Mathematics Teachers' views on CPD Provision and the Impact on their Professional Practice

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This study investigates CPD provision in Saudi Arabia by critically examining mathematics teachers' views on their experiences and their views on the impact of provision from a teacher-as-learner perspective. A questionnaire was administered to 605 teachers representing three educational administrations in Saudi Arabia (Mecca, Taif, and Majmah). The data was analyzed from a socio-cultural learning perspective with the intention of teasing out the assumptions about knowledge, learning and context that underpinned provision. There was tentative evidence that knowledge was typically conceptualized as a transferable commodity that could be imparted to teachers in ways that was intended to influence their professional practices and development. Yet, from the perspective of the majority of teachers, it failed to have a large impact on their practice beyond the immediate. Most teachers' descriptions of how they spent their CPD were deemed to be passive and subservient rather than active participation in knowledge creation or offering leadership to others. It was concluded that teacher learning is best facilitated through long term, practice-focused, community of practice-based provision and should encompass all activity in which a teacher feels they have learnt irrespective of whether it took place as part of their daily work or at a provided CPD event.

INTRODUCTION

Concerns about the future of teacher professional programs were raised at a high level by the Ministry of Education in Saudi Arabia due to the weakness revealed by teachers in the efficiency test that was administered to new teachers in the academic year 2003/2004 which shows only 27% of those participating teachers scored 40% of the total grade. Moreover, the percentage of teachers who benefited from short training programs (from 3 to 10 days) was only 5% of the teachers (El Abd El Karim, 2009). The continuing professional development programs and the developing managerial skills were two important goals out of ten which were highlighted in the strategic plan of the Ministry of Education in Saudi Arabia. This plan for developing the whole educational system in Saudi Arabia was reported in the 47th international Conference on Education

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State of the literature

- The literature suggests that mathematics teachers in Saudi Arabia are given CPD content that does not reflect their professional or mathematics needs
- It is not clear, however, whether CPD provision meets teachers' needs as learners.

Contribution of this paper to the literature

- The aforementioned gap in the literature is addressed in this paper by critically examining teachers' views through the lens of contemporary theories of learning
- This study explores mathematics teachers' views on their experiences of CPD and their views on impact of these experiences on their professional development and practice from a teacher-as – learner perspective
- Assumptions about knowledge, learning and context which underpin provision is teased out leading to a deeper understanding of current CPD provision and its impact and a questioning of these underlying assumptions
- The study shifts the focus of CPD research away from the provision of particular activities onto learning and adult learning in particular

organized by UNISCO, (Ministry of Education, 2003, p15). Teacher professional development is now widely recognized as a national priority in Saudi Arabia (Albalawi, 2010; Alshamrani, 2012).

The available evidence suggests that mathematics teachers in Saudi Arabia are faced with continuing professional development (CPD) programs that present content which does not reflect their professional or mathematical needs (Albalawi & Alrajeh, 2012). According to Albalawi & Alrajeh, there is a mismatch between ready-made programs and teachers' needs and preferences. It is not clear, however, from these studies how well CPD provision defined more broadly for mathematics teachers in Saudi Arabia is tailored to teacher needs as learners. If it is not, then this would represent a major flaw in CPD provision and a significant obstacle to teacher effectiveness and better student performance (Day, 1999; Adey et al., 2004; Jarvis, 2004; Graham, 2006).

The purpose of the present study was to investigate CPD provision in Saudi Arabia further by taking a wider definition of CPD and to critically examine teachers' views on their experiences including their views on the impact of provision from a learner's and a learning perspective. CPD in this study is taken to include both externally planned opportunities for teacher development and learning opportunities initiated by the teachers themselves. By eliciting mathematics teachers'

views on the types of CPD opportunities currently offered to them, their views on the impact of these activities on their professional practice and subjecting the findings to critical examination through the lens of contemporary theories of learning, it is intended that the study will offer a vision of future provision and pave the way for further exploration into teachers' professional development.

Theoretical positioning and research questions

Webster-Wright's (2009) extensive review of relevant literature concluded that the biggest obstacle to improving CPD is the way it has been implicitly conceptualized by providers and researchers. This, she argues, has maintained poor practice whilst upholding the status quo and has restricted critical evaluation and the potential for change (p 704). The discourse surrounding CPD practice, according to Webster-Wright, assumes shared views on knowledge and learning so the ontology underlying their conceptualization are never made explicit and remain poorly understood. It is necessary, therefore, to make explicit assumptions about learning and knowledge that underpin and inform CPD provision in order to improve provision.

The theoretical framing of this paper is within contemporary understandings of learning that include teacher learning. Our intention is to look at CPD provision and impact, as perceived by the teachers' themselves, through the lens of current literatures on learning and knowledge that inform, or potentially could inform, CPD. The relevant fields of study are teacher learning, lifelong learning, adult learning, professional learning, and workplace learning.

