MATHEMATICS TEACHERS' ATTITUDES TOWARDS THE SUBJECT: THE INFLUENCE OF GENDER, AGE AND TEACHING EXPERIENCE

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Abstract–Several studies indicate that mathematics teachers' attitudes have a vital influence on their learners' achievement. However, there is scant research on mathematics teacher attitudes in the South African context. The paper explores the attitudes of a group of mathematics educators and the role that their biographical attributes might play. The *Attitudes Towards Mathematics Inventory* (ATMI, Tapia & Marsh, 2004) is a recognised learner attitude detection instrument. Schackow (2005) tailored the ATMI towards mathematics teachers. It has four underlying dimensions, namely *value* (whether mathematical skills are worthwhile), *enjoyment* (whether mathematical challenges are enjoyable), *self-confidence* (how easily mathematics is mastered) and *motivation* (the desire to learn more about mathematics). The participants are 35 mathematics educators, enrolled for the Honours programme in Mathematics Education at the University of Johannesburg in 2014. Cross-tabulations were preceded by internal consistency measures, where after the Mann-Whitney U test detected three significant differences of various effect sizes. The paper is part of a larger research project, which endeavours to collect similar data from mathematics learners (or students) of these participating educators.

Keywords: Attitudes towards mathematics; Measurement of attitudes; Mathematics teacher attitudes; Mathematics achievement.

1. BACKGROUND CONTEXT AND PURPOSE

The relationship between attitudes towards and achievement in mathematics has been and rightfully still is the focus of many studies (Brown, McNamara, Hanley & Jones, 1999; Dowker, Ashcraft & Krinzinger, 2012; Ismail & Anwang, 2009; Khatoon & Mahmood, 2010; Schackow, 2005; Sweeting, 2011; Trujillo & Hadfield, 1999; and others). South Africa's dismal performance in the Trends in International Mathematics and Science Study (TIMSS) and in other international studies of its kind over the last decade, has led to a number of interrogative reports, with 'finger-pointing' findings. In the executive summary of the October 2013-report of the Centre for Development and Enterprise (CDE), the authors (McCarthy & Oliphant, 2013, p. 3) summarise the country's dreadful situation as follows:

> The teaching of mathematics in South African schools is amongst the worst in the world. In 2011, the Trends in International Mathematics and Science Study (TIMSS) showed that South African learners have the lowest performance among all 21 middle-income countries that participated. A recent CDE report further underlines the issue as it found rapid increases in enrolments in private extra mathematics classes, which was partly in response to poor teaching in public schools.

This condemning report and others (compare Spaull, 2014) once again positioned strategies to enhance teaching and learning in mathematics, science, reading, comprehension, quantitative literacy and other key domains in the centre of the national educational research agenda. Numerous potential mathematics achievement-related factors, for example learners' home and family contexts, biographical attributes, study orientations, learning strategies, levels of academic engagement, institutional adaption and the role that technology could play in learning, are being interrogated again, and again. Unfortunately, caution Bayaga & Wadesango (2014), does a rather consistent pattern of findings emerge – again and again.

It has also been shown in several studies (compare Durandt & Jacobs, 2013; Maat & Zakaria, 2010; Mata, Monteiro & Peixoto, 2012; Quinn, 1997; Sweeting, 2011; and others) that the quality of mathematics teaching and the nature of teacher attitudes have a pertinent influence on learners' achievement and eventually also on their dispositions towards mathematics. Oppong Asante (2012, p. 123) cites from a large number of studies, which prioritise the six main factors that were found to affect learner attitudes towards mathematics. In reverse order classroom experiences, parent attitudes and beliefs, learner achievement, the quality of teaching and teacher behaviour build up to the **number one effect**, "teacher attitudes and beliefs" (Beswick, 2007, p. 95). Surprisingly, there is still scant research on practising teachers' attitudes towards mathematics, especially in the South African context.

The *research question* that this paper attempts to address is: What are the attitudes toward mathematics of a group of educators, enrolled for the honours programme in Mathematics Education at a public higher education institution? In particular, how do these participants respond to and score on a widely recognised attitudes towards mathematics survey instrument, in respect of its four attitudinal components? The *goal* of the paper is to explore the attitudes towards mathematics of the aforementioned group, while the influence that selected biographical attributes might have will also be scrutinised.

