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Pre Service Teachers' Development of Pedagogic Content Knowledge: A Multifaceted Case Study

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ABSTRACT

One important aspect of research with regards to teacher's knowledge is explaining in detail how student teachers develop their pedagogic content knowledge. Pedagogic content knowledge is multidimensional, such research needs to be able to represent a rich picture of how pre-service teachers develop this knowledge during a teacher education programme. Therefore, research into teachers' pedagogic content knowledge requires not only multiple instruments for its exploration but also multi-method triangulation of data analysis. In this way not only are perspectives of pedagogic content knowledge explored but the practicality of focusing on and studying pedagogic content knowledge can also be estimated by corroborating the data to represent a rich picture of pedagogic content knowledge. Thus, this paper illustrates the so-called multifaceted case study that was conducted at a university Department of Educational Studies in England. Quantitative and qualitative data that resulted from the study were analysed and interpreted to measure whether the instruments and research design are adequate for constructing the judgment of the nature of pedagogic content knowledge among student teachers.

Keywords: Student teachers, pedagogic content knowledge, multifaceted case study

INTRODUCTION

Students entering teacher education programmes come from diverse backgrounds in term of their educational experience, field of qualifications, specific knowledge, cultural background, interests, maturity, and their intelligences (Abd Rahman, 2002a). They learn in various ways and at different rates (Wisdom & Gibbs, 1994) with different needs (Stroot *et al.*, 1998). In other words, they have different learning styles and learning strategies (Abd Rahman, 2002b).

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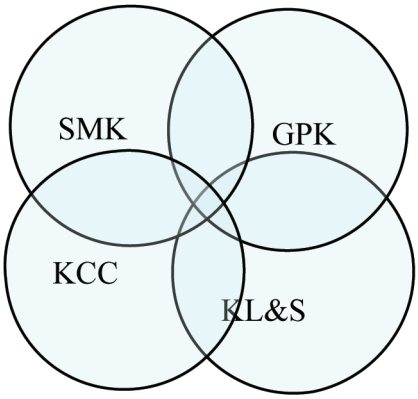
In this situation, how could a teacher educator provide pre-service teachers (PSTs) with a programme or course content without understanding what their needs are and how they learn well (Darling-Hammond & Baratz-Snowden, 2005; Darling-Hammond, Bransford & LePage, 2006).

In line with the above demand, Pedagogic Content Knowledge (PCK) is increasingly recognized as an essential component in understanding 'quality teaching' and in assessing the teaching of pre-qualified teachers. In order to teach a subject, one needs breadth and depth of PCK (Abd Rahman & Scaife, 2005), that is, a rich knowledge base with many interconnections which constitute a much more thorough understanding than is achieved purely from being a learner of the subject (Shulman, 1986a, 1987). Although PCK has come to be seen as important, details of its development, depth and quality among PSTs have remained something of mystery, as has the capability of PSTs to employ and adapt PCK in their actual teaching (Abd Rahman & Scaife, 2008). Thus, it is a challenge for researchers or teacher educators, or even STs themselves, to make explicit their espoused theories and theories-in-use and discover the inconsistencies between the two in order to increase their knowledge of teaching and of themselves as teacher inquirers.

PEDAGOGIC CONTENT KNOWLEDGE

PCK was originally conceptualised by Shulman in 1986 and developed with colleagues in the Knowledge Growth in Teaching Project (Shulman, 1986a, 1986b, 1987, 2002; Shulman & Grossman, 1988; Gudmundsdottir, 1990, 1995; Bromme, R., 1995; Halim, 1997; Halim & Meerah 2002; Veal & MaKinster, 1999; Li Xuhui,



Keys:
SMK: Subject Matter Knowledge
GPK: General Pedagogical Knowledge
KL&S: Knowledge of Learners and Self
KCC: Knowledge of Curriculum and Context

Fig.1: Concept of Pedagogic Content Knowledge (Abd Rahman & Scaife, 2005)

2001). PCK has been described as a component of the important 'know how' that PSTs should develop during their teacher education programme. It concerns what teachers should know about their subject matter and, crucially, how to transform that knowledge into classroom learning events (Carter & Gonzales, 1993). PCK can also be conceptualised as a teacher's interpretations and alterations of subject matter knowledge for the purpose of facilitating student learning (Abd Rahman & Scaife, 2005). Each is liable to influence the others and thus the whole. A static representation of this dynamic system is shown in Fig.1.

