculty. Also, interns might take more interest in the beliefs and support of their transitional faculty as it could affect their prospect of being hired at the same school or district after completing their internship. It could be that interns, while still technically university students, identify less as PSTs and more as full ISTs, and give more credence to their transitional faculty mentors than their clinical faculty counterparts.



## *Research Question 2*

The second research question of this study was: What was the relationship between the changes in the beliefs of novice ISTs during their first year of teaching and their perceptions of the beliefs of transitional faculty members who mentored them as well as the quality of support those faculty provided?

When participants were split into groups based on their perceptions of their mentor's belief and their curricula's alignment with RBMI, the difference in the current beliefs of the above and below median groups was found to be statistically significant for mentor teachers, coaches, administrators, facilitators, and curriculum materials. That is, there was significantly less recidivism among the ISTs who perceived one or more of their transitional faculty or their curriculum materials to be reform minded. These findings demonstrate, in a powerful way, the importance of mentors who have RBMI friendly beliefs. It appears that the effects that university experiences have had in shaping the RBMI beliefs of PSTs were overridden, even "washed out" (Zeichner & Tabachnick, 1981), by the mentoring of transitional faculty once the PSTs become novice ISTs. As the individual transitional faculty were examined more closely, facilitators and coaches were perceived to have the highest overall belief scores. This is somewhat unsurprising in the case of facilitators and might be attributed to the fact that the university participates in the selection of clinical faculty, and they are typically more connected with RBMI.

Mentor teachers and curriculum materials were perceived to have the lowest overall influence on beliefs. This is an unfortunate finding for those who champion RBMI because novice ISTs typically work with their mentor teachers and curriculum materials more frequently than their other transitional faculty. Mentor teachers having a relatively low overall belief score, as perceived by novice ISTs, might result from them being farther removed from university methods instruction and the delivering of professional development compared to the rest of the transitional faculty. Facilitators, coaches, and administrators all have responsibilities for delivering and overseeing the professional development of teachers, which might have given them more exposure to RBMI.

The perceived low score for curriculum alignment could on one hand be due to curriculum developers needing to create materials that can be used by teachers who represent every part of the belief spectrum regarding RBMI. This need to provide one-size-fits-all resources could lead to their catering to the beliefs of those whose beliefs are not as reform friendly. On the other hand, the curriculum material results could be viewed as a surprise because the curriculum materials used by the vast majority of participants were selected by their respective district offices for their perceived alignment with RBMI. One possible explanation to bring these two possibilities together is that novice ISTs might tend to adopt the attitudes that more experienced teachers around them have regarding curriculum materials, which attitudes aren't always positive (Remillard & Bryans, 2004). Another possible explanation is that the curriculum materials selected by district offices might be more RBMI friendly than what experienced ISTs typically use, but less RBMI friendly than what novice ISTs might be expecting as they leave their preservice training.

To further explore the influence that transitional faculty beliefs might have played in the changes in belief intensity of novice ISTs, the perceived beliefs of transitional faculty were compared. The pairings whose differences were the most statistically significant were coaches and mentor teachers and then coaches and administrators. Coaches being the higher of the two in both pairings, sheds light on both the positive work being done to select those with RBMI friendly beliefs to coaching roles as well as the need to further examine why mentor teachers and administrators are lagging behind coaches in their own beliefs. As will be discussed later, the effects of having all transitional faculty on the same page can have a strong influence on the beliefs of novice ISTs. It came as somewhat of a surprise to see a statistically significant difference between coaches and administrators when they ranked second and third, respectively, in the overall belief score. Also, it was interesting that there was virtually no difference between administrators and facilitators in the paired  $t$ -test. This might be explained by facilitators frequently being used as auxiliary administrators, and therefore spending increased time working alongside administrators.



Due to the potential influence that interpersonal relationships can have upon mentoring (Hargreaves & Fullan, 2000), this study also investigated the extent to which interpersonal relationships, in the form of mentoring support from transitional faculty and facilitators to novice ISTs, influenced the RBMI beliefs of those novice teachers. Just as was done to analyse the effects of transitional faculty beliefs, participants were divided into two groups using the median response for their perception of the support that they received from their transitional faculty and the facilitator for interns.