Much has been written on teacher (and student) learning in the field of mathematics education (see, for example, Adler, 1998; 2001; Boaler, 1997; Stein & Brown, 1997). This work recognizes Lave & Wenger's (1991) perspective in the process of learning to teach mathematics and Wenger's (1998) subsequent work. Two aspects of this theory are seen as relevant to mathematics CPD: (i) teachers' learning is enhanced by involvement in a community of practice where they are supported by other members of that community, (ii) implementation of change (e.g. a new curriculum) involves (contains) changes in teacher roles involving a process of identity transformation (Graven, 2004). The assumption underpinning CPD that involves engagement in a community of practice is that it is a long-term learning process. Learning is not seen as acquisition or located in the heads of individuals but process of co-construction through co-participation. The key features of learning from Lave & Wenger's perspective are participation in the practices of a community and a process of increasing identity change

within that community. Lave & Wenger see a community of practice as "a set of relationships among persons, activity, and world over time" (p 98). The implications of taking this approach to CPD provision are, one, the need to set up a community of practice where providers and practitioners learn from each other and, two, learning should take place in practical contexts i.e. it should be situated.

CPD is also based on the idea of lifelong learning (Goodson & Sikes, 2001). This encapsulates a notion of learning that continues through time, is active, takes place in a social context, is interactive, informal as well as formal, and related to practical experience (Hodkinson & Hodkinson, 2005). It is a view of learning that is relational in the sense that a key source of learning is through reflection and engagement with others. This contrasts with the type of learning that is ready-made, frequently packaged into bite-sized units and delivered devoid of context in a didactic manner to passive recipients of information. As the training model of teacher education falls into this latter category, teacher education has seen a shift in recent years away from training for practices based on situated learning experiences (e.g. Clark, 2001). CPD is also learning aimed at adults. Adult educators have long taken the view that learning is holistic in the sense that it involves the whole person (Freire, 1974) and change (transformation) is brought about through engagement with others and self-reflection (Brookfield, 2005).

CPD is about workplace learning that recognises that learning is context dependent and the workplace itself is an important context for learning (Stoll et al., 2006). Workplace learning acknowledges that learning takes place in formal and informal contexts (Hagar, 2004). CPD is about professional learning where knowledge is seen as co-constructed between and among people rather than existing separate from the learner (Darling-Hammond, 2006). Professional learning practices have seen a shift away from didactic approaches to more action-based and practice-focused learning (Biggs, 2003).

Each of these fields of study see learning as located within a social practice framework rather than within the heads of individuals. Their common feature is that the learner, the learning and the learning context are inseparable and that they provide a structural framework for analyzing CPD learning. Application of this framework means we are required to critically examine the CPD provision offered to and attended by Saudi mathematics teachers from the perspective of teachers themselves as learners in the CPD process. It also means we are required to consider the context of that learning as integral to the learning experience. Specifically our focus is on answering the following research questions:

What implicit assumptions about learning, knowledge and context underpinned the teachers' CPD experiences as articulated by them?

To what extent was their CPD learning experiences holistic rather than fragmented including being artificially separate from practice contexts?

To what extent was the knowledge imparted situated rather than delivered?

To what extent was there a focus on seeking to understand the experience of the teachers as adult learners and professional learners and to support them effectively in their places of work?

METHODOLOGY

The research reported in this paper forms part of a wider empirical investigation aimed at eliciting Saudi mathematics teachers' views on their CPD experiences and the value they placed on these programs in terms of supporting their professional practices.

Design

The wider study utilized two methodologies, in-depth interviewing and survey. The research reported here concerns the survey only. The purpose of the survey questionnaire was to focus on eliciting the personal value of the CPD programs held by teachers and the impact of these programs on participating teachers' professional practices. It was also important to determine whether the CPD programs had met the specific needs of the targeted teachers, and what their views were in terms of impact on the time they had spent and the efforts they had put in. It is worth mentioning that the most used tool for collecting data in the Saudi educational setting is closed-ended questionnaires.

Research instrument

A questionnaire was specifically designed to address the issues outlined above. We asked mathematics teachers to consider their CPD experiences from the point of view of opportunities offered to them, their own patterns of participation in the preceding 24 months, the modes of delivery utilized by providers, the emphasis of content, and the duration of the provision in which they had spent most of their time. They were also asked to rate their CPD experiences in terms of their perceptions of the impact of each type of CPD they had spent most time in, their perceptions of the area of impact, their perceptions of the level of impact in terms of various aspects of their professional practices including their professional development more broadly. Finally they were asked to consider the impact of their CPD experiences in terms of the extent to which they had shared their CPD experiences with

others. The design of each item (question) emerged from in-depth interviews with a focus group of five teachers who were deemed to be representative of the population from which the study drew its sample, coupled with an in-depth review of relevant literature (e.g. Fraser, et al, 2007; Opfer, et al, 2008; Joubert, et al, 2009).

The questionnaire was made up of the following eight modules:

Biographical information on each participant (9 items covering gender, nationality, specialism, subject taught, prior teaching experience, qualifications and type and level of the school in which they work)

Types of CPD opportunities offered (13 items covering the types of CPD set out in tables 2 and 4 below)

Patterns of participation in these CPD types operationalized via how teachers had spent most of their CPD time over the preceding 24 months (13 items as in table 2)

Forms of that CPD activity in terms of the methods providers used such as lecture, observation, or extended problem solving, etc. (13 items as set out in table 2 below)

Focus of content of CPD provision (11 items)

Level of impact (5-point scale as set out in table 3 below)

Area of impact as perceived by the teachers (16 items as set out in table 4 below)

Impact in terms of the extent to which CPD learning had been shared with others (5 items)

Participants

The population for this study was all the mathematics teachers in three educational administrations in Saudi Arabia (Mecca, Taif, and Majmah). The researchers selected some educational districts under each educational administration with the consideration that the selection should cover both the urban and suburban areas in each administration. Three out of nine educational districts under Mecca Educational Administration were selected. From Taif Administration, three educational districts out of ten were selected. From Almajmah, two educational districts out of four were chosen. In order to identify a suitable sample, the researchers contacted the schools' principals asking permission to conduct research in the school. Upon approval, the researchers sent each school the questionnaires with a covering letter explaining the purpose of the study, assuring teachers of confidentiality (no names required), and stating that filling in the questionnaire was on a voluntary basis.