Subject Matter Knowledge (SMK) refers to academic related knowledge, which includes information and the structures, rules, and conventions for organizing and using information. General Pedagogical Knowledge (GPK) is a combination of content and pedagogy, where information helps learners to an understanding, and it includes any way of representing a subject that makes it comprehensible to others. In relation to PCK research, the multifaceted approach can be considered appropriate because of the inherent complexity of PCK. In keeping with this approach, the study is based on case study research design, with multiple methods of data gathering, such as questionnaires, non-participant observation and semi-structured interviews. Quantitative and qualitative data are triangulated in order to describe and interpret the research findings.

THE THEORY OF ACTION

The constructivist perspective on 'learners are active participants in which they construct new knowledge and understanding based on what they already know and believe' (Argyris & Schön, 1974, 1978; Argyris *et al.,* 1985) provides an idea of the Theories of Action (ToA). According to Kane *et al.* (2002, p. 182), ToA are based on a view of humans as agents acting purposely on their environment and learning from their action, as well as using this learning to plan further actions. Argyris and Schön (1974) then distinguished the ToA with two types of theory of action, namely, *espoused theories of action* and *theories in use*. Meanwhile, the *espoused theories of action* is the world view and values people believe their behaviour is based on, and the *theories in use* is the world view and values implied by their behaviour, or the maps they use to take action (Anderson, 1997).

Argyris and Schön (1974) explain that integrating action with thought is a difficult task. As cited in Anderson (1997, p. 1), Argyris and Schön assert that people hold maps in their heads about how to plan, implement and review their actions. When someone is asked how he or she would behave under certain circumstances, the answer he or she would usually give is his or her espoused theory of action for that particular situation. This is the theory of action to which he or she gives allegiance, and which, upon request, he or she communicates to others. However, the theory that actually governs their actions is his or her theory–in-use, which may or may

not be compatible with his or her espoused theory; furthermore, the individual may or may not be aware of the incompatibility of the two theories (Argyris & Schön, 1974). They further emphasise the discrepancy between what people say they believe (their 'espoused' theories) and the ways in which they act (their theories in action).

Thompson (1992, p. 134, as quoted in Kane *et al*., 2002) signalled the need to examine theories-in-use as well as espoused theories:

> *Any serious attempt to characterise a teacher's conception of the discipline he or she teaches should not be limited to an analysis of the teacher's professed view. It should also include an examination of the instruction setting, the practices characteristic of that teacher, and the relationship between the teacher's professed views and actual practice.*

Furthermore, according to Kane *et al.* (2002), multiple methods can be used by researchers to gain access to both the espoused theories of action and the theories in use of teachers. For example, researchers studying the beliefs and conceptions or the espoused theories of action of teachers have adopted methods such as concept maps, interviews, metaphors, autobiography, narrative, and live history. In addition, direct observation, stimulated recall interviews, document analysis, and journal keeping have also been used to assess the thinking in action or the theories in use of a teacher. Thus, it is a challenge for researchers or teacher educators, or even PSTs themselves, to make explicit their espoused theories and theories-in-use and discover the inconsistencies between the two in order to increase their knowledge of teaching and of themselves as teacher inquirers.

On the other hand, a number of studies have suggested that (e.g., Putnam & Borko, 1996; Schifter & Fosnot, 1993), in general, teachers with greater subject knowledge tend to emphasise the conceptual, problem solving, and inquiry aspects of their subjects. Less knowledgeable teachers tend to emphasise facts, rules and procedures and stick closely to detailed lesson plans or the text, sometimes missing opportunities to focus on important ideas or connections among ideas. Wilson (1989, as cited in Putnam & Borko, 1996), found that PSTs with deeper knowledge of their subject placed more emphasis on conceptual explanations and more often drew connections among topics within the curriculum than did their colleagues with less deep knowledge. Grossman *et al.* (1989), in the Knowledge Growth in a Profession Project, noted that PSTs sometimes try to avoid teaching topics that they do not know well. When they cannot avoid teaching the unfamiliar topic, they may rely heavily on the textbook and stick closely to a detailed lesson plan.

RESEARCH METHOD

As an effort to contribute to the knowledge about facilitating student teachers to construct PCK during their teacher education programme, the overall purpose of this research was to construct an in-depth and coherent understanding of the development of PCK among PSTs towards the end of their teacher education programme from various perspectives. In order to achieve this objective, a variety of methods were used, including a survey questionnaire, structured observation, and semi-structured interviews (see Fig.2).

In this research, the questionnaire was administered at the very beginning of study. The questionnaire, besides gathering PSTs' backgrounds, was also aimed at eliciting the nature of PSTs' PCK through their own self-ratings. Based on the feedback from the questionnaire, three respondents were invited and agreed to participate in a further study through observation and interview. Non-participant observations were carried out during the PSTs' school placements. Observation data were recorded using a teaching checklist/chart which emphasised PCK. Interviews were carried out after the observations. During the interview sessions, PSTs were asked to reflect on their preparation and teaching practices (Fig.2). The multiple data sources analysed for this study would contribute to the trustworthiness of the emerging findings. After examining the data from the three sources individually, all the data were triangulated in order to obtain a synthesised description of PSTs' PCK from the various perspectives.

