UNIVERSITY STUDENTS’ PEDAGOGICAL KNOWLEDGE ABOUT LECTURERS’ USE OF QUESTIONS.

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RUNNING HEAD: Students’ pedagogical knowledge.

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Introduction

Students' construction of new knowledge is heavily dependent on their prior knowledge. In learning from teaching, the prior knowledge students need is not only knowledge of a subject or task domain but also knowledge about teaching and learning. This latter knowledge plays the role of mediator between the actions of teachers and students and can influence the effectiveness of teaching (Wittrock, 1986). However, as teachers and researchers we often focus only on students’ prior knowledge of a subject or task domain and neglect students’ knowledge about teaching and learning.

Teaching and learning is an interactive process where teachers’ intentions, plans and actions are mediated by students’ intentions, plans and actions. The knowledge underlying both sets of intentions, plans and actions will impact on the effectiveness of the interaction. Shulman (1986, 1987) outlined categories of knowledge that could be called upon by teachers. We propose that to be effective in study situations students also need access to pedagogical knowledge, to categories of knowledge that parallel those outlined by Shulman.

In this study we have focused on students’ knowledge of one of the most common teaching actions, the use of questions by a lecturer. Because the use of questions is so widespread in teaching, and because questions can have a range of different purposes, students should have a well-developed understanding in this area. We are interested in how students understand the functions of different types of teacher questions in the classroom teaching.

Students’ perceptions of learning and teaching

Students’ knowledge about learning and teaching and that ways that this knowledge mediates the effects of teaching has been investigated using a range of perspectives across the last 30 years. In terms of students’ broad approaches to learning their perceptions of the teaching context directly affect their motives and strategies for learning (e.g., Biggs, 1993; Entwistle, Meyer & Tait, 1991; Prosser & Trigwell, 1999). Student perceptions are also considered as metacognitive processes and one of the integral components of self-regulation of learning (Schunk, 1992). Effective self-regulatory activity is assumed to depend upon the student having access to well-developed knowledge of what should be regulated, how regulation can be enacted and when it appropriate to do so.
Marx, Howard and Winne (1987) examined the relations between students’ perception of teachers’ instructional cues, students’ perception of teachers’ intentions for students’ cognitive processing and their achievement. Their results suggested that accurate discrimination by the students of teacher signals for cognitive processing and the perceptions of teachers’ intention about influencing students’ cognitive processing were crucial for learning. The accuracy of such discrimination can be predicted to depend, to an important extent on the students’ knowledge about the teaching situation and of the range of purposes that teachers can have for specific teaching actions (Prosser & Trigwell, 1999; Luyten et al., 2001; Wittrock, 1986).

Studies have also been conducted into specific aspects of teaching and learning environment under the label of students’ metacognition of college studentship (Pressley et al, 1998). The results of these studies showed the range of knowledge that students have about strategies for studying and for coping with distractions and different lecturers’ and their course demands. In order to investigate students’ conceptions of the relationships between the instructional interventions and learning, Luyten et al. (2001) conducted a study in students’ perceptions about learning tasks. These researchers found that students’ task perceptions were significantly associated with their planned and executed learning activities.

Students’ perceptions of different teaching activities have also been the concern of researchers. Elen and Lowyck (1999) studied university students’ perceptions of the functionality of delivery systems and interventions. Students were able to explicate knowledge about the use of examples in teaching, focussing largely on the role of examples in clarifying theory and in relating theory to the student’s reality. Other research has shown that there are often mismatches between students’ perceptions and teachers’ perceptions of learning situations. These mismatches can be about teaching and learning environments in general, or related to particular aspects such as learning goals, the purposes of specific tasks or the nature of expected learning activities, (e.g., Tasker, 1981, 1992; Tasker & Freyberg, 1985, Killen, 1994). Winne and Marx (1982; 1983) argued that teaching actions would be effective only to the extent that the student was able to make appropriate responses to the move made by the teacher.