2. LITERATURE PERSPECTIVES: ATTITUDES TOWARDS MATHEMATICS

2.1 Theoretical framework

2.1.1 The relationship between teaching (teachers) and learning (learners)

The authors support the view of Grossman (1992) that how researchers frame the role of teaching predictably sway their opinions in respect of the influence(s) that teachers exert on their learners. Grossman (1992, pp.171-174) then proceeds to distinguish three (sometimes highly contested) models, which define the relationship between teaching (and envisaged teacher conduct) and learning (and envisaged learner conduct), from each other, namely:

- Kagan's (1992) developmental growth model, which regards learners' mastery of subject-related procedures and routines and therefore teachers' pedagogical expertise as pertinent,
- Shulman's (1986) knowledge growth model, which regards learners' understanding of the subject matter and therefore teachers' content knowledge as the key, and
- Richert's (1990) ethical growth model, which focuses on the exemplary behaviour, motivational and classroom management role of teachers, which of course determine expected learner behaviour.

The <u>first element</u> of the theoretical framework underlying this paper is Grossman's 1992-belief that the three abovementioned teaching-learning models function in a complementary manner. Effective teachers portray pedagogical knowledge and skills, subject content knowledge, exemplary conduct and learner motivation and management proficiencies, among other characteristics. A teacher's conduct, disposition and beliefs therefore have a fundamental influence on her/his learner's beliefs and attitudes.

2.1.2 Teacher beliefs about mathematics

The second component of the theoretical framework that underlies this paper, is the worldview of Schackow (2005) on teacher beliefs. By citing Kagan (1990), Schackow (2005, p. 12) defines teacher beliefs as the subjective ways in which teachers grasp their role(s) in a classroom, their learners, determinants of learning, the teaching environment, and the goals of education. She (2005, p. 11) then quotes Thompson (1992): "Studies have shown that teachers' beliefs about mathematics teaching and learning are mostly formed during their own schooling and are developed as a result of their own experiences as mathematics students. Their conceptions about mathematics and how it should be taught are deeply rooted and are difficult to change".

To Schackow (2005, p. 9) beliefs are primarily rational in nature, but "they play an important role in the development of attitudes and emotions about mathematics." She adds that even when student-teachers' beliefs appear to be aligned with the education program they're enrolled for, their teaching practices might not reflect this.

Schackow's 2005-philosophy on the beliefs of mathematics teachers is the second element of the paper's underlying theoretical framework. The authors deduced that mathematics teachers' beliefs (of which their attitudes are a facet) ominously influence how they interpret and implement mathematics curricula, while it also meaningfully affect their learners' beliefs (and attitudes).

2.2 Attitudes in general and more specifically towards mathematics

Even though mathematics is generally regarded as important, many people have a disposition towards the subject, either positive or negative. Attitudes form a central part of a person's identity. It is quite normal to love, hate, like, dislike, favour, oppose, agree, disagree, argue and persuade. All these are evaluative responses to an object. Hence, attitudes can be defined as a summary evaluation of an object (Bramlett & Herron, 2009). Eshun (2004, p. 2) defines an attitude as "a disposition towards an aspect of mathematics that has been acquired by an individual through his or her beliefs and experiences but which could be changed." Schenkel (2009) maintains that attitudes towards mathematics represent a like or dislike of the subject and they embrace beliefs, abilities and views on the usefulness of mathematics. It is interesting to note that Schackow (2005, in section 2.1.2 above) regards beliefs as rational in nature, with attitudes stemming from beliefs.

2.3 The relationship between attitudes and achievement in mathematics

Dowker et al. (2012) find that primary school learners generally show relatively positive attitudes towards mathematics, and that their attitudes tend to become more 'negative' as they grow older. Through a Malaysian study involving Grade 9 mathematics learners, Anwang (2008) identifies gender, home language, expected educational level, family background and educational resources at home as meaningful influences on their achievement. In the same year, Farooq and Shah (2008, p. 77) confirm that positive attitudes towards mathematics lead towards success, while 'negative' or neutral attitudes generally have the opposite effect. This is reaffirmed by Schenkel (2009), in the following year.