FINDINGS

The paper presents illustrative findings from the study of the nature of PSTs' PCK. The

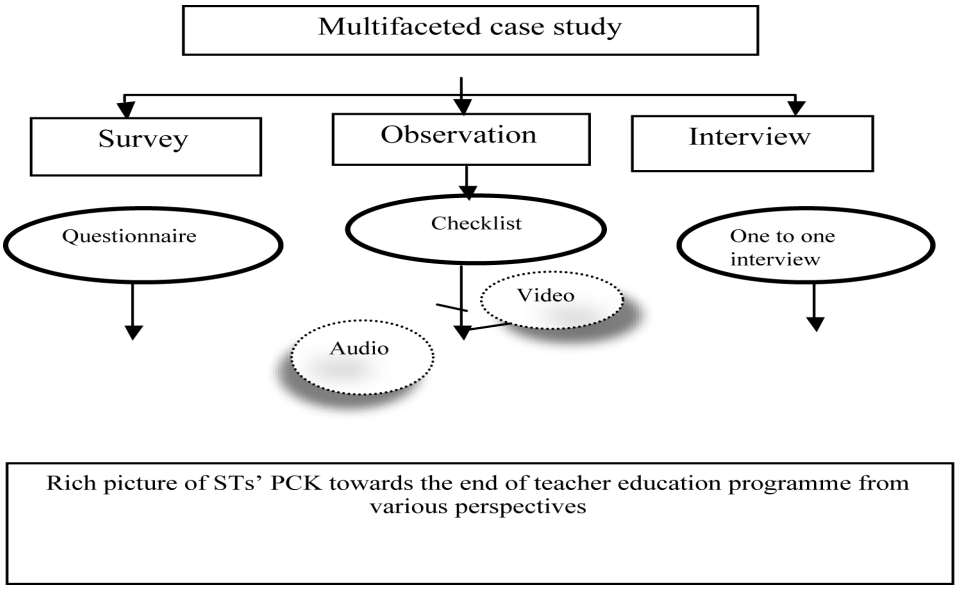


Fig.2: Multifaceted Approach in Examining PSTs' PCK

analysis was shaped by the combination of PSTs' questionnaire-based self-ratings regarding their application of PCK, observation of the PSTs' application of PCK and PSTs' reflections regarding their PCK practice during semi-structured interview. The discussion was particularly focused on the questions: *in which components of PCK do PSTs have strengths and in which components is there scope for development?*

Participants

The participants in this study were 20 pre-service teachers (PSTs) who were in their final semester of a one-year postgraduate programme and at the time of the study, were in school experience (practicum) placements.

The demographic characteristics of the STs considered for this study included gender, programme, qualification, and teaching experiences. Postgraduate Certificate in Education (PGCE) at the School of Education (SOE) is a one-year course designed to prepare PSTs to teach students in the 11-18 age range in the school. The major aim of the tutors and teachers in partnership schools who contribute to the course is to help PSTs acquire understanding and competence in the strategies of teaching, learning, assessment and classroom management. As shown in Table 1, the majority of the participants were female. Ten of the participants were from the Science Initial Teacher Education (PGCE) programme, followed by Maths, English, Modern Language, and Geography. Fifteen entered the PGCE programme with a qualification related to their PGCE and five STs had somewhat related qualifications; for example, if the PSTs' qualification was in Economics and he or she entered the Mathematics programme, or if the qualification was Zoology and he or she entered Science programme. The 'somewhat related qualification' was identified according to whether the content of the programme matches the teaching subject or it was a part of that subject. Most of the PSTs were relatively new to teaching. Ten of them had 11-20 weeks of teaching experience, five STs had 1-10 weeks teaching experience, four had 21-30 weeks of teaching experience and only one PST had more than 30 weeks of teaching experience. In general, it could be stated that the participants were mostly female, who entered the PGCE programme with an appropriate degree but with quite limited teaching experiences.

Self-Rating of Pedagogic Content Knowledge

In order to get an overall picture of the PSTs' self-rating of their performance of PCK, the mean scores for each sub-component were calculated. These are shown by the length of the bars in the bar chart below (Fig.3).

The bars are labelled with abbreviations of the dimensions to which they refer. The overall mean score in the judgement ratings for the complete sets is 2.4, as illustrated by the horizontal line in Fig.3.