Students’ knowledge about teaching

Students’ knowledge about teaching has been conceptualized in different ways. Peterson (1988) reported research into “cognitional knowledge for classroom
learning” which was defined as knowledge of mental processes by which students acquire knowledge through classroom learning. Elen and Lowyck (1999) referred to this knowledge as metacognitive instructional knowledge, knowledge about how instruction can help learning and which largely determines the students’ use of the instructional moves and activities of the teacher. In the model developed by these authors it is the teacher who is seen to have the central responsibility for delivering subject-matter, establishing effective relationships with students and structuring a supportive study environment.

We have been attracted by the possibility that students’ knowledge of teaching might be conceptualised in a way that is similar to the analysis of teachers’ knowledge presented by Shulman (1986). Shulman proposed seven categories of teachers’ knowledge: content knowledge, curriculum knowledge, general pedagogical knowledge (GPK), pedagogical content knowledge (PCK), knowledge of learners, knowledge of educational contexts and knowledge of educational ends, purposes and values and their philosophical and historical grounds. Although Shulman was considering types of knowledge required by teachers, the preceding discussion of the mediating effects of student perceptions suggests that in the teaching-learning interaction students also need to have similar categories of knowledge if they are to make effective responses to the moves made by a teacher. In order to learn effectively, beside other types of knowledge, students should also have their own well developed understandings of the categories of pedagogical and other knowledge identified by Shulman. We propose that beside these categories of knowledge students’ pedagogical knowledge will involve also knowledge about how to learn.

Studies have reported on the importance of pedagogical knowledge for prospective teachers as well as its necessity for expert teaching (Jegede, Taplin & Chan, 2000; Jones & Vesilind, 1996; Turner-Bisset, 1999). Jones and Vesilind (1996) examined the way that student teachers structured a collection of concepts before and after a teaching practicum and found changes in the ways that these concepts were structured. It is not yet clear such changes occur for all categories of pedagogical knowledge across the years of teacher training and this will be one of the points of focus in the current study.

This research will focus on students’ pedagogical knowledge about teacher’s use of questions in a lecture. We have focussed on this teaching situation because it is the dominant teaching situation in most Vietnamese universities.
Asking questions is a frequently used and major method of teaching. According to Savage (1998), most teachers’ instructional time is spent asking questions. Davis (1993) outlined a range of activities that could be stimulated by questioning, ranging across exploration and analysis, focussing of attention, presentation of challenges, prompting the establishment of relationships, probing of motives, generation of conclusions or extension of argument. In the revised version of Bloom’s taxonomy of educational objectives, Anderson and Krathwohl (2001) identified six categories of a cognitive process dimension all of which could be stimulated by teacher questions: remembering, understanding, applying, analysing, evaluating and creating. Mitchell (1994) studied teachers’ implicit theories concerning questioning and found that despite the difference in teaching experience and teaching context, teachers in his study had many common stances in their theories about questioning. Teachers in this study reported a wide variety of pedagogical functions of questioning which could be organised into three groups: management functions such as focussing attention; instructional functions focussed on establishing understanding; and social/affective functions such as building confidence.

Although, as discussed above, the effect of teaching can be mediated by students’ understanding of teaching activities and although questioning is a frequently used teaching method, there has been little investigation of students understandings about teacher’s questioning in the classroom. The richness of the area of questioning and the widespread use of questions by teachers suggests that this should be an area where students might be expected to have developed quite extensive pedagogical knowledge. In this study our concern was to seek answers to the following questions:

1. What pedagogical knowledge do students possess about the functions of teacher’s questioning in the classroom?
2. Does this knowledge vary across different types of teacher questions?
3. Does students’ pedagogical knowledge of questioning vary between groups of first year and final year students?
4. What are the similarities and differences between teachers’ and learners’ pedagogical knowledge?
5. Is there significant variation in complexity of knowledge of questioning between the student groups and among the student and teacher groups?
Method

Participants
Participants for the larger project in which this study is set were five lecturers and 100 students in a teacher education program in a university in central Vietnam who volunteered to take part in the study. Fifty students were beginning the four-year teacher education program and the other 50 were beginning the fourth year of the same program. Ten students from each of the first and fourth year groups also participated in follow-up interviews. The findings reported here are based on the analysis of the questionnaire and interview responses for five first-year students, five final year students and the interview data for the five lecturers. Because the coding of data is an intensive and lengthy process five students were chosen from the 10 interviewed at each of the year levels. The students in each group were chosen so that the shortest and longest interviews were included and then three other students were chosen at random from each group.