Similar to the results for beliefs, the differences in the beliefs of novice ISTs in the above and below median group was statistically significant for mentor teacher, coach, administrator, and facilitator support. In short, those that perceived that their transitional faculty were supportive had higher belief scores than those whose perceptions were not as positive. This finding suggests that the influence of transitional faculty having RBMI friendly beliefs is enhanced or reduced according to the quality of support they provided. For example, a novice IST who perceives his or her administrator to have RBMI friendly beliefs might be less influenced by the administrator if they only receive direct mentoring from that administrator a few times over the course of the year. On the other hand, a mentor teacher whose beliefs are perceived to be less RBMI friendly might be heeded more by a novice IST who knows that they will interact with that mentor teacher on a daily basis.

Among the transitional faculty and facilitators, the overall support score for mentor teachers was the highest. This does not come as a surprise considering mentor teachers typically interacted with their mentees daily. Facilitators were second highest for support, which can be attributed to their role as clinical faculty who are placed at the school for the purpose of guiding interns. Support from coaches was found to have the largest effect size along with being statistically significant, despite having the second lowest overall score for support, only ahead of administrators. This might be seen as an opportunity for improvement for those that influence the work of the transitional faculty. Coaches had the second highest overall belief score behind facilitators, and yet novice ISTs reported that they aren't receiving the same level of support from them as they receive from their mentor teacher and facilitator for interns. This might be explained by the fact that coaches are a resource for all the teachers at the school or even because coaches believe that interns have facilitators to mentor them. Whatever the reason, finding a way to make coaches more involved with novice ISTs could lead to less recidivism of RBMI beliefs.

Bahr's 2013 study of the influence that clinical faculty has on the RBMI beliefs of PSTs also examined how support, or interpersonal relationships as he termed them, play a role. Due to concerns about survey length, he only included items regarding support for the mentor teachers, concluding that the findings could be seen as comparable for the rest of the clinical faculty. Due to an improved survey design, this study was able to include items regarding support for all members of the corresponding transitional faculty and facilitator. The benefit of doing so is that the data speak for themselves in showing the statistical significance of mentors providing high levels of support.

### *Research Question 3*

The third question of this study was: In instances in which the ISTs perceived all three transitional faculty and their curriculum materials to be RBMI friendly and received high quality support, how did their changes in belief compare to those whose perceptions were otherwise? The collective influence of transitional faculty who all possess RBMI friendly beliefs and who provide high levels of support with the novice ISTs they mentor creates a village (Bahr, 2013). This village is a supporting ensemble who speak with a united voice regarding mathematics teaching and learning. Just as Bahr's study found that the belief intensity of PSTs increased dramatically when all their clinical faculty were unified in having RBMI friendly beliefs and demonstrated a high level of support, the same was found in this study. Of all participants, those whose responses placed them in the above median group for all perceived belief, support, and curriculum groups were placed in a group together. All other participants were placed in another group. The difference in the beliefs of the groups was found to be statistically significant. That is, the degree of recidivism ISTs in the village group experienced was significantly less than ISTs in the other group.



While it might not come as a surprise, this result demonstrates how influential a united group of mentors can be. Novice ISTs go through a challenging experience of developing their own personal teaching identity during the beginning years of their career. Bullough (1991) used the term “chameleon” when describing how novice ISTs change their identities during this formative stage. Based on the findings of Bahr’s study and this study as a continuation, the beliefs of PSTs and ISTs can be positively and significantly influenced when their mentors form a unified village. It is not a stretch to say that these villages could go a long way in helping novice ISTs navigate this challenging stage.

## Implications for Future Research

Generally speaking, future research could and hopefully will seek information about why novice ISTs experience so much recidivism at all. In Bahr’s (2013) previous study with PSTs, RBMI belief intensity increased dramatically for participants, not just those that had a full village of clinical faculty. Why would novice ISTs, just a year or less removed from completing their own practicum experience, see their beliefs decrease to a similarly dramatic extent? One potential way of conducting such research would be to invite novice ISTs to participate in qualitative research that has them reflect on why they believe their beliefs towards RBMI decreased. Perhaps then it might be possible to find common trends or themes.

This study examined how the RBMI beliefs of novice ISTs were influenced by the perceived beliefs and support of transitional faculty and curriculum. The actual beliefs of transitional faculty were not studied. While using the perceptions of the novice ISTs does not equate to being a limitation, it does open the door to researching the beliefs of these mentors according to what they would say about themselves. Asking transitional faculty to respond to the same items about their beliefs as novice ISTs respond to according to their perception of their transitional faculty could also lead to interesting data about the accuracy of perceptions of novice ISTs. Understanding that dynamic and how accurate those perceptions are might also colour the findings of this and other studies.

