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Identifying beliefs underlying the teacher's decision to teach mathematical problem solving: An elicitation study using the Theory of Planned Behaviour

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Abstract

The study sought to identify barriers and motivators as perceived by primary school teachers, when considering teaching mathematical problem solving, within the context of the Theory of Planned Behaviour (TPB) framework. A sample of 50 teachers, recruited from six primary classrooms in a large, mainly rural local education directorate in Ghana, responded to an open-ended question interview designed to elicit perceptions of positive/negative consequences, approving/disapproving referents, and easy/difficult circumstances in relation to teaching MPS. Coded responses were content analysed into behavioural, normative, and control beliefs as explored in the TPB model. Findings suggest that teachers: (1) view teaching MPS both positively and negatively; (2) feel referents would more likely approve of them teaching MPS than disapprove; (3) view the availability/lack of resources and time, amongst others, as key facilitating/impeding factors to teaching MPS. The implications of the findings for practice are discussed.

Keywords: teacher beliefs; teaching intentions; mathematical problem solving

Introduction

For the purposes of this study, Mathematical Problem Solving (MPS) is defined as unstructured activities that require pupils to model situations with mathematics; make reasoned assumptions; construct series of reasoning; and interpret solutions in context (Hwang & Riccomini, 2016). Recent curricular imperatives and standards emerging from global educational policy (including Ghana) highlight the importance of 'teaching through problem solving' whereby students are supported to explore mathematical tasks in multiple, innovative ways to develop deeper understandings and find solutions, often transferable to 'real world' problems (Scheuermann & Pedró, 2009).

However, despite such policy imperatives, official reports suggest that pupils struggle to apply their mathematics knowledge innovatively (MOE, 2014), with traditional teacher practice viewed as an important limiting factor. Although several factors are influential, teacher beliefs, knowledge, and attitudes, as well as the social context of the teaching situation, have been identified as major determinants of instructional decisions and actions (OECD, 2009), in turn emphasising the importance of cognitive and social functions. Some researchers (e.g. Wong, 2013) have focussed on teacher beliefs, with a view to improving classroom instruction and raising academic achievement.

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The concept of teacher beliefs has been the subject of different and often competing interpretations (Mansour, 2009), and might be understood as conceptions, world views, philosophies, or "mental models" (Ernest, 1989, p. 250) that actively shape learning and teaching practices, and influence pupil learning. Pajares (1992) described beliefs as a 'messy construct', concluding that "defining beliefs is at best a game of player's choice" (p.309). In this study, by teacher beliefs, we mean people's conceptions about desirable ways of teaching and how pupils learn.

Initiatives to improve the quality of mathematics education may prove more effective when teacher beliefs are considered and challenged (Lannin & Kathryn, 2013). However, research that seeks to understand teacher beliefs including their knowledge and attitudes, specific to teaching MPS, remains relatively sparse (Pampaka, 2014).

Theoretical Framework

Previous studies (e.g. Ernest, 2004) have examined how teacher beliefs impact classroom practice in the general mathematics field, and the opportunities and constraints of particular social contexts. For instance, Xenofontos and Andrews (2014) argue that teachers' beliefs coupled with mathematics content are the major determinants of their intentions which find expressions in 'their plans'.

Similarly, Ernest's (2004) study argues for espoused (what teachers say) and enacted (what they actually do) beliefs underpinned by the teacher's epistemic perspectives (i.e. beliefs about nature of knowledge and knowing), which influence their conceptions of knowledge and the nature of mathematics, and their pedagogical views. Raymond (1997) highlighted the influence of factors including teacher education and experiences, teachers' and pupils' lives outside school, and teachers' personality traits, on the beliefs/practice connection.

Specific socio-cognitive theories, including the Theory of Planned Behaviour (TPB) (Ajzen, 1991), suggest that observed beliefs-practice relationships are likely to be attenuated by intentions to act, understood as the proximal determinant of a person's behaviour (Fishbein & Ajzen, 2010). The TPB is adopted here to investigate how teacher beliefs may influence their intentions to implement curriculum reform. The TPB states that behavioural achievement depends on both motivation (behavioural intention) and ability (behavioural control). Intentions, in turn, should be determined by attitude, subjective norm and PBC. It distinguishes between three types of beliefs namely behavioural (positive/negative consequences), normative (approving/disapproving referents) and control (easy/difficult circumstances), leading to the formation of attitude, subjective norm and PBC respectively (see Figure 1).