Procedure
All participants watched a 15 minute video of a lecture in Vietnamese on the topic of attribution theory, a topic that, while new to all students, was chosen to be of relevance to their studies. At three points during the lecture the lecturer asked a target question. One question was designed to require students to recall a definition, one required them to relate concepts in the lecture and the remaining question asked them to apply lecture content to a practical teaching situation. The questions were designed to focus the recall, understanding and application levels of the revised Bloom’s taxonomy (Anderson and Krathwohl, 2001).

After each of the target questions was asked in the lecture the tape was stopped and students were given time to answer the six questions that related to that target question. After students had finished watching the lecture and had completed the questionnaire, a call was made for volunteers for a later interview. The six questions about each of the target questions were presented to students in a questionnaire and were used to structure the interviews with both students and lecturers. Those questions were:

1. Why do you think that the teacher asked this question at this point in the lecture?
2. What might be the effects on the students of asking this question?
3. What might be the effects on the teacher of asking this question?
4. What did the teacher want the students to think about when she asked this question?
5. When the teacher asked this question, what could the students do to help their learning about this topic?
6. Do you think that this was a good question to ask at this time? Explain your answer?

The purpose of the interview was to seek clarification and further exploration of the student’s responses to the questions on the questionnaire. Their responses were probed to seek explanation of any new concepts or procedures that formed part of a response. The probing was designed to get students to produce a detailed explanation of their thinking about the function of the teacher’s questions. Students could refer to the videotaped lecture if they wanted to do so. The lecturers were interviewed individually and were asked to watch the videotaped lecture and to participate in the same interview format as the students. As was the case for the students, the tape was stopped at three times when target questions were asked and the lecturers responded to the same six questions about each of the target questions. Lecturers were asked to clarify and explain their responses and probe questions were used to explore further their thinking about the function of the different target questions. All interviews were audiotaped.

Data analysis

Answers to the questionnaire and talks in the interview were transcribed for analysis. In order to explore the content of student pedagogical knowledge about teacher questioning we developed an initial framework for analysis using questionnaire responses from 10 students. The objective for this initial analysis of transcripts was to assess the suitability of the student knowledge categories that were counterparts to the teacher knowledge categories identified by Shulman (1986). We read and reread those responses and looked for units of text that focused on distinct teaching and learning themes. These segments of transcripts were translated into English. Translation done by the researcher was checked with that done by an independent native Vietnamese speaker for a sample of transcript segments.

The initial analysis showed that the Shulman categories could be used to classify text units in our transcripts if an additional code for knowledge of learning was added. GPK and knowledge of learning then were divided into four subcategories: motivational knowledge (motivational), knowledge of cognitive activity (cognitive),
knowledge of metacognitive control (metacognitive), and other. Inter-rater reliability of coding was checked using an independent coder. The agreement between the two coders was 91%, giving a Cohen’s (1960) kappa of 0.84 (p < .001)

**Concept map analysis**

In order to examine the structure of students’ pedagogical knowledge in the interviews we created concept maps from the above coding analysis. A central assumption of contemporary cognitive science is that ‘having’ knowledge implies that it is structured in some form (e.g., Rumelhart & Ortony, 1977). We make this assumption here and argue that it is important to examine the connected nature of students’ pedagogical knowledge. In doing this we have used the analysis of knowledge connectedness of Mayer (1975). In Mayer’s analysis, internal connectedness refers to the degree to which new nodes of information are connected with one another to form a single well-defined structure, while external connectedness is the degree to which a knowledge structure is connected with other related structures.