Negative attitudes towards mathematics: (1) are typically a result of recurrent failures during mathematical task execution (Nicolaidou & Phillippou, 2005); (2) tend to inhibit learner intellect and curiosity (Bragg, 2007) and (3) generate less enjoyment and usefulness and lower confidence levels among learners (Shrestha, 2006). However, despite an overwhelming evidence of a positive relationship between the two, Hean, Craddock and O'Halloran (2009), as well as Mata et al. (2012), claim that attitudes don't seem to affect mathematics achievement.

2.4 The effect of mathematics teaching on learners' attitudes

It was fragrantly stated in section 1 that the quality of mathematics teaching and the nature of teacher attitudes have a pertinent influence on learners' achievement and eventually also on their attitudes towards mathematics. Yara (2009) confirms that teachers with positive attitudes towards the subject likewise stimulate favourable attitudes in their learners. Henderson and Rodrigues (2008) and Quinn (1997) regard the main source of negative learner attitudes toward mathematics as inappropriate teaching practices and teacher attitudes. Ma and Wilkins (2002) finally put the vital role of teacher attitudes and beliefs into perspective, when they posit that learners who believe that teachers have high expectations of them tend to have a more positive attitude towards mathematics.

3. RESEARCH DESIGN, PARTICIPANTS AND DATA COLLECTION

3.1 Research paradigm

The inquiry primarily attempts to determine the attitudes toward mathematics of a group of educators, enrolled for an honours programme in Mathematics Education at a public higher education institution? A second goal is to ascertain how the participants score on the four dimensions of a recognised attitudes towards mathematics survey instrument. The research paradigm for this study, post-positivism, is firmly based on the abovementioned goals. The postpositivist paradigm (Taylor & Medina, 2013) is a milder form of positivism, basically following the same principles, but allowing for more engagement between the researchers and the participants, by using a survey (containing both qualitative and quantitative items) as data collection instrument.

3.2 Participants

The participants are 35 mathematics educators and post-graduate students, who are enrolled for the B.Ed. Honours in Mathematics Education programme at the University of Johannesburg in 2014. They study on a part-time basis over two years and are made up of first (n=14) and second year (n=21) subgroups. Table 1 below displays elements of their demographics. The majority are fe*male* (63%), *black* (83%), *indigenous language* speaking (74%), *younger than 40 years* (60%), teachers for *ten years or less* (63%), and *60% or more* for matric mathematics achievers (57%). It's also noteworthy that almost half of the participants (45.7%) are *first-generation* students, and thus the first members of their families to engage in studies beyond matric level.

Table 1: Demographic profile elements of participants

Profile variable		N	%
Gender (n=35)	Female	22	62.9
	Male	13	37.1
Ethnic group (n=35)	Asian, incl. Indian	3	8.6
	Black	29	82.9
	White	3	8.6
Home language (n=35)	Afrikaans	1	2.9
	English	8	22.9
	Indigenous	26	74.3
Age in years (n=35) (Median = 38 yrs)	21 to 29 years	7	20.0
	30 to 39 years	14	40.0
	40 years and older	14	40.0
Years teaching (n=32) (Mean = 9.4 yrs)	Up to 3 years	11	34.4
	4 to 10 years	9	28.1
	11 to 20 years	9	28.1
	21 years plus	3	9.4
Math mark in Gr 12 (n=35) (Median = 60-69%)	49% or lower	3	8.6
	50 – 59%	12	34.3
	60 – 69%	11	31.4
	70 – 79%	7	20.0
	80% or higher	2	5.7

3.3 The data collection instrument and process

A close and open-ended, structured, self-designed section, followed by a section, containing an existing inventory of Likert scale items, made up the questionnaire. The questionnaire was used to collect information from the participants (all of them postgraduate (honours) students), during their second contact session of the year (a two hour session on a Saturday in March 2014).

3.3.1 Section A: Demographical information

Section A contains 14 demographical and opinion-based items. The list of demographical items include gender, ethnical group, home language, age, current teaching responsibilities, generation status, Gr 12 performance in mathematics and years of teaching experience. Reasons underlying their decisions to become mathematics teachers, why they are engaged in postgraduate studies, and thoughts that come to mind when they look back upon their Gr 12 mathematics experience (as learners) constitute the open-ended, opinion-based questions in the section. This enabled the researchers to construct a fairly detailed participant profile.