The total number of teachers within the selected districts who volunteered to take part in the study was 605. All 605 were mathematics specialist and Saudi nationals. The sample was made up of 394 males and 211 females drawn from primary (*n*=224), intermediate (*n*=182) and secondary (*n*=199) schools. Almost all (*n*=573) were teaching in state schools. Between them they had teaching experience varying from less than 5 years (n=163) to more than 21 years (n=47). 535 of them had been educated to BSc level, 5 had a master's degree and the others had a diploma in mathematics education.

Data collection procedures and analysis

Once a sample of volunteers had been identified, the researchers, helped by trained field workers, visited each school to administer the questionnaire and collect the completed questionnaires. In each case the respondents were re-assured that they would remain anonymous and that all information supplied by them in the questionnaire would be confidential. The data was coded and entered into an SPSS V19 file for analysis. It was made up of normative and ordinal variables and, for the purposes of this paper, was analysed using descriptive statistics (frequencies).

RESULTS AND INTERPRETATION

The results have been set out under two headings, 'provision and participation' and 'impact'. In order to make the link between data and evidence explicit, interpretations are offered alongside the results.

Provision and participation

The types of CPD provided

The immediate interest was in determining the types of CPD that teachers perceived they were being offered and compared these with the types of CPD teachers reported that they had spent most of their time in during the 24 months preceding the survey. The results for both these aspects are set out in Table 1.

Column 1 of Table 1 lists the types of CPD provision from most commonly offered to least commonly offered according to the teachers. Column 3 lists this rank ordering from 1-13. Next to it in column 4, the rank ordering of most commonly to least commonly attended, according to how the teachers reported they had spent most of their time in the preceding 24 months. Also included in table 1 are the actual numbers (and percentages) of teachers who responded 'yes' to being offered this type of provision (column 2) and 'yes' to spending most time in this provision (column 5).

We can see from this table that more teachers said they were offered out-of-school workshops than any other type of provision with nearly twice as many teachers (*n*=395 or 65% of the sample) saying they had been offered this form of provision compared to those who said they had been offered in-school workshops (*n*=208 or 34% of the sample). This could suggest that, from the teachers' perspective, most CPD workshop

opportunities offered to them were biased towards externally initiated provision rather than provision arising directly from the teachers' own classroom practices. If this was the case, then it could imply that CPD workshop provision was based on a view of knowledge as a transferable object, as something that could be acquired from the more expert rather than co-constructed in a social context (Resnick, 1987; Sfard, 1998).

Adding weight to this view is the evidence that teachers also saw 'attending a lecture or presentation' as a common form of provision with 250 (41% of the sample) saying they had been offered the opportunity to attend this type of CPD provision. Whilst co-operating with other teachers on doing research in school was seen as not commonly offered with only 11% of the sample (67 teachers) saying they had been offered this form of provision. Both these observations imply a notion of learning amongst CPD providers that is decontextualised rather than situated in teachers' daily practices and routines (Fullan, 2007; Lave and Wenger, 1991; Sfard, 1998).

This evidence, however, needs to be balanced against evidence that would appear to be contradictory. For example, the second most common type of CPD offered was 'observation of peers' with 383 teachers (63% of the sample) saying they had been offered this suggesting a more local and contextualised form of provision closer to teachers' everyday work. Similarly, what could be regarded as more remote and thus potentially less contextualised types of provision were not commonly offered to teachers such as accredited courses and online provision. Accredited courses were found to be the least likely types of provision to be offered with only 34 respondents (6% of the sample) saying they had been offered the opportunity to attend non-university accredited courses and only 42 (7% of the sample) saying they had been offered the opportunity to attend university-accredited courses. Only 9 per cent of the sample (56 respondents) said they had been offered online provision.

The type of CPD however does not necessarily reflect the approach to learning taken within it. It all depends on the approach taken by an instructor/facilitator in a given session. CPD provision held out of school or in school may be of equal value in the eyes of teachers particularly if they are able to draw on their own examples of practice. Whilst Sztajn et al. (2007) put their emphasis on developing communities of practice within and across schools, Joubert (2009) found that teachers valued time away from school to reflect and discuss.

When the types of CPD offered were rank ordered according to how the teachers said they had spent most of their time in the 24 months preceding the survey, we found that this rank ordering followed more or less the same pattern as the opportunities offered (i.e. comparing columns 3 and 4 in Table 1). This strongly suggests that teachers' patterns of participation were being dictated and thus severely restricted by the provision offered to them. It also adds weight to a view implicit in more traditional models of CPD that teachers tend to see themselves as passive recipients of the types of CPD offered to them rather than initiative takers

Table 1. Perceived types of CPD provision offered and reported patterns of participation.