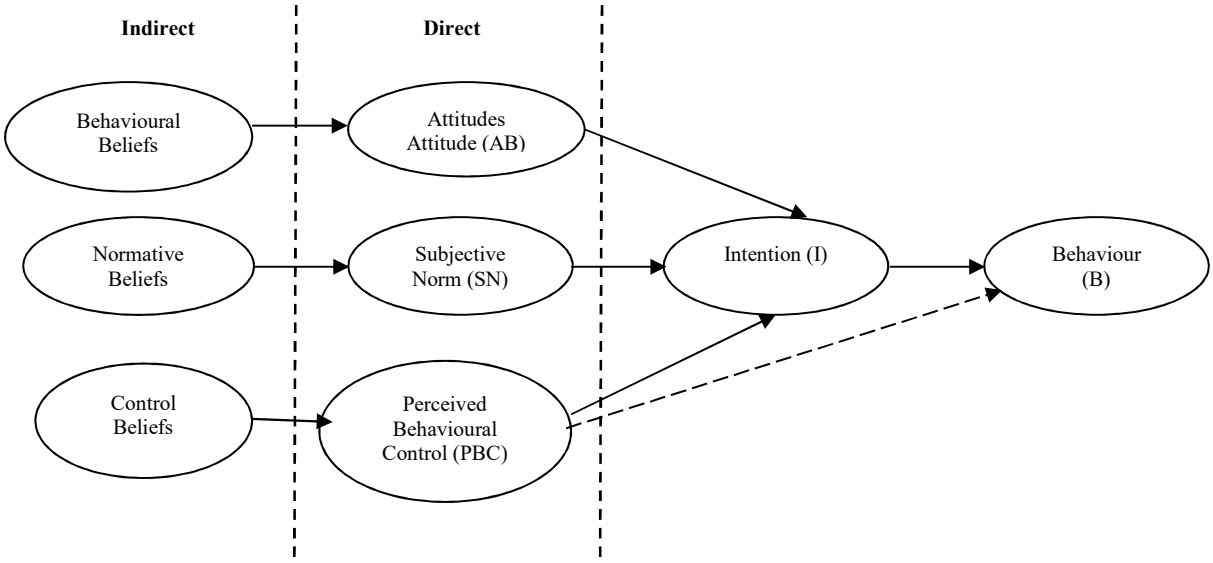

Fig 1: A Path model for the Theory of Planned Behaviour (Ajzen, 1991)

The TPB suggests that to predict teacher intention to teach MPS, it is important to explore whether the teacher:

(i) perceives teaching MPS with positive consequence (attitude);

(ii) perceives approval from education authorities, colleague teachers and/or pupils to do so (subjective norm); and

(iii) has the knowledge, relevant skills and resources to do so (PBC).

Understanding the underlying beliefs about teaching MPS could help to explain why teachers with similar beliefs teach differently, and may be considered as the first step in being able to design an intervention to change ineffective teaching practice (Ajzen 2006). Empirical studies specifically exploring beliefs toward teaching MPS are largely unreported.

Application of TPB in Education Research

Whilst the TPB model has been widely applied in the context of general education (e.g Kuyini & Desai, 2007; Yan & Sin 2015), only a few studies focus on mathematics education. Pierce and Ball (2009) examined mathematics teachers' intentions to change practice to incorporate the use of technology, and established that the TPB is an "effective instrument for gathering data on mathematics teachers' perceptions" (p. 314). Similarly, Oh's (2003) study of Korean mathematics teachers' willingness to shift their role towards "facilitators," who create a learning environment that reflect students' own views, provided empirical support for the TPB with attitudinal beliefs emerging as the best predictor of intentions, concluding that the model is useful in "predicting and understanding the structure underlying reform-oriented teachers' willingness to teach mathematics in a student-centred way" (p.409). The current study represents a new contribution to this field, with a particular focus on MPS teaching in the Primary schools.