The initial organizing of the concept maps involved arrangement of response segments into the four main fields represented in the questions to which students and teachers were asked to respond: the purpose of the lecturer’s question, the effects of the lecturer’s question on students, the effects of lecturer’s question on the lecturer, and the actions students could do or were expected to do once the question had been asked. Within the concept maps text units were represented as nodes and those nodes that were related in the interview were placed in the same area of the map. If a relationship was specified between text units that relationship was represented on the map by a line and where possible, a label for that relationship was included on the map.

Knowledge connectedness in a map was represented by four measures: (c) depth, (d) branching, (e) crosslinking and (f) complexity of relationships. *Depth* here refers to the extension of connections in a concept map in vertical directions along a single path. Within-schema depth is a measure of the degree of vertical connection in a schema. We refer to this spread of connections as occurring over different vertical layers of the nodes in the concept map. Links made over more than two layers were assigned a rating of ‘level 3’ for depth; those across two layers and at a single layer being scored as ‘level 2’ and ‘level 1’ respectively on this measure.
Branching is a measure of the number of paths associated with a layer 1 node. If there was evidence of branching from a node at a single layer a rating of 'low' was assigned. Branching at two layers and at more than two vertical layers were assigned ratings of 'medium' and 'high' respectively. Crosslinking is a measure of horizontal linking between branches from a node or between nodes in different sections of the map.

All identified relationships between nodes, the links between nodes in the map, were rated for level of complexity of reasoning. The lowest level of complexity was assigned to relationships that were merely stated. Level 2 ratings were assigned to relationships that made explicit more complex relationships, such as cause-effect or conditional relationships or relationships that could be related to themes in contemporary theory of learning.

Results

In the first section of descriptive analysis the results of analysis of students responses related to the GPK and knowledge of learning categories will be reported. This is followed by analysis of quantitative comparisons among student and teacher groups. In this discussion we use the term ‘teacher’ as a synonym for ‘lecturer.’

Descriptive Analysis

As a group, students’ responses included text units that referred to each of the eight major categories in the coding scheme However, the frequency of students’ talk in relation to each category varied substantially, with three categories being mentioned by only one student. The distribution of students’ responses in the eight categories is shown in Table 1.

Table 1. Participants’ discussion of issues in each of the major code categories in questionnaire or interview responses.a

<table>
<thead>
<tr>
<th>Category</th>
<th>Year 1</th>
<th>Year 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3 4 5</td>
<td>6  7  8 9 10</td>
<td></td>
</tr>
<tr>
<td>Content</td>
<td>y</td>
<td>y</td>
<td>y</td>
</tr>
<tr>
<td>Curriculum</td>
<td>y</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Students’ pedagogical knowledge

<table>
<thead>
<tr>
<th>Category</th>
<th>Y</th>
<th>Y</th>
<th>Y</th>
<th>Y</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learner</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>3</td>
</tr>
<tr>
<td>Context</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>4</td>
</tr>
<tr>
<td>Purposes</td>
<td>Y</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>PCK</td>
<td>Y</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>GPK</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>10</td>
</tr>
<tr>
<td>Learning</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

A ‘Y’ indicates that the category was represented in the questionnaire or interview for that participant.

Four students talked about motivation and attribution theory, the two topics of content knowledge mentioned in the videotaped lecture. This talk revealed their identification of the nature of these topics:

- *Motivation comes from the meeting of objects and people’s needs. If we have motivation, our results will be better.* (S6)
- *When students succeed they rarely think about reasons. But when they fail they do and often blame the failure on external reasons.* (S4)

Students could recognize the relationship between teacher questions and the educational context. Teacher questions were seen to influence the teaching and learning environment as well helping students to perceive characteristics of their educational situations.

- *The teacher asked a question] to avoid the situation where she keeps giving the lecture, the students just listen, take notes and some of them are sleepy...and the classroom is boring.* (S10)

Regarding knowledge of learners, three students talked of some characteristics of themselves or of other students as learners.

- *Students often learn roughly...learning like “rolling a mat”. They are rarely concerned with what they understand when learning that thing because of many different subjective and objective reasons.* (??)

Only one student expressed knowledge about each of the educational ends and purposes, curriculum knowledge, or pedagogical content knowledge categories. With regard to purposes S9 noted that.