A number of instructive results seemed to have emerged from this questionnaire. However, as Argyris and Schön (1974)

stated that '*we cannot learn what someone's theory in use is simply by asking him'*. Thus, to determine the PSTs' PCK in greater depth, further observation was made of the three STs. These data are illustrated and discussed below.

Practices of Pedagogic Content Knowledge

In order to explore this, and thus to draw inferences about PCK, observations were carried out during PSTs' school experience (teaching practice). Data from the observations were recorded using a teaching checklist adapted from Tilstone's ABC of Behaviour Chart which emphasises PCK (Tilstone, 1998). A tape and a video recorder were used to help with the recording of the PSTs' behaviour during the classroom teaching. To record the categories of observation, data were grouped into the four components of PCK. They were Subject Matter Knowledge (SMK), General Pedagogical Knowledge (GPK), Knowledge of Curriculum and of Context (KCC) and Knowledge of Learners and of Self (KLS). Each component contains further sub-components that have emerged from the observation. The observations were recorded using the following codes: - *cannot be detected*, /: *little utilised*, //: *average utilised*, and ///: *highly utilised*. Tables 7 to 10 illustrate the nature of the PSTs' practices of PCK.

As shown in Table 1, there are three dimensions of SMK recorded from the observation: *specific topics mentioned* (labelled as SMK1), *key points of topics briefly explained* (SMK2) and *further explanation of the topics* (SMK3).

TABLE 1
Observation Summary of the STs' SMK Practices

SMK / Participants	SMK1 Specific topics	SMK2 Key points	SMK3 Explanation
Martin	/	/	/
Mick	//	/	-
June	-	/	/

Key: ///: considerable application inferred; //: moderate; /: low; - : could not be detected

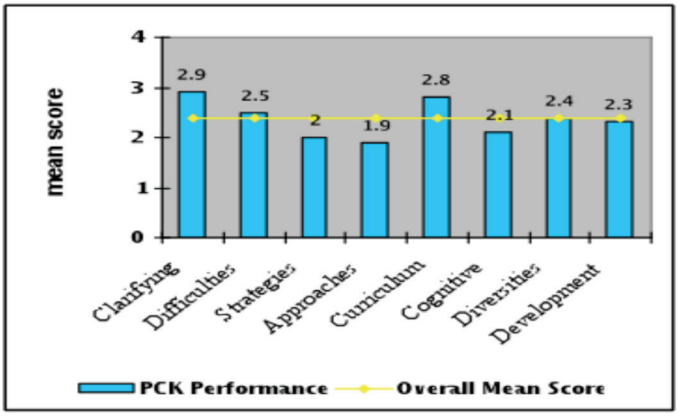


Fig.3: PSTs' Self-Rating of Pedagogic Content Knowledge

There were slight differences between each respondent. For example, Martin simply mentioned the topic of subject, slightly mentioned the key points regarding the topic and explained a bit further regarding the topic. Meanwhile, Mick mentioned the topic quite clearly, managed to explain a few points regarding topic but did not explain details regarding the topic. June did not mention the topic of the subject but slightly mentioned a few points of the topic and was able to explain a bit further.

General Pedagogical Knowledge (GPK) is a combination of content and pedagogy, where information that helps learners to an understanding, including any way of representing a subject that makes it comprehensible to others. Six dimensions of GPK were recorded, namely, GPK1: *class management*, GPK2: *teaching strategy*, GPK3: *teaching approach*, GPK4: *teaching technique*, GPK5: *student-teacher interaction*, GPK6: *pupils' motivation*. According to Putnam and Borko (1996), the domain of GPK encompasses a teachers' knowledge and beliefs about teaching, learning, and learners that transcend particular subject matter domains. It includes knowledge of various strategies and arrangements for effective classroom management, instructional strategies for conducting lessons and creating a good learning environment, as well as fundamental knowledge and beliefs about the learners, including how they learn, and how that learning can be fostered by teaching. Putnam and Borko (1996) argue that having a flexible, thoughtful and conceptual understanding of subject matter is critical for effective teaching. In this manner, they claim that teachers need to know more than just the facts, terms and concepts of a subject matter. The knowledge of organizing ideas, connection among ideas, ways of thinking and arguing, and knowledge growth within a discipline is an important factor in how a teacher will teach the subject.

As shown in Table 2, Martin's teaching is strong in the dimension of class management and student-teacher interaction, average in teaching strategies, approach, and technique and pupils motivations.

Meanwhile, Mick's teaching seemed to be strong in terms of class management, average in terms of teaching strategy, but quite low in teaching technique and not clearly utilised in term of teacher-student interaction and pupils' motivation. June's teaching seemed to be average in class management and teaching approaches, and fairly low in teaching strategy, teaching technique, teacher-student interaction, and students' motivation.

In terms of KCC, there were also six dimensions revealed through the observation, as shown in Table 3 below.