Sufficiency Assumptions and Criticism of TPB

Whilst many accept the TPB's basic reasoned action assumptions, the main criticisms have largely concerned the sufficiency of the model in predicting behaviours, its unidirectional linear

assumptions and certain measurement limitations (Ajzen, 2011). The TPB sufficiency assumption states that adding more variables should not add any more explained variance in intentions or behaviour, and not improve their prediction. In criticism of the sufficiency assumption, Wolff, Nordin, et al., (2011) accused the TPB of excluding affective processes, with its focus more on instrumental outcomes of behavioural actions, which are understood as the cognitive component of attitudes assumed to reflect in anticipated positive or negative consequences in relation to performing the behaviour. They suggest that affect can influence behaviour in a more direct fashion but that this possibility is not sufficiently accounted for in the TPB.

Other authors have modified the theory by adding new variables including behaviour specific factors such as past behaviour, habituation and moral obligation (see Bosnjak, Tuten & Wittmann, 2005). For example, a secondary data analysis reported (Abraham & Sheeran, 2003) that variance in physical activity explained by the TPB increased significantly with the addition of past physical activity. Consequently, other theoretical frameworks (e.g. Gibbons, Gerrard, Ouellette & Burzette, 1998) have been developed to address modifications to the TPB.

Despite such limitations, the TPB was adopted for the current study due to its relative ability to understand and predict behaviour, simplicity, and ease of operationalization (Sosu, 2008). It offers the authors opportunity to unpack the psychosocial and cognitive determinants of teachers' instructional decisions about mathematical problem solving.

Using an Elicitation Study

Researchers exploring the TPB model are advised to initially conduct an elicitation study to identify the beliefs applicable to the particular cultural setting. This normally involves using open-ended questions to access immediate thoughts related to performing a particular behaviour, espoused without much cognitive effort, known as *salient beliefs* (Ajzen, 2006). Elicitation studies underpin meaningful understanding of reasons underlying teachers' instructional decisions. Despite their theoretical importance, many TPB studies have failed to conduct such studies (Kuyini & Desai, 2007), often adapting existing TPB questionnaires.

Authors have cautioned that lack of an elicitation study may compromise the TPB's utility for understanding and explaining human social behaviour. For example, Downs and Hausenblas (2005) argued that since teacher beliefs are not innate but acquired through daily encounters, resulting in differential learning experiences, it is important to identify the target population's salient beliefs. Furthermore, they highlighted that conducting an elicitation study overcomes inappropriate methods that can potentially undermine the TPB's usefulness.

It is anticipated that the findings will add to the growing body of knowledge about the TPB model, and elicitation studies in particular, and provide a psychosocial framework for interrogating contextual beliefs-intention activity. Rigorous searches uncovered no previously published elicitation procedures for mathematics-related TPB studies, and this study represents a new contribution to this academic field.

Research questions

This study is the initial phase of a larger research project which sought to explore factors underlying primary teachers' willingness (or unwillingness) to teach MPS, with a view to

developing quantitative survey instruments, and providing insights into the design of effective interventions in classroom practice.

Three complementary research questions underpin the study:

1. What salient behavioural beliefs do teachers report relative to their attitudes regarding teaching MPS?
2. What salient normative beliefs do teachers report relative to their subjective norms regarding teaching MPS?
3. What salient control beliefs do teachers report relative to their perceived behavioural control regarding teaching MPS?

Methodology

Sampling

Purposive non-probability sampling selected a predetermined number of participants based on previous knowledge of the population, and predefined selection criteria (Patton, 2015). Fifty teachers from six primary schools in a large, mainly rural local authority in Ghana defined the sample. Participant selection characteristics were:

(i) extent of teaching experience;

(ii) teaching in public or private schools in urban or rural localities;

(iii) teaching at lower or upper Primary levels;

(iv) teachers and head teachers teaching Primary level mathematics.

The sample enabled the researchers to "learn a great deal about issues of central importance to the purpose of the research" (Patton, 2015, p. 53), through collection of data representing a wide range of perspectives. Prescribed guidelines for TPB elicitation studies (Fishbein & Ajzen 2010) suggest that 25 participants should be adequate to reach an information saturation point. However, in this case, open-ended responses from 50 teachers were collected due to the uniqueness of the study.