Types of CPD offered as perceived by teachers	Perceived CPD Provision		'Most time spent'	
	Number (%)who said they had been offered this type of provision	Rank ordering of CPD provision offered	Rank ordering in terms of 'most time spent' by participants in preceding 24 months	Number (%) who reported spending most of their time in this type of CPD in preceding 24 months
Out-of-school workshops	395 (65%)	1	1	360 (60%)
Observation of peers teaching	383 (63%)	2	2	350 (58%)
Attend a lecture or presentation	250 (41%)	3	3	241 (40%)
In-school workshops	208 (34%)	4	4	212 (35%)
Coaching done by other teachers	170 (28%)	5	5	155 (26%)
Coaching done for other teachers	128 (21%)	6	6	131 (22%)
Teacher networks or teacher collaborations	108 (18%)	7	7	103 (17%)
Independent study	83 (14%)	8	8	87 (14%)
Conferences	77 (13%)	9	9	64 (11%)
Co-operating with other teachers on doing research in school	67 (11%)	10	9	64 (11%)
Online CPD	56 (9%)	11	11	59 (9%)
University accredited courses	42 (7%)	12	12	39 (6%)
Non-university accredited courses	34 (6%)	13	13	36 (6%)

Note. CPD = Continuing Professional Development

actively engaged in seeking out CPD opportunities for themselves to suit their own particular priorities and needs.

It is reasonable to infer from this evidence that the teachers in this study appeared to see themselves as only recipients of provision and not as both providers and recipients. If this is the case then it follows that, rather than making real choices based on their own priorities and preferences, teachers' CPD choices were being imposed upon them by providers. It also follows that they perceived that power lay with the CPD providers to determine what was valued and justifiable to learn. It was the providers' responsibility and not the teachers' to decide what was legitimate knowledge (Apple, 2000). In this sense, a study by Mansour *et al.* (2013) about Saudi Arabian teachers' and supervisors' views of professional development needs indicates that there is a mismatch between teachers' perceptions of their CPD needs and their supervisors' perceptions.

One implication of this is that there needs to be greater continuity between the learning that takes place in the everyday practice of teachers' lives and the learning that takes place on CPD programs (Beckett & Hager, 2002; Day, 1999). This means that CPD (or, more precisely, teacher learning) can refer to any activity in which a teacher feels they have learnt, irrespective of whether it took place as part of their daily work or at a provided CPD event. This not only avoids any artificial separation between methods and subject knowledge and CPD sessions and teaching practice, but also moves the teacher's role from passive recipient to active contributor with local context-sensitive learning arising from experience given the same legitimacy as book knowledge (Aubrey & Cohen, 1995). Hae-Jin Lee (2007) and Bailey (2010) found that when CPD curriculum and teaching methods aimed at mathematics teachers are jointly developed by providers and recipients, they achieve better outcomes.

A tension related to this line of argument is that of ownership. If the purpose of CPD is to bring about change in teaching and teacher perspectives, then the teachers who are going to implement the change must feel that they have been involved in creating and redesigning it (Farmer, et al, 2003). But change is often about the new and unfamiliar rather than the status quo. This requires a vision of a future that is different in some way which is possibly imposed from outside. Hence there is a tension between teachers bringing what they are already familiar with and the more novel and sometimes vague view of what things might be like in the future. Ball (1995) saw this as a problem in teacher professional development that was often overlooked.

To give us an insight into what was considered legitimate knowledge in these teachers' CPD, we turn our attention to what the teachers had to say about the focus of content of the CPD sessions in which they had

spent most of their time in the preceding 24 months. Most teachers said that the strongest emphasis of the CPD activities was on teaching and learning methods (84%) with thinking skills (82%) and curriculum design and development (80%) coming in at second and third place respectively. Behaviour management (78%), pupil consultation (76%), catering to the needs of different groups (76%) were also identified as commonly occurring content as well as approaches to pupil assessment (75%) whereas use of ICT in learning (61%) and deepening knowledge of the subject area (43%) were the least likely to be identified by the teachers as the focus for their CPD content. Taken together, these results show that the content of most CPD provision was biased towards methods of teaching, classroom management issues, and learning and assessment rather than subject content knowledge. Two points arise from this. The first is the artificial separation of subject content knowledge from methods of teaching and the second concerns what was considered 'legitimate knowledge' in these teachers CPD experiences. We deal with each in turn.

Several commentators have argued that mathematics teachers' pedagogic knowledge is embedded in the specific context of the mathematics classroom (McLaughlin and Talbert, 1993; Wineburg and Grossman, 1998). This means that methods of teaching mathematics (pedagogic knowledge specific to mathematics) cannot be separated from mathematic content knowledge. Peressini et al (2004) argued that teaching mathematics consists, at least in part, of "selecting and developing worthwhile tasks which have the potential to immerse students in significant mathematics content, and orchestrating classroom discourse focused on mathematical thinking, reasoning, and communication" (p 79). According to Peressini and his colleagues, there is an interdependency between mathematics content (the tasks) and the discourse of enquiry around these tasks (methods of teaching and learning mathematics). This is a perspective that recognizes the notion of a community of knowledge that is built up through discourse around relevant tasks and introduced to novices through discourse and practice (Lave and Weger, 1991). This view of teaching mathematics is based on a framework that conceives knowledge as situated and not fragmented. By focusing on the contexts of practice in which knowledge is developed, one is forced to take a holistic view where subject content knowledge is inseparable from pedagogic knowledge (Schulman, 1986; Webster-Wright, 2009).

