A comparative study of mathematics education (ME) beliefs among mathematics curriculum leaders (MCLs) in English and Nigerian schools

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The beliefs of MCLs in England and Nigeria have received limited research attention despite their relevance to school mathematics. This paper reports part of a study that compared the espoused ME and leadership beliefs of MCLs in Nigeria and England. To infer their beliefs, MCLs from Nigeria and England were interviewed. Responses were analysed using proportions, agreement rates and deductive thematic analysis. Consistent with national cultural expectations, the English MCLs demonstrated a slightly higher proportion of constructivist beliefs than those from Nigeria. The results of this study, in agreement with those of other studies, suggest that mathematics education beliefs appear to resonate with cultural assumptions. They further revealed that certain cultures might encourage individuals' holding of contrasting beliefs.

Keywords: culture; beliefs; mathematics curriculum leaders; semi-structured interview; acculturation

Theoretical background

ME beliefs[1] have been researched using diverse respondents and contexts (see Leder, Pehkonen & Törner, 2002), because teaching behaviour is grounded in their beliefs (Pajares, 1992). Beliefs act as filters through which experiences are interpreted (ibid.). Beliefs are said to be held to different depths (Nespor, 1987); they could also be held in isolation (Andrews, 2007), and do not require social consensus and internal consistency (Pajares, 1992). Hence the possibility of an individual holding beliefs that seem logically incompatible (Ernest, 1989; Pajares, 1992; Andrews, 2007).

Given that leadership is the process of influencing people towards the achievements of common goals (Northouse, 2011) then MCLs, experts leading the teaching and learning of mathematics in schools (Perry, Howard & Tracey, 1999), could arguably influence the practice and beliefs of their subordinates. Acknowledging Perry, Howard and Tracey (1999), despite the importance of MCLs in discussion of ME beliefs, their voices had limited contribution to theoretical discussion on beliefs and those of mathematics teachers in Nigeria remain unevaluated. As a contribution to filling this gap, this study compared the ME beliefs of MCLs in England and Nigeria. It is worth clarifying that this study is intended to raise awareness pertaining to the cultural influence on beliefs rather than being evaluative. It is exploratory in nature and not intended to be universally applicable.

Although there are numerous classifications of ME beliefs (see Leder et al., 200), this study focused on two; beliefs about the nature of mathematics and those concerning the acquisition of mathematical knowledge (Ernest, 1989). Thompson (1984), who provides a basis for most frameworks for evaluating belief of the nature of mathematics, carried out a multiple case study of three teachers – whilst one saw mathematics as a coherent set of inter-related concepts, another perceived it as an

[1] "interpreted as an individual's understandings and feelings that shape the ways that the individual conceptualises and engages in mathematical behaviour" (Schoenfeld, 1992, p.358)

entity that is to be discovered and verified, while the third concluded that it is "prescriptive and pre-determined" (Andrews & Hatch, 2000, p.35). Teachers' beliefs about the acquisition of mathematics knowledge are beliefs about, and key determinants of, how mathematics is presented in the classroom, and resonant with teachers' beliefs of the nature of mathematics (Ernest, 1989). Bearing those arguments in mind, the ME beliefs' categories can be combined.

Supposing that Thompson's multiple case study presented evidence from more than three teachers, then more than three classifications might have emerged, so limiting classifications to these three might be an over simplification. Dionne (1984) suggested that individuals displayed different combinations of beliefs and considering that "there are no standard taxonomy of teachers' perceptions" (Mura, 1993, p.375), I assume that one can hold beliefs aggregations, in varying proportions, of two ends of the belief continuum. Therefore, in this study, I adopted Dionne's label of traditionalist beliefs – beliefs that mathematics is well-defined, "prescriptive and pre-determined" (Andrews & Hatch, 2000, p.35), and is transmitted from teachers to students – and constructivist beliefs – beliefs that mathematics is creative, "eternally open to revision" (Ernest, 1995, p.452)– as my conceptual ME belief model.

Comparative studies promise to reveal hidden and taken-for-granted aspects of education (Andrews & Hatch, 2000) which may not be noticed due to their inherence in the system being evaluated (Stigler & Hiebert, 1999). As such beliefs, which "may lurk beyond ready articulation" (Munby, 1982, p.217), would be better accounted for if compared between cultures. The English and Nigerian cultures are considerably different (Hofstede, 2013), so difference in the beliefs of MCLs in an equivalent context could be attributed to cultural factors.