Instrument and Data Collection

An open-ended question interview was administered at participating schools for completion with a researcher present. In introductory participant information, MPS was explained in a manner that reflected the definition provided in the Introduction. Participants were asked to reflect on their MPS activities, particularly at the *end of each planned topic for the term*. Six open-ended qualitative questions were developed, using wordings suggested by Fishbein and Ajzen (2010), to probe for salient behavioural, normative and control beliefs related to teaching MPS in that particular term (see Table 1).

Table 1: Questions used to identify salient beliefs

	Beliefs Question
1.	What do you believe to be the **advantages** of teaching MPS in class? [behavioural]
2.	What do you believe to be the **disadvantages** of teaching MPS in class [behavioural]
3.	Please list the individuals or groups, if any, who would **approve** of you teaching MPS in class? [normative]
4.	Please list the individuals or groups, if any, who would **disapprove** of teaching MPS in class? [normative]
5.	Please list any circumstances that you think would make it **easy** for you to teach MPS in class? [control]
6.	Please list any circumstances that you think would make it **difficult** for you to teach MPS in class? [control]

Five spaces were provided for responses to each question, aligning with the assumption that people are only able to process about five to nine items of information at any given time (Mandler, 2011).

Ethical Considerations

This study was conducted in line with published ethical guidelines (BERA, 2011), and approved by the Ethics Committee at the host university. Participants were provided with information regarding the purpose of the study, their expected contribution, and assurances regarding confidentiality, anonymity and their right to withdraw. Each participant completed an active informed consent form.

Analysis of Elicitation Data

Analysis involved: (i) thematic coding and categorization of individual responses; and (ii) content analysis to identify the proportion of responses falling within each category (Patton, 2015). Table 2 shows an example of common response set for the “advantages” question.

Table 2: Code frame for developing pupils' "critical thinking skills" theme

Advantage Beliefs (Attitude)	Common responses
Theme: Critical Thinking Skills	▪ It develops their thinking. ▪ It help the pupils to be fast thinkers ▪ It helps them think deep and come out with solutions. ▪ It enables the pupil to be a critical thinker. ▪ It helps pupils to explore and think critically in their day to day activities ▪ It also develops the thinking abilities of children in the class ▪ It aids critical thinking in both the pupils and the teacher ▪ It will enable pupils to solve problems on their own and also enable pupils to become critical thinkers.

Two external researchers were asked to conduct independent thematic coding for internal and external heterogeneity, and to generally increase the validity of the content analysis (Patton, 2015). Final lists of themes were generated (see Tables 3 to 8). Subsequently, a quantitative content analysis involving a frequency count of responses falling into each category (theme) established most common *(modal) salient beliefs,* using MS Excel.

Results

Overall Data

The total number of beliefs expressed ranged from 62 for the "Disapprove" belief question 4, to 99 for the "Approve" question 3 (see Table 3). The mean number of beliefs ranged from 1.24 to 1.98 responses per person, suggesting that on average, more than one belief was attributed to each type by respondents. A large proportion (n=37, 74%) stated three or more beliefs, suggesting that they were not constrained by the question wording or response format.

Table 3: Response statistics for six open ended questions

Question	Types of beliefs	Total beliefs expressed	Mean number of beliefs per respondent	No of respondents who gave 3 or more beliefs
1	Advantages	91	1.82	11
2	Disadvantages	66	1.32	4
3	Approve	99	1.98	9
4	Disapprove	62	1.24	3
5	Easy	79	1.58	7
6	Difficult	67	1.34	3
	Total	**464**		**37**

"Advantage" and "Disadvantage" questions 1 and 2 (Attitude*)*

Salient behavioural beliefs (positive/negative consequences) contribute to determining attitudes towards performing a behaviour (Azjen, 1991). Table 4 shows "Advantages" beliefs distribution. Participants (38% of them) mostly mentioned that teaching MPS facilitates both " critical thinking skills in pupils" and "real life application of mathematics in class". These salient beliefs

combined with "conceptual understanding" constitute 59% of the overall set of reported advantages or positive consequences of teaching MPS.