Another area for future research could involve taking a closer look at the 18 participants of this study whose belief intensity increased during their first year of teaching despite the overall belief average of all participants experiencing a statistically significant decrease. Looking at the perceived beliefs and support of their transitional faculty could yield important insights, especially if there are commonalities as to which mentors were higher or lower. Also, following up with those 18 participants to interview them about their perceptions and experiences could shed light on why the intensity of their beliefs grew while the intensity of their peers’ beliefs receded.

The findings of this study have implications for a variety of practitioners, including mentor teachers, coaches, administrators, facilitators, novice ISTs, those who choose curriculum materials, and those who have an influence over the collaborative work of transitional faculties. Implications for mentor teachers, coaches, administrators, and facilitators are similar. As their understanding of the influence that their beliefs and support can have on the novice ISTs they mentor, it can lead to improved mentoring practices. For instance, this study could lead transitional faculty to greater collaboration concerning how they mentor their novice ISTs, including how they present their beliefs and coordinate their support. Being on the same page in the mentoring practices and RBMI beliefs would, as the findings of this study show, reduce recidivism of RBMI beliefs for first year teachers. It could also lead transitional faculty to deeper reflection about their own beliefs, which reflection could in turn lead to the development of beliefs that are more reform friendly.

Looking at individuals specifically, coaches should be an area of focus. Their beliefs were generally seen as positive towards RBMI, yet the level of their support was perceived to be the lowest besides administrators. What currently seems to be a missed opportunity could become an area of strength for novice ISTs, especially those that previously completed student teaching. They no longer have access to facilitators, who were the only group to be perceived to have higher belief scores than coaches. Systems could be created that allow coaches more opportunities to give novice ISTs support.

For mentor teachers, the findings are nearly the inverse for coaches. They received the highest overall ratings for support, and yet they received the lowest overall ratings for how their beliefs are



perceived besides curriculum materials. While novice ISTs would certainly benefit from increased support from coaches, the implication with mentor teachers is not to decrease their level of support, but rather to find a way to either help them develop RBMI friendly beliefs if they do not already have them or help them more clearly share the RBMI friendly beliefs they already have.

There are also implications for administrators who typically select mentor teachers. There are obviously many valid factors that go into deciding where novice ISTs are placed. That being said, if the selection of mentor teachers was more purposeful with regards to their beliefs and the level of support, it could positively influence the beliefs of those they mentor. Also, administrators, as the leader in their schools, could lead out in bringing each novice IST's transitional faculty together prior to the beginning of the year to create unity within the mentoring team, thus improving the likelihood of the team acting as the village described by Bahr (2013).

Finally, there are implications for those, usually at the district level, who have influence over either the selection of curriculum materials or the collaborative work of transitional faculties. If university personnel, who work for years to help PSTs develop positive RBMI beliefs, were invited to participate in the selection of district wide curriculum materials then it might lead to materials being chosen that more closely align with the teaching and learning ideals of novice ISTs.

## Conclusions

According to Ma (1999), the responsibility of moving the reform movement forward falls on preservice teacher educators and, as an extension, the PSTs they educate. Bahr (2013), speaking of that responsibility stated, "The fulfillment of that responsibility is more likely to occur if villages of university and clinical faculty synchronously encourage similar dispositions toward mathematics, the learning of mathematics, and the teaching of mathematics" (p. 529). Considering that novice ISTs are like PSTs in their development, this study examined how a corresponding group of mentors, termed the transitional faculty, influenced the RBMI beliefs of first year ISTs. Just as the perceived beliefs and support of the clinical faculty significantly influenced the beliefs of PSTs in the 2013 study, this study similarly found that the perceived beliefs and support of transitional faculty and curriculum significantly influenced the beliefs of novice ISTs during their first year of teaching.

It might not come as a major surprise that how novice ISTs perceive the beliefs and support of their transitional faculty influences their own beliefs. That being said, based on the findings of this study, which showed the RBMI beliefs of novice ISTs drop significantly, it is clearly something that needs to be stated. The recidivism of novice ISTs might be prevented, and even further positive belief growth achieved, if the transitional faculty who mentor them are reform friendly and collaborate purposefully. Just as high-quality teaching is centred on doing what is best for students, the high-quality mentoring of novice ISTs should be centred on creating unified villages of mentors that allow for those novice ISTs to build on the tender RBMI beliefs that took root during their preservice preparation.

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## Ethics Declarations

### *Ethical approval*

Ethical approval for the research was granted by the Institutional Review Board of Brigham Young University and informed consent was given by all participants for their data to be published.