Collected demographical data were captured in a Microsoft Excel worksheet and then analysed via the frequencies, cross-tabulations and descriptive statistics options of the Statistical Package for the Social Sciences (SPSS, version 22). Individual feedback per open-ended, opinion-based question was consolidated into a worksheet and hence analysed via the constant comparative method (Jacobs and Du Toit, 2006:305-306), as a directed form of content analysis (Hsieh and Shannon, 2005:1281). Appropriate participant views per category, by quoting their direct words, have been integrated into the findings.

3.3.2 Section B: Attitudes towards mathematics

The Attitudes Towards Mathematics Inventory (ATMI, Tapia & Marsh, 2004) is an internationally recognised instrument, used for gaining learner attitudes towards mathematics as subject. Schackow (2005) tailored the ATMI towards mathematics student- and practising teachers, making it appropriate for this study. The ATMI has four underlying dimensions, namely *value* (whether mathematical skills are worthwhile and necessary, 10 items), *enjoyment* (whether mathematical problem-solving and challenges are enjoyable, 10 items), *self-confidence* (expectations about doing well and how easily mathematics is mastered, 15 items) and *motivation* (the desire to learn more about mathematics and to teach it, 5 items). Each of the 40 items uses a Likert-type response scale, ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*). When reverse coding (which applies to approximately a third of the items) was done, all item responses in each of the four dimensions are added, yielding total scores for value and enjoyment (maximum 50 each), self-confidence (maximum 75) and motivation (maximum 25). Analysis of ATMI data, including normality testing and reliability measures, were also performed via the Statistical Package for the Social Sciences (SPSS, version 22).

3.3.3 Ethical measures and participant's consent

After the goal of the research, the nature of the data collection instrument and their rights and responsibilities as respondents have been explained to them, individual written consent was obtained from all participants to safeguard the confidentiality of collected data and the anonymity of each participant.

3.3.4 Trustworthiness, validity and reliability

Strategies to maintain the *trustworthiness* of the data collected via the demographical and opinion-based items (in section A) included selected credibility, transferability, dependability and confirmability measures, originally prescribed by Lincoln and Guba (1985). A thorough description of the study, its planning and implementation, the properties of the participants, the data collection instrument and methods of analysis enhance transferability. A dense description of the methodology employed in the constant comparative and directed content analysis methods promotes dependability and rigour. The credibility of the research is augmented through a proper interrogation and triangulation of the findings by both researchers, while the original questionnaires were maintained for possible follow-up purposes.

The creators of the Attitudes Towards Mathematics Inventory (ATMI), Tapia and Marsh (2004, p. 18-19) report that the survey shows a high degree of internal consistency (Cronbach's alpha was in the region of .88), while its factor structure "…covers the domain of attitudes towards mathematics, providing evidence of content validity". The researchers conducted a pilot study (involving four current B.Ed. Honours students, who weren't participants) on the questionnaire, fine-tuning its perceived sight *validity*. Five Cronbach's alpha coefficients were hence calculated in respect of the four ATMI dimensions (Value, Enjoyment, Self-confidence and Motivation), as well as the Total ATMI score (the sum of the four dimensions). The coefficients are portrayed in Table 2 below and it is interesting to note that in total 13 of the 40 items were removed from all further analyses, in striving to optimise the reliability of the data. The five coefficients in table 2 confirm that the participants' responses to the remaining 27 ATMI items (in Section B of the questionnaire) have high internal consistency (*reliability*).

Table 2: Reliability of the Attitudes Towards Mathematics Inventory (ATMI)

ATMI dimension	Cronbach's alpha
Value (7 items❶)	.840
Enjoyment (6 items❷)	.750
Self-confidence (12 items)❸	.834
Motivation (2 items)❹	.804
ATMI Total (27 items)❺	.889

❶ The original Cronbach's alpha value was .801 for all 10 Value items, but after the stepwise removal of items 1, 2 and 6, the alpha for the remaining seven items increased to .840

❷ The original Cronbach's alpha value was .711 for all 10 Enjoyment items, but after the stepwise removal of items 11, 12, 13 and 20, the alpha for the remaining six items increased to .850

❸ The original Cronbach's alpha value was .822 for all 15 Self-confidence items, but after the stepwise removal of items 22, 25 and 34, the alpha for the remaining 12 items increased to .834

❹ The original Cronbach's alpha value was only .590 for all five Motivation items, but after the stepwise removal of items 36, 38 and 40, the alpha for the remaining two items increased to .804

❺ The Cronbach's alpha value was obtained by removing 13 items from the original list (as recommended by the reliability analyses of the four dimensions of the Inventory) and by using the remaining 27 items

4. EMPIRICAL FINDINGS

4.1 Participants' motivation to become mathematics teachers

Their responses to the question: '*What is the main reason(s) underlying your decision to become a mathematics teacher?*' indicate participants' interest in the teaching profession and their relationship with the subject mathematics. Four main categories of feedback were detected with the most pertinent mentioned firstly.