Table 4: Results from "Advantage" question 1

Item Code	Advantage Beliefs	Number	% of total respondents
A1	Critical Thinking Skills	19	38
A2	Real Life Application.	19	38
A3	Conceptual Understanding	16	32
A4	Improved Reading Skills	8	16
A5	Activity-Based	7	14
A6	Develop Creativity	6	12
A7	Enjoy Math Lesson	5	10
A8	Child-Centered Learning	5	10
A9	Interdisciplinary teaching	3	6
A10	Miscellaneous / Unclassified	3	6
A11	Did not list	2	4

The most recorded "Disadvantage" belief was that "teaching MPS is time consuming", which was mentioned 24 times (48%). This belief combined with "it is difficult for pupils with limited understanding of the English language" (i.e. language barrier), accounted for 59% of the total stated disadvantages or negative consequences of teaching MPS (see Table 5).

Table 5: Results of the "Disadvantage" question 2

Item Code	Disadvantage Beliefs	Number	% per respondent
B1	Time consuming	24	48
B2	(English) Language barrier	15	30
B3	Pupil feel bored and less attentive	6	12
B4	Classroom management difficulties	5	10
B5	Lack of TLM	4	8
B6	Dislike Math	3	6
B7	Increased work load	2	4
B8	Contradicts traditional method	2	4
B9	Miscellaneous / Unclassified	5	10
B10	Did not list	3	6

"Approve" and "Disapprove" questions 3 and 4 (Subjective Norm)

These questions were used to measure salient normative beliefs, thought to determine the subjective norm (Azjen, 1991). Respondents essentially identified the same individuals or groups as approving (C1-C8) and disapproving (CC1-CC8) of their intentions to teach MPS (see Table 6). "Colleague teachers" received the highest number of approvals and disapprovals indicating a split in beliefs. The second highest approval rating was attributed to "head teachers", suggesting the extent of influence they could exert on decisions to teach MPS. Around a quarter of

respondents (26%) expressed the view that no group/individual would disapprove of their decision to teach MPS. A higher proportion of teachers (16%) could not think of people who would disapprove of them teaching MPS, than those (6%) who could not think of people who would approve. In general, participants thought that more referents would approve of them teaching MPS.

Table 6: Results of the "Approve" and "Disapprove" questions 3 and 4 (Subjective Norm)

		Approve		Disapprove	
Item Code	**Beliefs**	**Number**	**% Total Respondents**	**Number**	**% Total Respondents**
C1	Colleague Teachers	23	46	14	28
C2	Head teacher	19	38	8	16
C3	Pupils	18	36	8	16
C4	Officials of District Education Directorate	15	30	10	20
C5	Parents	11	22	6	12
C6	No group/individual	3	6	13	26
C7	PTA/SMC	2	4	1	2
C8	Community leaders	1	2	1	2
C9	Miscellaneous / Unclassified	7	14	1	2
	Did not list	3	6	8	16

"Easy" and "Difficult" questions 5 and 6 (PBC)

Salient control beliefs are assumed to determine a respondent's PBC (Ajzen, 1991). Table 7 shows occurrences of nine such beliefs elicited by the "Easy" questions. A dominant proportion of teachers (72%) said it was easy for them to teach MPS if they have resources. All respondents were able to express at least one "Easy" belief.

Table 7: Results of the "Easy" questions (PBC)

Item Code	Easy Beliefs	Number	% Total Respondents
D1	Resources (funding, curriculum materials supplies, and equipment)	36	72
D2	More time allocation	9	18
D3	Classroom space & arrangement	7	14
D4	Period of teaching (time of day-morning)	7	14
D5	Professional Development	4	8
D6	Pupils interest and learning outcome	4	8
D7	Pedagogical Content Knowledge	3	6
D8	Small class size	3	6
D9	Reduced workload	2	4
D10	Miscellaneous / Unclassified	4	8
D11	Did not list	0	0

Many of the beliefs for the "Difficult" question mirrored those from the "Easy" question (see table 8). The highest "Difficult" belief mentioned was "lack of resources for teaching MPS", receiving 42% of responses. Belief E1 combined with E2 "Lack of time allocation" and E3 "Limited professional development opportunities" dominated belief responses. Fewer "difficulty" beliefs were highlighted than "easy" beliefs.

Table 8: Results of the "difficult" questions (PBC)

Item Code	Difficult Beliefs	Number	% Per Respondent
E1	Lack of resources	21	42
E2	Limited time allocation	17	34
E3	Limited professional development opportunities	15	30
E4	Poor classroom space & arrangement	7	14
E5	Poor pupils reading skills	3	6
E6	Increases workload	2	4
E7	Large class size	2	4
E8	Miscellaneous / Unclassified	0	0
E9	Did not list	2	4

Discussion

The following sections present discussion of the participants' reported salient beliefs for the three belief-types of the TPB.