Methods

Since complexities are best captured using multiple modes of inquiry and mixed methods (Tashakkori & Teddlie, 2009), despite data collection being through semi-structured interviews from 18 MCLs, they were collected in two forms (structured and semi-structured response) and two analytical methods were employed. The structured aspect consists of the structured statements which are responded to using agreement scales[2], which as other researchers (e.g. Martella, Nelson, Morgan & Marchland-Martella, 2013) observe, makes such responses easy to analyse and useful in comparing groups. Such scales are also reputed for their ability to capture latent constructs (Leder et al., 2002). The structured statements used in the study were taken from Perry et al.'s (1999) study. This study was chosen for its rigorous design, taking into account the theoretical perspectives of important factors in this research area and the fact that it has been used in cross-cultural study (e.g. Perry, Wong & Howard, 2006); in addition, the participants in the original study were MCLs. In the absence of an internal consistency measure, there was a need for the findings from this aspect to be triangulated (Robson, 2011) which necessitated the deductive thematic analysis of the semi-structured aspect.

The semi-structured response consists of two parts: the justification of the structured response and the response to the standard questions. Semi-structured responses were reduced into key ideas, confirmed by participants, and then coded as constructivist or traditionalist with inter-rater (κ = 82%) and intra-rater agreement (κ= 91%). The percentage of constructivist and traditionalist statements and the corresponding indexes were similar with two of eighteen interviews presenting over

[2] Rated 0 – completely disagree to 5 – completely agree

10 per cent total disparity between both methods. Although the interaction of the interviewer and participant is a concern for researchers using interviews (Martella et al., 2013), seeing it offered increased flexibility (ibid.), promoted clarity of questions (Robson, 2011) and enhanced shared understanding (Speer, 2005), it was adopted for this study. The impact of the interaction was mitigated as I adopted the researcher as the learner approach in conducting the interview and ensured that the participants were aware that there were no right responses to the statements.

Mathematics Education Beliefs (statements adapted from Perry et al. 1999):
M1. Mathematics is a creative subject
M2. Mathematics problems given to students should be quickly solvable in a few steps
M3. Mathematics is the dynamic searching for order and pattern in the learner's environment
M4. Mathematics is computation
M5. Define mathematics
M6. The role of a teacher is to transmit mathematical knowledge to the students and to verify that learners have received the knowledge
M7. Students are rational decision makers capable of determining for when their solutions are right or wrong
M8. Routine exercise is essential for students to understand the taught concepts
M9. Being able to memorise fact is crucial to mathematics learning
M10. Periods of uncertainty, conflict, confusion and surprise are significant part of mathematical learning
M11. It is crucial for students to get sufficient practice on key mathematical skills before they understand them
M12. A discussion between teacher and students in which meanings and connections are explored verbally, and misunderstandings are made explicit and worked on constitutes good mathematics learning
M13. Investigational work is an essential part of mathematics learning
M14. In mathematics learning, ability is more important than effort
M15. Mathematics learning is about being able to get the right answer quickly
M16. Describe how best you think mathematics can be taught
M17. Why is mathematics important?

Figure 1 structured statements[3] and standard questions (M5, M16, M17) used in this study.

Discussion

The analysis for ME beliefs was carried out with the average response of the individual constructivist and traditionalist beliefs; the average for the constructs were then calculated as proportions (in percentage). Table 1 presents the results of proportional percentages for the ME beliefs according to the responses of the participants during the structured interview. While the ME beliefs of all the English teachers appear to be dominated by constructivist beliefs, for the Nigerian MCLs, most (six of ten) are dominated by traditionalist beliefs with the others are slightly constructivist.

Whilst acknowledging the limitations of this study, the non-representative and small sample size, and disparities in the teaching experience of both groups of participants, this finding tends to accord with the cultural expectation.

Nigeria

	ID #	Teaching Experience (years)	Trad. Index (%)	Const. Index (%)
Eze	1	19	41.5	58.5
Ese	2	21	53.8	46.2
Akin	3	32	49.1	50.9
Wole	4	23	58.8	41.2
Yomi	5	20	50.0	50.0
Ada	6	9	40.8	59.2
Femi	7	13	46.8	53.2
Chika	8	17	57.4	42.6
Dada	9	29	65.3	34.7
Fola	10	26	56.6	43.4

England

	ID #	Teaching Experience (years)	Trad. Index (%)	Const. Index (%)
Mark	1	4	32.6	67.4
Paul	2	14	50.0	50.0
Mary	3	16	40.0	60.0
John	4	5	45.7	54.3
Ken	5	7	31.6	68.4
Alfred	6	7	33.3	66.7
David	7	6	30.6	69.4
Blake	8	5	29.7	70.3

Table[4] 1 summary of the structured aspect

In Table 1, the English MCLs being more constructivist appears to resonate with Hofstede's (2013) individualist and low power distance cultural expectation of

[3] utilized with permission from Perry et al. (1999)
[4] Names are pseudonyms

student-led belief expectation. On a similar note, the Nigerian traditionalist dominant belief appears to agree with the framework for a high power distance and collectivist society (ibid.).