- The opportunity to make a difference to learners in disadvantaged communities, who lack good mathematics education and to change perceived negative learner attitudes towards the subject ["*It can be fun if taught properly and in a hands on, fun method. I wanted to show pupils this and help all pupils to achieve in Maths*" or "*To identify why in SA learners are performing poorly in Mathematics. Is it because of educators' styles of teaching? Or is it because of learners' misconceptions about the subject?*" or "*To break the misconception that mathematics is irrelevant and uninteresting. To develop in learners the passion for mathematics*"]
- The joy that they get through their engagement in mathematics and the passion that they always had for numbers and aspects of a mathematical nature ["*I am called to be a Maths teacher. Maths is my passion*" and "*Mathematics was always my passion. From small, I loved Mathematics. I was good at Mathematics in school as well as university.*"]
- The personal enrichment and cognitive development dividends gained from being involved in mathematics ["I find Maths a very interesting subject. It allows the development of problem solving skills and critical thinking"].
- interestingly enough, to counteract their initial negative attitudes towards and unsatisfactory achievement in mathematics, and also those of others ["*I had a phobia for Maths and I wanted to end that phobia in my life and help our future generation to have a positive attitude*".]

4.2 Participants' ATMI scores, reflecting their attitudes towards mathematics

Sweeting (2011, p. 53-54) categorises teacher attitudes towards mathematics (represented by their total ATMI score) on five levels, which she respectively labels as "strongly negative, negative, neutral, positive and strongly positive". Her categorisation is based on 20%-intervals, which means that someone who is regarded as *strongly positive* has scored 80%+ of the maximum ATMI total. Likewise, someone with a score from 40 to 59% would be regarded as *neutral*.

Table 3 (on the next page) provides a breakdown of the participants' ATMI scores. The researchers expected the overwhelming majority of the participants (all of them are practicing mathematics teachers, who are also furthering their qualifications), to portray a *strongly positive* disposition towards mathematics. Our expectations were confirmed (and probably exceeded), as more than 90% of the participants in respect of three of the four dimensions (the exception is the *Motivation* dimension, although it is still highly comparable to the others) and the ATMI total displayed strongly positive attitudes. The ATMI is a self-rating survey and although these findings are not entirely unexpected, they are viewed with a subtle scepticism.

4.3 Testing for significant differences between ATMI scores

The Mann-Whitney U test, as appropriate non-parametric statistical technique was used to analyse differences between the medians of the responses of participants in the two gender groups, the two honours year groups, in various age categories, in years of teaching experience categories, and in various matric mark for mathematics categories respectively. The Mann-Whitney test is considered appropriate, because the responses do not follow a normal or t-distribution, they are measurable on an ordinal scale, they are comparable in size and they are independent (responses from one subgroup cannot affect the responses of other subgroups (Milencović, 2011:74). Tables 4 and 5 below present the *test statistics* and *ranks* on the ATMI's **Value** dimension, with age group and years of teaching experience as grouping variables.

Table 3: Distribution and descriptive statistics of ATMI scores

ATMI dimensions and intervals		N=	%
VALUE (7 items) (Mean = 33.69)	29–35	34	97.1
	21–28	1	2.9
	Less than 21	0	0.0
ENJOYMENT (6 items) (Mean = 28.26)	25–30	32	91.4
	19–24	3	8.6
	Less than 19	0	0.0
SELF-CONF (12 items) (Mean = 55.80)	49–60	32	91.4
	37–48	3	8.6
	Less than 37	0	0.0
MOTIVATION (2 items) (Mean = 9.00)	9 or 10	26	74.3
	7 or 8	8	22.8
	Less than 7	1	2.9
TOTAL SCORE (27 items) (Mean = 109.0)	109–135	34	97.1
	83–108	1	2.9
	Less than 83	0	0.0