Salient behavioural beliefs underlying attitudes

Teachers held both positive and negative attitudes towards teaching MPS. Such coexistence of positive and negative evaluation of an attitude object is understood as attitudinal ambivalence. The TPB model suggests that people's beliefs about behaviour can be ambivalent if they believe that the behaviour is likely to produce desirable and undesirable outcomes. Such ambivalent attitudes are, generally, a feature of weak attitudes and more susceptible to persuasion efforts (Armitage & Conner, 2000), and can offset the impact of attitudes on intentions and behaviours (e.g. Conner, Povey, Sparks, James & Shepherd, 2003). Since participants reported more salient "Advantages" than "Disadvantages" beliefs, they perceive more positive consequences for teaching MPS and can potentially influence their motivation to teach MPS. Thus, ambivalence may have been resolved to some extent because more weight was given to positive outcomes (van Harreveld, Nohlen, and Schneider, 2015).

Additionally, teachers reported that the salient behavioural beliefs underlying their attitudes toward teaching MPS would largely connect with pupils through factors including developing pupils' critical thinking skills; applying mathematics to real life situations; and invoking activity-based learning in the classroom. This prevalence suggests that attitudes towards teaching MPS are consistent with previous findings that it can foster students' conceptual understanding, enhance their interests and curiosities, and promote their reasoning abilities, amongst others (Killen, 2009). Indeed, Killen (2009) suggests that problem solving can encourage students to develop deeper understanding through applying ideas to real-world situations.

Many of the identified advantages for teaching MPS focused on making mathematics more interesting and meaningful for pupils. One implication is that by emphasizing these salient beliefs through professional development interventions there is potential to improve teachers' attitudes towards teaching MPS, and ultimately drive their pedagogical intentions and actions.

However, participants also identified disadvantages of teaching MPS, many revolving around perceptions of inconveniences and discomfort associated with delivery. Studies (e.g. Anamuah-Mensah, Mereku & Ghartey-Ampiah, 2008; MOE, 2014) have consistently shown that pupils find word problems difficult due to weak conceptual understanding and poor English language. It can be a challenging problem for MPS teaching (Krick-Morales, 2006) to support pupils to read and comprehend the text of the problem, identify the question, and finally create and solve a numerical equation. Authors (e.g. Bernardo, 2005) have equally expressed concern that children who are not good readers and those with English as Second Language (ESOL) (as in the case of Ghana) may have difficulty reading and understanding written content, and require additional teacher support. Schettino (2003) provides analysis of difficulties encountered in problem solving lessons, and suggests that teachers' unwillingness to teach MPS to their pupils may partly be a consequence of their limited repertoire of classroom management approaches.

Salient normative beliefs underlying subjective norms

Consistent with previous studies (e.g. Yan & Sin, 2015), the results suggest that teachers give consideration to opinions of a range of referents. Teachers believed that this group will

demonstrate higher approval of them teaching MPS to their pupils, than will disapprove, acting as major determinants of normative influences. However, compliance with the perceived approval of referents may occur because of beliefs of reward/punishment. For instance, education authorities and head teachers have the power to ensure teachers comply with policy requirements including expectations of the inclusion of appropriate problem solving activities in lesson plans. Respondents may be motivated to comply with expectations to avoid sanction for noncompliance or secure reward for compliance.

This has implications for the design of professional development interventions. Education authorities and head teachers need to clearly, and supportively, communicate their vision of the benefits (for teachers and their pupils) of, and provide implementation support for, teaching MPS through collaborative activity. In addition, support from colleagues appeared to encourage primary teachers to intend to teach MPS. Therefore, CPD opportunities at school level might provide space for teachers to share and discuss successful teaching styles and increase likelihood of MPS in daily lessons in classrooms, whilst resolving particular needs or deficiencies identified. These suggestions concur with Oh (2003): referents may constitute another source of motivation regarding willingness to teach MPS.