### *Competing interests*

The authors declare there are no competing interests.





## Appendix

### *Instrument: Survey of First Year Teacher Beliefs and Perceptions*

There were six responses for items in the first seven sections ranging from strongly disagree to strongly agree. There were five response categories for items in Section 8–11. Additionally, items were repeated in order to obtain responses about each transitional faculty and the curriculum in Sections 3–7, and for each transitional faculty in Sections 8–11.

#### *Survey Section 1*

Item	To what extent do you agree that these statements characterize the approach you take in teaching mathematics in your classroom?
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- |      |   |
|------|---|
| 1.1  | I use math problems that can be solved in many different ways.  |
| 1.2  | I regularly have my students work through real-life math problems that are of interest to them.   |
| 1.3  | When two students solve the same math problem correctly using two different strategies I have them share the steps they went through with each other. |
| 1.4  | I tend to integrate multiple strands of mathematics (number, geometry, measurement, etc.) within a single unit.                                       |
| 1.5  | I often learn from my students during math time because my students come up with ingenious ways of solving problems that I have never thought of.     |
| 1.6  | It is not very productive for students to work together during math time.   |
| 1.7  | Every child in my room should feel that mathematics is something he/she can do.   |
| 1.8  | I integrate math assessment into most math activities.  |
| 1.9  | In my class, students learn math best when they can work together to discover mathematical ideas  |
| 1.10 | I encourage students to use manipulatives to explain their mathematical ideas to other students   |
| 1.11 | When students are working on math problems, I put more emphasis on getting the correct answer than on the process followed.                           |
| 1.12 | Creating rubrics for math is a worthwhile assessment strategy.  |
| 1.13 | In my class it is just as important for students to learn data management and probability as it is to learn multiplication facts.                     |
| 1.14 | I don't necessarily answer students' math questions but rather let them puzzle things out for themselves.   |
| 1.15 | A lot of things in math must simply be accepted as true and remembered.   |
| 1.16 | I encourage my students to master basic mathematical operations before they tackle complex problems.  |
| 1.17 | I teach students how to explain their mathematical ideas.   |
| 1.18 | Using computers to solve math problems distracts students from learning basic math skills.  |
| 1.19 | If students use calculators they won't master the basic math skills they need to know.  |
| 1.20 | You have to study math for a long time before you see how useful it is.   |

#### *Survey Section 2*

Item	NOW THINK BACK TO THE TIME IMMEDIATELY BEFORE YOUR FIRST YEAR OF TEACHING BEGAN. To what extent do you agree that these statements characterize the approach you planned to take in teaching mathematics <u>based on how you felt before your first year of teaching began</u> .
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(The items in this section are the same as the ones in the first section, so are not repeated here for sake of space.)



### Survey Sections 3–7

To what extent do you think your mentor teacher, instructional coach, school administrator, and facilitator (for interns only) would agree or disagree with these? To what extent do you think your school/district provided curriculum materials align with these?

- 1 Students should have access to multiple strands of mathematical knowledge, not just numbers and operations.
- 2 Students should be invited to solve complex, open-ended problems embedded in real-life contexts.
- 3 Students are capable of discovering important mathematical ideas and solving mathematical problems without direct instruction from the teacher.
- 4 The teacher's role in the mathematical classroom is that of co-learner and creator of mathematical community rather than sole knowledge expert.
- 5 Students should have ready access to various mathematical tools and manipulatives to aid their problem-solving activity.
- 6 Student-to-student interaction will facilitate the learning of mathematics.
- 7 Assessment of student learning should integrate with instruction, allow for multiple levels of performance, and be relevant to students' lives.
- 8 Mathematics is a growing, ever-developing body of knowledge.
- 9 Mathematics is a subject for which teachers should foster students' self-confidence.

### Sections 8–11

When it comes to your mathematics experiences during your first year so far, to what extent does your mentor teacher, instructional coach, school administrator, and facilitator (for interns only) support you in the following ways?

- |   |         |   |
|---|---------|---|
| 1 | Faculty | Guide you toward lesson resources to help you plan your lessons   |
| 2 | Faculty | Plan with you prior to your teaching experiences  |
| 3 | Faculty | Provide appropriate guidance for you when planning  |
| 4 | Faculty | Help you to feel welcome at the school  |
| 5 | Faculty | Provide appropriate feedback after your teaching experiences  |
| 6 | Faculty | Provide/encourage opportunities for you to apply the methods you learned in your preservice methods class |