In this component of dimensions, Martin's teaching apparently has its strength in KCC1 and KCC2, average in terms of KCC4, while not clearly utilised in terms of KCC6. Mick's teaching is obviously strong in KCC1 and average in KCC5. However, KCC2, KCC3, KCC4, and KCC6 were found to be not clearly utilised during his/her teaching. June's teaching revealed

TABLE 2
Observation Summary of the PSTs' GPK Practices

GPK / Participants	GPK1 Class management	GPK2 Strategy	GPK3 Approach	GPK4 Technique	GPK5 Interaction	GPK6 Motivation
Martin	///	//	//	//	///	//
Mick	///	//	/	/	-	-
June	//	/	//	/	/	/

Key: ///: considerable application inferred; //: moderate; /: low; - : could not be detected

TABLE 3
Observation Summary of the PSTs' KCC Practices

PCK / Participants	KCC1 Syllabus	KCC2 Context	KCC3 Objective	KCC4 Cognitive skills	KCC5 Teaching materials	KCC6 Assessment
Martin	///	///	//	/	/	-
Mick	///	-	-	-	//	-
June	///	-	//	//	/	-

Key: ///: considerable application inferred; //: moderate; /: low; - : could not be detected

slightly different practices of PCK, although June's teaching was also found its strength in KCC1; she was also average in KCC3 and KCC4, but not clearly utilised in KCC2 and KCC6. It happened that KCC6 could not be detected in the observations of any of the three participants whose data are shown in Table 3. Three dimensions of KLS were recorded, namely KLS1: *Learners' background*, KLS2: *Learners' interests* and KLS3: *Learners' Capabilities*.

As shown in Table 4, Martin's teaching was average in utilising KLS2 but slightly low in terms of KLS1 and KLS3. On the contrary, Mick's teaching seemed to be slightly low in terms of KLS2 and KLS3; nevertheless, she/he apparently did not deal with pupils' background. June's teaching seemed to be very good in KLS1, average in KLS3; however, she/he was unable to deal with KLS2.

In summary, the PSTs demonstrated substantial application in GPK1 (class management) and in KCC1 (the syllabuses used). The results indicate that the PSTs had no difficulty in applying GPK1 and KCC1 during their teaching. They showed little engagement with SMK2 (describing topics they were teaching) and SMK3, i.e. explaining further the topics they were teaching, though they may not necessarily lacked that knowledge. It also seemed that they did not demonstrate KCC6, which is knowledge about the use of assessment during their teaching. This uncertainty may not mean that they lack the knowledge of this element.

TABLE 4
Observation Summary of the PSTs' KLS Practices

PCK / Participants	KLS1 Learners' backgrounds	KLS2 Learners' interests	KLS3 Learners' capabilities
Martin	/	//	/
Mick	-	/	/
June	///	-	//

Key: ///: considerable application inferred; //: moderate; /: low; - : could not be detected

Reflection on the Application of Pedagogic Content Knowledge

In order to gather information regarding how PSTs reflect on their practices (theories in use), semi structured interviews were carried out after the observation sessions. The interview focused on the preparations of lessons, expectations of learning outcome, satisfaction in teaching, and the room for improvement.

In this session, the PSTs were invited to reflect on their teaching, both in the observed lessons and more generally. The interviews were recorded and data were then transcribed. The researcher has used a checklist *matrix* (Miles & Huberman, 1994) to help with the coding and themes in the rewording process. The analyses were then related to the components of the PCK that PSTs emphasised on during their reflections on their teaching. A summary of the PSTs' reflection in relation to a few focus aspects of the interview is given in Table 5.

For the aspect of *the preparation of lessons* depicted in Table 5, KCC was the most significant component to be referred to by the PSTs. However, GPK and SMK were seen as secondary considerations. Interestingly, none of the STs referred to KLS is connected to preparing the lesson. It seemed that learners' backgrounds were not taken into consideration when the PSTs were preparing their lessons.

Referring to the *expectation of learning outcome,* all the PSTs were shown to stress on the component of SMK. This indicated that the PSTs felt that the content of subject is the most important element to be learned by their students. In addition, there was reference to KLS by all the three PSTs who seemed to be fully aware that learning outcomes are very much dependent on students' individual capability. The significant issue here is that, although in the *preparation of lessons*, the sub-components of KLS were not taken into consideration, the PSTs anticipate that different students will achieve different levels in terms of the *expectation of the learning outcome*. They were apparently aware of their students' diversity when reflecting on the *expectation of learning outcome*.

There was also diversity in the responses to the aspects of *satisfaction in teaching* and *room for improvement* reflected by the STs. This result indicates that PSTs have their own strengths and limitations.