Salient control beliefs underlying Perceived Behavioural Control (PBC)

PBC is a perception of the extent to which performance of the behaviour is within teachers' control (easy or difficult). Results indicated that teachers perceive less difficulties than easiness in relation to teaching MPS. On one hand, participants believed that factors such as the availability of resources, good classroom space and arrangement, and morning delivery of mathematics would support MPS teaching. On the other hand, the absence of these factors, as well as poor pupil reading skills, increased workload and large class sizes, would potentially make it more difficult for (or discourage) them. Institutional barriers (e.g. limited resources, and time allocation) appeared to be the most cited impeding factor.

Consistent with the TPB, the more teachers believe that they have limited time allocation and classroom space and arrangement, the weaker their autonomy over teaching MPS. Additionally, increased CPD opportunities on the development of appropriate problem-solving skills and knowledge, will strengthen their control beliefs (or PBC). When teachers perceive their relevant skill levels or knowledge of problem solving heuristics as low, it could prevent them from teaching certain aspects, with resultant considerable time requirements to acquire the pedagogic knowledge to be able to lead learners and colleagues in future MPS activities. Given that people with low self-efficacy are often pessimistic about their capabilities and personal development (Tschannen-Moran & Hoy, 2007), teachers' heuristic knowledge and skills can influence their decisions about, and ability to teach, MPS.

However, teachers' beliefs that opportunities to teach mathematics in the morning would encourage them to teach MPS seem inconsistent with empirical research on suitable time for mathematics instructions. Hartley and Nicholls (2008) pointed to increased mathematics achievement as a result of afternoon, rather than early morning instruction (Hartley & Nicholls, 2008). In particular, afternoon learning may be more beneficial to long-term memory recall which underpins MPS activities (Wile & Shouppe, 2011). Thus, the findings regarding beliefs about morning teaching may be misplaced, and could potentially generate the belief that instruction in

the afternoon is less effective. Professional development interventions may seek to emphasize the benefits of teaching mathematics, especially MPS, in the afternoon to encourage long-term memory recall.

Study limitations

Given the design of elicitation studies, this study has methodological and theoretical limitations. Firstly, an open-ended question approach was utilised, a method known to be reliant on often flawed self-reporting. Participants can be sincere and think they are reporting honestly, but are subconsciously constructing what they think in the moment. Conceptions of the term 'problem solving' may widely vary, and it can be difficult to get a teacher to review (and write about) their own activities when completing a questionnaire (despite the use of open questions). The process of verbal interaction in interviews may enable additional questions to be asked and "reading between the lines" of teachers' responses.

Secondly, our approach adhered to the recommendation of the theory's authors to conduct an elicitation study with the view to accessing the beliefs that come readily and spontaneously to mind. Thus, by encouraging discussion of ideas, interviews can lead to uncovering of such beliefs. The open-ended questions were used in isolation, aligning with recommended elicitation study procedures. No attempt was made to triangulate the findings.

In addition, since the study did not attempt to examine the theoretical constructs of the TPB, or determine how the constructs predict and explain intentions to teach MPS, the results are more indicative than confirmatory.

Conclusion and Future Studies

This study explored teachers' beliefs regarding teaching MPS using the TPB framework. Exploration of salient beliefs was an important step in gaining an understanding of the psychosocial factors underlying why teachers may, or may not, teach MPS. This, in turn, may help educators and researchers to target these underlying beliefs with a view to encouraging MPS activities in classrooms. Policy makers may focus on any misleading beliefs when developing professional development opportunities.

Although the TPB has been supported in various domains, a major concern with its application is the limited use of elicitation studies (Downs & Hausenblas, 2005). This study may serve as a model for elicitation phases to be adapted in future (TPB) studies in mathematics education.

The findings were subsequently used to develop and validate an instrument that may be useful for examining the theoretical constructs of the TPB, especially for teaching MPS to pupils in different contexts. Having explored teachers' attitudes, subjective norms, and PBC over teaching MPS, and identified the underlying cognitive structures, it is now appropriate to determine how these factors can predict and explain intentions to teach MPS. Thus, relationships between intention and the theoretical determinants of the TPB model will be examined in the next study phase to support understanding of teachers' decision-making processes for this important teaching behaviour (see Authors, 2018). Future research would also be required to determine whether the beliefs identified would be similar in a larger sample of current Ghanaian primary teachers, with subsequent impact on the development of follow-up data collection tools.

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