Table 4: Test Statistics[a] for the Atmi's Value Dimension

	Age group interval 1[b]	Age group intervals 2[c]	Teaching experience intervals[d]
Mann-Whitney U	23.500	22.000	30.000
Wilcoxon W	51.500	50.000	96.000
Z	-1.997	-2.142	-2.322
Asymp. Sig. (2-tailed)	.046[e]	.032[e]	.020[e]
Exact Sig. (1-tailed)	.056	.046[e]	.027[e]

a Grouping variables: Age and Years of teaching experience
b Participants in the age group 21 to 29 years are compared to participants in the age group 30 to 39 years
c Participants in the age group 21 to 29 years are compared to participants in the age group 40 years plus
d Participants, who have up to 3 years teaching experience are compared to participants, who have 11 years or more teaching experience
e Significant at the 95% level of confidence

Table 5: Ranks In Respect of the Atmi's Value Dimension

Demographic attributes	Groups	N=	Mean Rank	Sum of Ranks
Age group intervals 1 [N=21]	21-29 years	7	7.36	51.50
	30-39 years	14	12.82	179.50
Age group intervals 2 [N=21]	21-29 years	7	7.14	50.00
	40 years+	14	12.93	181.00
Years of teaching experience [N=23]	3 years or less	11	8.73	96.00
	11 years+	12	15.00	180.00

The Mann-Whitney test findings firstly indicate that mathematics teachers in this study, between the ages of 21 and 29 years (*Mdn* =33) have a significantly lower (at the 95% confidence level) **Value attitude towards mathematics** as their 30 to 39 year old counterparts (*Mdn* = 34.5), *U* = 23.50, *p* = .046. Cohen's effect size (r = .44) is in the medium to high interval (Milencović, 2011:77), which implies that the finding has moderate (to high) practical significance.

The findings secondly indicate that mathematics teachers in this study, between the ages of 21 and 29 years (*Mdn* = 33) also have a significantly lower (at the 95% confidence level) **Value attitude towards mathematics** as their 40 years and older counterparts (*Mdn* = 35), *U* = 22.00, *p* = .032. Cohen's effect size (r = .47) is again in the medium to high interval, indicating that the finding also has moderate (to high) practical significance.

The findings thirdly indicate that mathematics teachers in this study, who have three years or less teaching experience (*Mdn* = 33) have a significantly lower (at the 95% confidence level) **Value attitude towards mathematics** as their counterparts who have more than ten years of teaching experience (*Mdn* = 35), *U* = 30.00, *p* = .020. Cohen's effect size (r = .48) is very close to the high interval, implying that this finding also has moderate (to high) practical significance.

5. CONCLUSION

The research questions that this study attempted to find answers to were two-fold, namely:

- What are the attitudes toward mathematics of a group of educators, enrolled for the honours programme in Mathematics Education?
- How do these participants respond to and score on the Attitudes Towards Mathematics Inventory, in respect of its four attitudinal components and its total?

It was found that more than 90% of the participants display strong positive attitudes towards mathematics as subject, also in respect of all four dimensions of and the total ATMI. This means that these mathematics teachers, who are currently also enrolled for a postgraduate qualification in Mathematics Education, regard the acquisition of mathematical skills as worthwhile and necessary, enjoy mathematical problem-solving and challenges, have high expectations about doing well in mathematics and also have a desire to learn more about mathematics and fulfil their roles as mathematics teachers.

Significant differences (statistical and practical) were detected between mathematics teachers aged 21 to 29 years and their 30 to 39 year old, as well as their 40 year and older counterparts in respect of the value that they attach to mathematics, with the 'younger' group attaching lesser value. In addition, participants who have three years or less mathematics teaching experience also attach significantly less value to the subject than those who have more than 10 years teaching experience.

The credibility (and truth value) of the ATMI as a self-rating questionnaire has not been ascertained yet. However, the instrument definitely makes a meaningful contribution. Attitudes towards mathematics are complex and dynamic and most certainly also needed to be interrogated via other mechanisms and instruments. The larger research project, which endeavours to collect similar data from learners (or students) of mathematics educators, is a logical next step. This study (and the larger project) aspire to contribute to the number one effect on mathematics learners' attitudes (and also their achievement), namely teacher attitudes and beliefs.

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