TABLE 5
A summary of the PSTs' Reflections on the Application of PCK

Participants / Focus aspects	Martin	Mick	June
the preparation of lesson	SMK-KCC-GPK	KCC-GPK-KCC	KCC-GPK-SMK
expectation of learning outcome	SMK-KLS-KLS	SMK-KCC-KLS	SMK-SMK-SMK
satisfaction in teaching	KCC	GPK	KLS
room for improvement	GPK	GPK and KLS	KCC

Perspective, Practice and Reflection on Pedagogic Content Knowledge

One of the purposes in this study was to carry out research from various perspectives into student teachers' knowledge of various aspects in teaching. This sub-section considers the question, 'to what extend are the PSTs' self-rated PCK (espoused theories of action) consistent with their practices of PCK (theories in use)? To help with the illustration in this sub-component, researcher triangulated the findings from the PSTs' perspectives, practices, and reflections on the PCK. The data used in this sub-section came from the analysis of self-rating performance of the PCK, as well as the observation and interview of three PSTs, namely Martin, Mick and June.

The Subject Matter Knowledge

With all the respondents clearly understanding the terms that have been used, the components of SMK, particularly in terms of *clarifying topic* and *dealing with learning difficulties* were adequately developed by PSTs. Being strongly confident in presenting ideas clearly, the PSTs seemed to be reluctant to *spend time after class* and *repeat part of the lesson.* This finding revealed that most of PSTs believe 'quality time' during teaching, that is, the ability to *present ideas clearly* is better than 'quantity time' such as '*spend time after class'* or '*repeat part of the lesson'*. It also seemed that PSTs had difficulties *using appropriate analogies* during teaching. This suggests that this is an issue for attention in further observation and interview.

During observation, PSTs showed little active engagement in SMK2 (describing topics they were teaching) and SMK3 (explain further the topics they were teaching). It is unclear why PSTs did not perform in this dimension.

During the interview, while asking about room for improvement, none of PSTs stressed on any dimension of SMK. Most of them agreed that they have adequate command in SMK, although a component on the teacher education programme may still be needed to refresh their SMK:

> *Martin : Since I was at school and I've got a vague recollection of most things, but sometimes finding it out, getting it out of my head is difficult so with Y7, stuff like this, generally*

it's not too complicated and I'm quite happy with the subject content

Mick: For my degree I did English Language and Literature. So in some respects I'm better placed than people who did straight Literature or straight Language because obviously, I've got both sides of it. We've done all the stuff at university on it but because of the schools I've been in, it's just not been an issue.

June: My content knowledge is OK. I have a fair idea of the skills of English, how you analyze literature, how you look at language, how you communicate, how you express yourself in writing and in speech.

This suggests that though the PSTs have had adequate subject content knowledge, they may not have necessarily transformed it effectively into their classroom teaching.

From the PSTs' view, a teacher education programme should act as a 'revision' or 'refreshment' centre:

Mick: Obviously we have a lot of time at university in lectures, tutorials, which has been sort of revising stuff we did on degree but stuff that we've probably forgotten. So that's been quite useful, going back over stuff.

June: I did an English degree but I don't think that's prepared me… there are lots and lots of other things that I need to know because you can be teaching books and literature that you've never read before, often that happens.

The General Pedagogic Knowledge

The application of GPK in terms of teaching strategies indicated that the PSTs seemed to be more comfortable with direct teaching strategies as compared to indirect teaching strategies. Although a constructivist perspective suggests experiential learning strategies as one of the more effective learning strategies, it seems it was difficult for PSTs to apply this particular teaching strategy. This phenomenon can be seen in the actual teaching as Martin's teaching used whole class demonstration and individual tasks, Mick's teaching tended to use whole class work and group discussion, and June also used whole class discussion and individual task strategies. In the context of teaching approaches, Martin, Mick and June seemed comfortable to apply text book approaches and brainstorming.

Interestingly, the PSTs demonstrated substantial application in GPK1 (class management). While talking about GPK, PSTs mentioned having difficulty in GPK1 at the beginning of teaching practice although there was some improvement after a few weeks of teaching practice. Most of them worried about class management factors such as time management or class discipline more than the content that they

were to teach:

> *Martin: I think when I first started, obviously the most important thing to get straight away is classroom management, and in the first few weeks I found that that was taking up most of my time in teaching, the actual learning was becoming secondary.*

> *Mick: What I've been looking at in the last few weeks is the transition time in the lesson, from ending one activity and starting another, because throughout the course of the lesson I might lose five minutes by letting things run over and what I really want to do is try to tighten that up so I can keep to my time plan a little bit better.*

> *June: Classroom management which probably most teachers would say is something they want to work on because pupils can be quite difficult to manage sometimes. I've got an Y10 class and they have been a challenge because they don't always want to be there.*

In this respect, it could be seen that when PSTs were concerned about a particular PCK dimension, they would pay more attention. These circumstances will lead to the improvement of those practices throughout their teaching.