Concluding this comparison based on this summative information might be overly simplifying (Robson, 2011), raising the need for further data exploration. Acknowledging the issue of moderation associated with the use of rating scales in cross-cultural studies (Lee, Jones, Meneyama & Zhang, 2002), the data was categorised into agreement percentage (AP) and presented for each item. For instance, nine of the ten Nigerian participants for item M2 implies that 9 participants agreed (those who rated as agree, strongly agree and completely agree) and one disagreed.

	M1	M3	M7	M10	M12	M13	M14	M2	M4	M6	M8	M9	M11	M15
Belief	C	C	C	C	C	C	C	T	T	T	T	T	T	T
Nigerian AP (%)	100	100	80	90	50	90	70	90	100	100	100	70	90	80
English AP (%)	87.5	87.5	87.5	100	87.5	75	75	0	12.5	37.5	87.5	62.6	25	12.5

Table 2 statement AP (C – constructivist, T – traditionalist)

The Nigerian leaders prominently held contrasting beliefs they had comparably agreed more to; both traditionalist and constructivist statements as presented on Table 2. This suggests participants' responses (of both countries) to constructivist mathematics belief statements might not be unrelated to their being mathematics graduates so their responses might have being influenced by their knowledge, as beliefs and knowledge are inherently integrated (Leder et al., 2002). On a similar note, another interesting twist to the disparity seen on Table 1 is that the MCLs had similar responses on the constructivist statements but differed considerably on the traditionalist ones: M2, M4, M6, M11 and M15.

The item M4, 'mathematics is computation', is of particular interest due to the high disparity between the group members' responses and similarity in their justification of their responses. While all Nigerian teachers agreed to it, this contrasted with their English counterparts who all but one disagreed with the statement. Bearing in mind variability in meaning of key words between cultures even when interviews are conducted in the same language (Delaney, Ball, Hill, Schilling & Zopf, 2008), further analysis of the justifications offered for their responses revealed that both sets of leaders suggested that mathematics was initially computation but that it has evolved into being a more reasoning and structurally based subject.

According to Hofstede's (2013) pragmatic-normative dimension, the English culture being more pragmatic than the Nigerian might have been the reason behind their easy adaptation of the innovation. This also raises the question of the impact of culture to acculturation to global mathematics educational reforms; how teachers acculturate to mathematics educational reforms. Acculturation is "the process in which individuals learn and adopt the norms and values of a different culture" (Cleveland & Laroche, 2007, p.250). This change expected in reforms could be seen as professional cultural change. In the case of statement M4, whilst the English MCLs seem to have assimilated the reform's constructivist approach which was evident in their rejection of the traditionalist statement, the Nigerians appear to adopt an integrated acculturation mode, holding on to the traditionalist view and integrating the constructivist agenda.

Complementarily, Harzing and Hofstede (1996) argued that collective societies give rise to a collective mindset, so deviations from norms could risk punishment, and they further opine that individuals from high power distance cultures like Nigeria, due to their dependence on authority, are less likely to adapt to change. The opposite is the case for individualist and low power distance societies.

The English leaders' high level of agreement to certain traditionalist statements could be critical to the traditional approach in English classrooms as highlighted by OFSTED5 (2012). Conversely, the Nigerian teachers seem to demonstrate high level of constructivist beliefs, contrary to their cultural expectation, mostly due to their higher mathematics qualifications. Their holding on to traditionalist beliefs, which appears more culturally than educationally related, might have given rise to the rote-learning approach evident in Nigerian mathematics classrooms (Ebiendele & Olaoye, 2014). That being said, there is still a need to evaluate the relationship between beliefs and practice in a cross-cultural study.

Conclusion

Whilst constrained from making too strong an assertion due to the methodological and epistemological limitations of this study (as research participants could be atypical of the population and the inherent difficulties in separating knowledge and beliefs) nevertheless, consistent with other studies (Andrews & Hatch, 2000, Andrews, 2007; Pipere & Lepik, 2013), culture seems to affect ME beliefs. It also raises the question of the impact of culture on acculturation to global mathematics reforms.

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