Legitimate knowledge in this case was, according to the teachers, generalized methods of teaching, generalized methods of assessment, and classroom management. We use the adjective 'generalized' because pedagogic knowledge was separated from subject

content knowledge even although it is generally known that competence and professional expertise develop in different ways depending on context and the professional's understanding of that practice (Beckett & Hager, 2002; Glazer & Hannafin, 2006). This approach to CPD content is not only problematic for the reasons already outlined but also implies a professional context of control and standardization.

Observable, measurable professional skills appeared to be valued over subject content knowledge. Weil (1999) amongst others has argued that focusing on performance indicators such as these that are measurable is about professional regulation, standardization of practice and central control rather than solving problems. Performativity seemed to be the basis of much CPD offered to mathematics teachers in this study and elsewhere (Friedman & Phillips, 2004). However, it is important at this juncture to acknowledge an unresolved tension that exists in all CPD work between what is of value to stakeholders to whom professionals are accountable and what is of value to teachers' practice and their careers. The tension is on how best to balance the needs of an individual teacher's career-long learning and supporting and maintaining professional standards and competences across the teaching profession as a whole. With this tension in mind, there is a need in any CPD provision to critically reflect on the extent to which performance focused CPD inputs may actually narrow professional practice rather than enhance it (Brockbank et al., 2002).

The evidence reported above suggests that, at least from a teacher's perspective, the approach to CPD content adheres to conventional notions of CPD in which knowledge and learning are seen as something that can be packaged and delivered to teachers to meet some perceived deficit. The implication of this more traditional view of knowledge and learning is that it reinforces focus on the CPD program and its content rather than on understanding the learner's perspective (i.e. the perspective of the teacher as a learner) and the context in which professional learning takes place. This is a transmission model of teaching where the provider decides what knowledge is legitimate and has precedence over context-dependent knowledge constructed locally by the teachers themselves (McWilliam, 2002).

Several commentators have highlighted the importance of giving thought to the format of provision in addition to the content. Farmer et al (2003) argued for the importance of modelling learner-centred instructional materials. This enabled the teachers in their study to adopt new instructional techniques directly and integrate them into their daily professional practices. Falmer et al (op cit) also found that this put the CPD providers on a level pegging with the teachers in that both CPD facilitators and teachers became co-learners and co-constructors of mathematics as enquirers in their own classroom milieus.

It is of interest then to consider what the mathematics teachers in the present study saw as the most common methods of teaching used by the CPD providers. The answer to this question is set out in Table 2.

Teachers' participation

The majority of teachers reported that they had spent most of their time observing a demonstration of a lesson or unit (n=389), and listening to a lecture (n=356). The rank ordering set out in Table 2 adds some weight to the earlier evidence that there is a bias towards teachers spending most of their CPD time in activities that put them in passive rather than active

Table 2. Forms of CPD activity in which teachers said they had spent most of their time in the preceding 24 months

Form of activity	Number (%) of teachers who reported they had spent most time in this activity	Rank ordering according to the most time spent in this activity by teachers in the preceding 24 months
Observed a demonstration of a lesson or unit	(389: 64%)	1
Listened to a lecture or presentation	(356: 59%)	2
Participated in a small group discussion	(354: 59%)	3
Engaged in extended problem solving	(344: 57%)	4
Assessed pupil's work	(320: 53%)	5
Collaborated as a colleague with other teachers	(245: 41%)	6
Developed or reviewed instructional or curriculum or materials	(221:37%)	7
Conducted a demonstration lesson, unit or skill	(211:35%)	8
Produced a paper, report or plan	(157: 26%)	9
Led a small-group discussion	(130: 22%)	10
Gave a lecture or presentation	(120: 20%)	11
Assessed fellow participants' knowledge or skills	(98: 16%)	12
Led a whole-group discussion	(70: 12%)	13

roles. Also they spent the least amount of time in activities that put them in leadership and management roles. However there is some evidence that runs counter to this. Several teachers said that they had spent most of their CPD time in small group discussion (n=354), being engaged in extended problem solving (n=344), and assessing pupils' work (n=320), each of which suggests a more active participatory role.

What the teachers surveyed had to say about the duration of their CPD experiences also raises issues about the quality of these experiences. 456 teachers (77%) said that their CPD experiences had lasted between 1 and 6 days and 207 teachers (66%) said that their experiences had lasted less than a day. 93 teachers (15%) said that their experiences had lasted between a week and a month. Only 16 teachers (2.6%) attended provision that lasted between one month and one year and only 15 (2.5%) experienced provision that lasted more than a year. The evidence thus shows that the bulk of CPD provision for the teachers in this study was short term and, by implication, fragmentary.

Prolonged CPD activities suggest greater teacher engagement. Desimone (2009) maintained that the length of the CPD activity was important because it should include the following elements: content, active learning, time for reflection and development, coherence, collective participation or co-operation. Longer lasting CPD experiences meant that the development of activities could be spread over an appropriate period of time. His recommendation was that CPD activities should last at least a semester. Time is needed to develop understanding, particularly in the learning of mathematics (Ma, 1999). Without sustained support and reasonably long gestation periods, learning will be limited.

The data suggests that it is unlikely that the majority of the CPD activities the teachers in this study experienced were conducive to prolonged active participant involvement. Short CPD episodes suggest a view of knowledge as a commodity that can be packaged into discrete finite episodes (Wenger, 1998). Time for reflection is as important as practical experience through active participation and a prolonged period of time is usually necessary to achieve this (Reason & Bradbury, 2001). In keeping with the findings of this study, Hill (2011) also evidenced that too many CPD opportunities were typically too short and fragmented to be a worthwhile learning experience.