Knowledge of Curriculum and Context

In the KCC, dimensions of *promoting thinking skills* and *curriculum implementation* were considered. In terms of *promoting thinking skills,* the overall results were not encouraging. STs agreed that they had applied several thinking skills particularly in *promoting critical* and *deductive thinking skills* but seemed not to have addressed the *meta-cognitive skills*. This phenomenon could be seen during observation, whereby most of the PSTs rarely addressed this particular issue in their teaching. During the interview, one of the PST mentioned the following:

> *Mick***:** *I think with the higher attaining set you are more likely to just give them a problem or give them ... You've got to challenge pupils no matter; you've got to stretch them. But not stretch them too far so that they get into panic mode about 'We don't know what to do'.*

Findings from the observations also show that only one PST had attempted to apply creative thinking skills in teaching and this was confirmed during the interview:

> *June: We'd move on to discuss how fairy stories could be changed for a particular purpose and then by the end I wanted the pupils to have written their own fairy stories with changes, in draft and then a best copy and that was the aim of the whole scheme of work*

However, the PSTs demonstrated a good application of KCC1 (i.e. the syllabus they used). This was confirmed during the interview, whereby most PSTs referred to the KCC1 while preparing for their lessons.

The Knowledge of Learners and of Self

In the component of the KLS, the PSTs agreed that they have good knowledge. In this area, all the mean scores were above the overall mean score, especially in the aspect of *teaching goals address diversity*. It seemed that all the respondents clearly understood the terms used in this component. This phenomenon was also highlighted in the PSTs' lesson plans which had been gathered during the observation. All the PSTs wrote teaching goals which addressed different abilities of their students.

In terms of students' assessment, although the PSTs' mean score was 2.5 and rated as above the average mean score (M=2.4), it seemed that they did not demonstrate KCC6 (knowledge about the use of assessment) in their teaching. In addition, none of the PSTs mentioned the use of assessment with regard to reflection on '*room for improvement'* during the interview.

As for the aspect of professional development, PSTs admitted that they improved their professionalism through reading various sources, as it is rather rare to get the opportunity to attend any conferences or courses. However, it was really helpful when one of the PSTs got an opportunity to attend a course:

> *Mick: I was here, to be sent on a course, which is unusual for students because normally they save it up for teachers, but about six to eight weeks ago I got sent on a course at a local primary school, which was called Brain Gym and it looked at how links between one side of the brain and the other are created in younger pupils and how this relates to poor literacy skills and poor skills in behavior when they get older and that was really useful because we were told about the best ways of developing them.*

DISCUSSIONS

The literature has acknowledged that learning is viewed as a life-long process (Alkove & McCarty, 1992; Jonassen, 1996; Zemelman *et al.*, 1993). In this context, learners such as the PSTs who had taken part in the present study were encouraged to continue learning through observations, literature review, and reflections on their own practices. As noted by Alkove and McCarty (1992), reflection is particularly important because it plays an important role in a teacher's search for congruency between her or his beliefs and practice. This section of the analysis focuses on the consistency between the perspectives, practices, and reflections of the PSTs based on the Theories of Action (Argyris & Schön, 1974, 1978; Argyris *et al.,* 1985).

To show the consistency between the three areas of perspectives, practices, and reflections, the information was summarized

and grouped into the following categories: general pedagogic knowledge, curriculum/ context knowledge, subject matter knowledge, and knowledge of learners and of self. Perspectives, practices, and reflections were thus brought together under the same theme to identify their differences and similarities.

In relation to the perceptions of performance of the general pedagogic knowledge, the PSTs believe that they are relatively confident in clarifying their current subject knowledge, except for the use of demonstrations and appropriate analogies. In fact, these PSTs felt that they were more confident in their ability to clarify topics through their use of language to explain ideas, than their ability to use illustrations, apply meaningful activity, demonstrate or use appropriate analogies. This was also shown in their practices. In their reflections on their teaching satisfaction and the room for improvement regarding GPK, a diversity of responses were obtained; however, so no definition conclusion could be reached in relation to reflections. A number of studies have suggested that in general, teachers with greater subject knowledge tend to emphasise on the conceptual, problem solving, and inquiry aspects of their subjects (e.g., Putnam & Borko, 1996; Schifter & Fosnot, 1993). Less knowledgeable teachers tend to emphasise on facts, as well as rules and procedures, and stick closely to detailed lesson plans or the text, and sometimes missing opportunities to focus on important ideas or connections among the ideas.