It is important however to recognise that a tension exists between teachers devoting their time in busy classrooms to the needs of their students and fitting good quality CPD around their already stretched workloads. It may be that building communities of practice within (and across) institutions that is in tune with their everyday work is one answer to this conundrum (e.g. Sztajn et al. 2007).

Impact

Teachers' perspectives of the impact of the CPD types provided

The first line of questioning was focused on the level of impact of the CPD types teachers had selected as the ones in which they had spent most of their time in the preceding 24 months (see Table 1). Because the number of teachers choosing to spend most of their time in a given CPD type varied considerably, percentages of those who said 'yes' to a given type of CPD rather than actual numbers are used in Table 3 which shows how the teachers responded to the questions posed.

The general pattern to emerge from eyeballing Table 3 is that responses were roughly split into one third, one half and one sixth with a third of teachers seeing their CPD as having had a large impact, one half seeing it as having had a moderate impact and around one sixth seeing the activity as having had no impact or a low impact. This pattern is relatively consistent for all types of CPD except independent study and non-university accredited courses with the former being perceived as having a large impact and the latter as having no impact or a small impact. Of the 82 teachers who said they had spent most time in independent study 40 (49%) said that this type of activity had had a large impact. Of the 45 teachers who said they had spent most of their time in non-university accredited courses only 7 (16%) said this type of CPD had had a large impact. Similarly, the rank ordering in column 1 shows that by far the largest proportion of teachers (42%) who spent most of their time in non-university accredited courses said this type of provision had little or no impact. And 33% of those who said they had spent most of their time in university-accredited courses said these had little or no impact.

The contrasting views expressed towards independent study and accredited course work is worthy of comment. It is reasonable to infer from the differences in response that the teachers saw independent study as something other than attending accredited courses. Independent study involves, at least in some cases – and perhaps in the cases that were perceived as having the most impact – a form of CPD that has been personalized in the sense that the teachers themselves are more likely to have initiated the content of their study and by so doing tailored it to their own needs, expectations, preferences and values. Accredited courses (both university and non-university), on the other hand, were perceived as having little or no impact by a considerable proportion of those who took part in these. Perhaps accredited courses were seen as being remote and separate from their everyday professional practices compared to self-selected themes for independent study.

Independent study, unlike formal inputs, permits a shift away from dichotomizing formal learning and informal learning from everyday learning and professional growth (Day, 1999; Jarvis, 2004). Independent study allows the teacher and not the CPD provider to identify situations in which they can learn. Unlike accredited courses, which were seen as having little impact, independent study enables the focus to move from seeing the CPD activity aimed at filling a knowledge gap or addressing some other deficiency in need of direction compared to engagement in self-directed learning. According to Coolahan (2002), it is recognized internationally that teacher development is often best promoted within the context of school development, with more and more schools being encouraged to engage in collaborative development planning.

Online CPD was seen as having had limited impact. This concurs with evidence presented above, namely, both as a type of CPD provision and how the teachers spent their time, online learning came near the bottom of the rank order (11th out of 13 – see Table 1). Likewise when the teachers were questioned about the emphasis of their CPD experiences, ICT in learning was middle ranking below, for example, use of curriculum materials and behaviour management. There is, therefore, clear evidence emerging that CPD providers were making only limited use of ICT technologies and this is reflected in the teachers' perceptions of their CPD experiences. One important reason for this result was that when the Ministry of Education offered the online training, it was optional not obligatory. Also, there are not enough equipped training cents in all Saudi cities.

It is of interest to note that 'observation of peers', 'coaching done by other teachers', 'coaching done for other teachers', 'teacher networks or teacher collaborations', and 'co-operating with teachers on doing research' had the lowest proportions of teachers saying they had spent most of their time in these types of provision and the fewest number of teachers saying these activites had little or no impact. This may be because these types of activities lend themselves more to active engagement in the process as teachers are initiating, jointly planning and designing provision. They may therefore feel more of a participant rather than an observer and so are unlikely to perceive these activities as having little or no impact. It may also be that in these types of provision learning is less likely to be broken up and delivered in bite-sized chunks separate from the professional context in which it is to be used. Put another way, knowledge is more likely to be seen as holistic with pedagogic knowledge less likely to be separated from the everyday context in which it is practised. This approach to CPD is not only more in keeping with socio-cultural theories of learning but also

more empowering for the teachers involved in these types of provision. Hence they are perceived as more likely to have had an impact on professional practices.

Areas of professional practice the CPD had reportedly impacted

When the teachers were asked to identify the area or areas of their professional practice on which the CPD had impacted, 70% (n=422) said that they had been prompted to use new curriculum materials. Less than a quarter of them (24%; n=144) said it had helped them gain promotion. The full rank ordering is shown in Table 4.

Table 4 shows that teachers were more likely to say that CPD had helped them in tangible practical ways that were visible and measurable and that concerned their immediate everyday classroom environment. The top eight in the rank ordering are examples of areas of impact that fall into this category. In contrast, only a few teachers said that there had been an impact in less tangible areas including their longer-term professional development such as their belief systems and their professional identities (for specific examples see those ranked lowest in Table 4). There is also evidence that teachers were less likely to feel their CPD experiences had impacted on their wider school roles such as school policy and school level practices. This may be simply because most of the teachers in our sample were in a more junior role making them less able to influence change beyond their classrooms or it may be due to the focus of the CPD activities in which they were engaged. As evidenced earlier, this was by and large concerned with teaching methodologies rather than wider school and professional concerns. Thus implying that the focus of CPD content as perceived by the teachers had a bearing on their perceptions of the area of impact.