As for the knowledge of curriculum and context, the PSTs believed they were able to integrate standard curriculum, but felt less assured about promoting cognitive skills. The PSTs were also comfortable with direct teaching strategies, such as whole class work and group work strategies and were able to deal with students' learning difficulties, as evidenced in their practices. Nonetheless, they were not really sure about indirect teaching strategies, self-directed learning, computer based learning and field learning strategies. This was also clearly shown in their practices.

The PSTs believe that they have quite strong curriculum and context knowledge, specifically in terms of the sources related to the syllabus and goals encompass curriculum. On the contrary, they were not sure about the assessments based on the national standards and multiple context of the subject matter. The practices show that they have used critical and creative thinking skills as well as deductive thinking in their lessons. However, it does not seem promising for them to apply higher order thinking skills and meta-cognitive skills. Once again, reflections were unable to reach definitive conclusions due to the diversity of the responses obtained.

In addition, the PSTs also believe that their performance was quite high in clarifying topics and integrating standard curriculum with respect to curriculum/ context knowledge. The performance in the areas of application of teaching strategies, teaching approaches, and promoting cognitive skills was perceived to be low and their practices further confirmed this

view. In particular, the PSTs were relatively confident with their knowledge of the subject matter and curriculum, as well as context knowledge in terms of integrating standard curriculum but they had difficulties in general pedagogic knowledge, particularly in promoting cognitive skills. Reflections showed that the reasons for this could be the case. Preparation of lessons within the area of curriculum/context knowledge was the most significant component, while learners' backgrounds were not taken into consideration when the PSTs were preparing their lessons. The reflections also indicated that none had shown knowledge about the use of assessment during their teaching. Most were strong in terms of syllabus and context, but not in the cognitive skills and assessment.

As for their perceptions and practices of subject matter knowledge, the results were rather mixed. With regard to practices, there were little differences between the respondents as they simply mentioned the topic of the subject, touched on a key point regarding that particular topic and explained a bit further. Perceptions showed the PSTs thought they had knowledge about the subject, but could not look into the subject in-depth.

The reflections on the subject matter knowledge in terms of the expectations of learning outcomes also showed that the PSTs stressed on the component of subject matter knowledge. The PSTs felt that the content of the subject was the most important element to be learned by their students. However, the PSTs did seem to be fully aware that the learning outcomes are very much dependent on the individual student's capability. The reflections also showed that the PSTs were aware that they had evidenced little engagement with describing topics that they were teaching and further explaining the topics they were teaching.

As for the knowledge of learners and self, the findings were consistent across the perceptions, practices, and reflections. In more specific, the PSTs' perceptions showed that they were confident in their class management ability and student-teach interaction, but rather average in their teaching strategies, approaches, and techniques. The PSTs also perceived themselves as having low skills in the area of pupil motivations. The practices confirmed these views, especially in relation to pupils' motivations. The reflects were also found to be consistent with the perceptions and practices.

CONCLUSION

What have researchers found by triangulating the three categories of data? This illustrative study has led to the following observations about the findings and also the research approaches used. The overall nature of PCK was fairly good (based on the self-rating score); however, some elements such as promoting thinking skills and application of indirect teaching strategies and experiential learning need to be highlighted. Table 6 shows a summary of the findings derived from the questionnaire, observations and semi-structured interviews. The PSTs are sometimes aware of their capabilities/

limitations but most of them need further facilitation to help them to recognise the specific aspects of their potential and limitations.

The overall quality of PCK was fairly good; however, some elements such as promoting thinking skills, application of indirect teaching strategies and experiential learning, need to be highlighted. PSTs are sometimes aware of their potential or limitations, but in general, it seems that they need further facilitation to recognise their potential or limitations. Through the employment of a multifaceted approach, it may be possible to come to a rich picture of the PSTs' knowledge and learning needs.

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TABLE 6
Triangulated Data on the Nature of the PSTs' PCK

Questionnaire	Observation	Interview
PSTs self- rating:	*PSTs demonstrated :*	*PSTs understand:*
-good in SMK especially in clarifying topic	- little explanatory knowledge in SMK regarding topic	-KCC and SMK become a focal point in preparation of lesson
-moderate in KCC and having some difficulty in promoting thinking skill especially meta-cognitive skill	- substantial application in GPK regarding class management	- SMK should have been emphasized as a crucial learning outcome
- moderate in GPK, good in class management however prefer to apply direct teaching strategies rather than in-direct teaching strategies	- good in KCC which is application of the syllabuses	- have a strength at different elements of PCK
- good in KLS especially teaching goal address diversity	- having difficulty in applying appropriate assessment or task	- diversity in learning needs (improvement in teaching)

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