Data presented earlier revealed that CPD provision was prioritizing methods of teaching and assessment over subject knowledge and less tangible goals. Table 4 shows clear dichotomies in terms of impact response patterns with the strongest impact perceived as being on the more tangible rather than the intangible, on the measurable and immediate rather than on the ephemeral and more remote such as self-confidence/self-esteem or promotional prospects and wider school issues. Data was also presented earlier showing that teachers spent most of their time in activities that put them in passive rather than active roles with teachers spending the least time of all in activities that put them in leadership and management roles. This implies that the focus of CPD provision needs to shift away from CPD programs that are more concerned with training (professional competencies) rather than learning. This is because training has a tendency to reinforce current practices rather than deepening teacher understanding and

Table 3. Perceived level of impact by CPD type

Type of CPD	Level of impact as perceived by teachers		
	Percentage (seeing no or a very low impact)	Percentage (seeing a moderate impact)	Percentage (seeing a large impact)
Out-of-school workshops	14 (7)	53 (1)	33 (8)
Observation of peers teaching	7 (13)	50 (6)	43 (3)
Attend a lecture or presentation	18 (5)	52 (2)	30 (11)
In-school workshops	16 (6)	51 (5)	33 (8)
Coaching done by other teachers	11 (10)	45 (8)	44 (2)
Coaching done for other teachers	13 (9)	47 (7)	40 (4)
Teacher networks or teacher collaborations	11 (10)	52 (2)	37 (6)
Independent study	14 (7)	37 (13)	49 (1)
Conferences	20 (4)	41 (10)	39 (5)
Co-operating with other teachers on doing research in school	11 (10)	52 (2)	37 (6)
Online CPD	27 (3)	40 (11)	33 (8)
University accredited courses	33 (2)	38 (12)	29 (12)
Non-university accredited courses	42 (1)	42 (9)	16 (13)

Table 4. Teachers' perceptions of the areas of CPD impact

Area of impact	Number (%) of teachers who reported this area of impact	Rank ordering of area of impact according to the number of teachers who reported an impact in this area
Prompted me to use new curriculum materials	422 (70)	1
Improved pupil performance or outcomes	410 (68)	2
Changed pupil learning practices	402 (66)	3
Your teaching skills	379 (63)	4
Changed pupil behaviour	365 (60)	5
Made me more aware of teaching and learning issues	365 (60)	5
Changed my views about teaching and learning	354 (59)	6
Changed the climate in my classroom	354 (59)	6
Prompted me to seek further information or training	347 (57)	7
Your leadership skills	339 (56)	8
Changed the way I think about teaching and learning	332 (55)	9
Your self-confidence/self-esteem	317 (52)	10
Improved school-level practices	306 (51)	11
Changed my beliefs about pupil learning	287 (47)	12
Led to changes in school policy	220 (63)	13
Helped my promotion	144 (24)	14

teacher learning. Shifting the focus onto teacher learning means the learner and the context of learning and, more importantly, the interaction between the three are foregrounded.

Finally the teachers were also asked if they had shared their CPD experiences and learning with others. In response a clear pattern emerged showing that impact in terms of cascading CPD learning more widely was limited largely to those in their school who had also attended the CPD activity. 77% (n=463) said they had discussed what they had learnt with other teachers in the school who had also attended the CPD activity but this reduced to 54% (n=326) when it came to sharing what they had learnt with other teachers in the school who had not attended the activity and 156 (n=26%) when it came to discussing what they had learnt with attendees from other schools. Only 223 (n=37%) said they had discussed what they had learnt with school leaders.

As flagged up earlier when discussing the duration of CPD sessions, there is tension here between teachers' CPD workloads and their classroom workloads. It is a very challenging proposition to expect teachers to become engaged in building communities of practice within their own schools, and across schools, where they can continue to learn and develop their own knowledge of mathematics and mathematics teaching whilst still attending to the needs of those they teach. There are, however, examples in the literature where this has been done successfully. For example, Sztajn et al. (2007) drew on concepts of trust and care to facilitate collaboration between mathematics teachers within and across schools.

Key Findings

The impetus for the study was to contribute to knowledge concerning the improvement of practice amongst experienced mathematics teachers throughout their careers by examining CPD provision and impact from a teacher-as-learner perspective. The findings in terms of answering the research questions posed earlier are set out in the following paragraphs.

The teachers' CPD experiences, as articulated by them, were examined for the implicit assumptions about learning, knowledge and context that underpinned them. It was found that the majority of CPD opportunities provided appeared to be based on a view of knowledge as transferable and residing in the head of an expert rather than co-constructed socially. That is, knowledge resided outside of schools and classrooms and had to be brought to the teachers in ready-made packages. It was inferred from the teachers' responses that they were inclined to see themselves as passive recipients of knowledge rather the active creators of knowledge based on practice, that they spent most of their time in passive subservient roles rather than actively participating in a knowledge creation community or offering leadership to others. In this sense the knowledge that was being imparted was being delivered to the teachers.

This view was supported by the shortness of almost all CPD experiences. This was seen as not conducive to prolonged active reflection and engagement of the sort associated with lifelong learning, workplace learning, and adult learning. However, on this specific point, the picture was more mixed with some CPD provision appearing to place emphasis on knowledge and learning that was situated in communities of practice wherein teachers were encouraged to interact between and amongst each other and create knowledge through sharing their expertise. Examples include observation of peers, coaching done by and for other, teacher networks and teacher collaborations, teachers co-operating on doing research with other teachers. Although only a minority of teachers said they had spent most of their time in these activities, those who did were less inclined to have been seen them as having little or no impact. It was conceded, though, that the type of CPD in and of itself did not necessarily reflect the approach to learning taken by an instructor/facilitator.

Pooling evidence from the various lines of questioning in the study, it becomes clear that the teachers' descriptions of their CPD experiences reveal a form of learning that is fragmentary. First there was the artificial separate of theory from practice contexts with the majority of provision on offer to them and attended by them showing little evidence of continuity between the learning that took place in the everyday practice of their lives and the CPD learning that was offered to them. Second there was the artificial separation of method and subject content knowledge. Third there was evidence that by far the majority of their CPD experiences lasted less than a week, and this was deemed to be not long enough to encourage prolonged engagement in a community of learners.

It was inferred from the lack of time devoted to a given CPD experience, that insufficient thought was being given to sustained support for the teachers. Teachers did perceive, however, that they were being helped in tangible practical ways of immediate concern to their classrooms although few said that there had been an impact on their deeper and longer-term learning such as their professional identities and belief systems. Also most saw the impact as limited to their classroom environment rather than their roles in the wider school environment. This was interpreted as being a reflection of the content of the CPD in which they had spent most of their time. The basis of sessions seemed to be on training teachers in professional competences (performance indicators) rather than on seeking to understand the experience of the teachers as adult learners and professional learners and to support them effectively in their places of work. On the contrary, there was evidence that they were being inadvertently disempowered. In a community of practice, empowerment can be conceptualized as moving from peripheral engagement to more central engagement and mastery (cf Graven's (2004) conceptualization of confidence). Seen from this perspective, the empowerment of teachers is seen as stemming from engagement in social interaction through making a contribution. Thus, as with learning, empowerment is something that happens through the process of social participation rather than in the heads of individual, hence the need for long lasting CPD initiatives.

CONCLUSION

This paper has sought to make a contribution to knowledge by focusing on the learning experiences of teachers rather than on evaluating CPD programs, their content, delivery and outcomes within a conventional framework. It has moved beyond just looking at competency approaches to CPD (Wilson, 2000) and thus avoided reinforcing a view of CPD learning as the filling up of empty vessels with knowledge lifted from the latest official report. Instead it has sought to tease out the assumptions about knowledge, learning and context that underpin provision. In this sense it has sought to understand more about the experience of teacher learning and to begin the process of questioning underlying assumptions. In seeking to move forward, it is useful to reflect critically on the usefulness of the theoretical framework that informed the study.

A common failure of socio-cultural learning theories is that they often neglect to address the role of teaching in the learning process. The focus tends to be on informal rather than formal learning contexts (Resnick, 1987). Graven (2004) draws our attention to how in Lave & Wenger's (1991) theory the emphasis is on learning from relationships between and among participants in a learning community rather than on a teacher/learner dyad. Wenger (1998) talks about "maximizing learning and minimizing teaching" (p 267). Neglecting the role of teaching is tantamount to undermining it. This is problematic for providers of planned CPD who need to be teachers, instructors, facilitators, or co-coordinators of provision and are also accountable to stakeholders, in this case the Ministry of Education in Saudi Arabia, for effective teacher learning. Therefore, a further research is needed into the role, views and practice of the parties involved on the planning for the CPD and their epistemological and pedagogical views of mathematics and mathematics education.

CPD is frequently about stimulating change from old and familiar ways of working to new and unfamiliar practices. Given this, it is neither practical nor reasonable to expect teachers to 'discover' new materials and novel ways of working for themselves. Intervention in some form or another is necessary and this usually means teaching. Just like the students for which they are responsible, teachers need to be 'enabled' to 'master' the new. The argument in this paper, stemming from the theoretical position it has taken, is that teacher learning is best 'enabled' through long term, practice-focused, community of practice-based CPD programs "in which reflective practice, networking, and focusing on developing a deeper mathematical and mathematical pedagogic knowledge [are] central" (Gravin, 2004, p 186). This approach to CPD should encompass all activity in which a teacher feels they have learnt irrespective of whether it took place as part of their daily work or at a provided CPD event.

We concur with Webster-Wright (2009) that there is a need to move beyond questions of how best to provide CPD programs to addressing questions that are more fundamental about how adults continue to learn throughout their professional lives. This shifts the research focus away from the provision of particular activities onto learning. It may be that as Webster-Wright argued there is a need to change the discourse from professional development to professional learning as "Development of professionals implies a deficiency discourse, where professionals are incapable ingénues needing authoritative shepherding …this discourse is not congruent with a notion of professionals as engaged, agentic individuals, capable of self-directed learning" (p 724). This approach to CPD needs to be empirically investigated in a subsequent study. In the meantime there are some excellent examples in the work of Farmer, *et al.* (2003), Graven (2004), and Sztajn, *et al.* (2007).

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