- *Students learn not really for having the grade for their certification but for knowing.*

About curriculum knowledge student 5 argued that:

- *We have to think broader... because there are many small ideas in a learning subject. Attribution theory is only a lesson but not a [whole] subject. Students...*
will have an overview of the content in a lesson which relates to each idea in the subject.

The single reference to pedagogical content knowledge (PCK) was made by student 10. There are many ways to introduce a lesson. English teachers use a game to test new vocabulary or to make the classroom livelier.

We do not interpret the very low frequency of discussion about these last three categories as an indication of complete lack of knowledge about these parts of teaching in the other students. Although the design of our procedure did not preclude student consideration of these topics it did not provide major stimulus for accessing of such ideas. Of relevance for this initial survey of students’ knowledge about teacher use of questions is that these three topics were referred to at all, even though only by a single student in each case. As GPK and knowledge of learning were the two knowledge categories discussed by all students, we will focus on these categories in the following section.

**Students’ knowledge about motivation**

Students’ GPK and knowledge of learning was classified into four subcategories of teacher concern: Motivational, Cognitive, Metacognitive, and Other. Only a few statements were included in the Other subcategory. When the frequency of statements in the other three subcategories was compared students made the greatest proportion of statements about cognition spoke least about the motivation ($\chi^2 (2) = 48.56, p <.001$).

Categorisations in the motivational category included those referring to the motivational state of both teacher and students. Six of the students noted the use by teachers of questions that were designed to stimulate student learning activity:

*The question* invited students to discuss and exchange ideas.

An interesting related argument made by two students was that a question could be used by the lecturer to create interest in the teaching for the lecturer. The level of student interest was also seen to be relevant for the lecturer who could use a question to improve student engagement with the lecture, “to create interest for students.” Five students also described effects of questions on the motivational state of students attending a lecture.

In addition students were aware of the relationship between teacher questioning and the emotional states of lecturer and students, Half of the students mentioned the
teacher’s general emotional state in their responses, student 6 suggesting that “[The] high concentration during teaching is stressful for the teacher” and another student suggesting that a question could help reduce this pressure by creating “time for the teacher to relax.”

Six of the students recognized the effect of teacher question on students’ dispositions which in turn would influence students’ motivation to learn. After hearing and answering teacher question “Students would be more confident before going into a new lesson” and conversely “would be shy and unconfident when they could not answer the question.” (S4)

In summary, students had knowledge of the functions of teacher questions that related to the motivational states of both teacher and students. Students were aware that use of a question could be designed to impact on the teacher’s general motivational and emotional states and could also be directed at changing the motivational states of students. However, the responses showed a limited concern for types of motivational knowledge discussed by Winne (1991). Some students did refer to students’ level of confidence that could be related to self-efficacy and to interest that Winne includes in his incentive category. No mention was made of students’ attributional processes that were the subject of the lecture, or of a consideration related to Winne’s utility category of motivational knowledge. On the other hand the discussion of teacher and student emotional states is interesting because it reminds us of the affectively ‘hot’ characteristics of learning and teaching that do not receive much attention in the literature on learning.

Students’ knowledge of cognitive activity related to teaching and learning
Students did refer to cognitive activity being undertaken by the teacher in use of questions in the lecture. This could be seen as teacher thinking in the sense of that term used by Clark and Yinger (1979). Five of the students reported on the use of questions to influence different teaching processes, such as helping the teacher to introduce or conclude lessons, to transmit knowledge, or to have identify the need for reteaching or as means to help the students to consolidate knowledge. Four students were aware that a teacher question could help teacher to provide a reminder to students or could guide the direction of their learning.

Questions were also seen as a means of generating information for the lecture, so that a lecturer “could draw on [this] experience for the next lectures” (S4). Four out
of ten students mentioned this function of teacher questions. Fewer students (3) identified the use of questions to engage in discussion, or to correct a student answer.

Questions were also seen to give teachers a means to create different types of links, such as links between parts of a lesson or between lessons, or links to prior knowledge or to real life examples:

_The question created a foundation for the following lecture. There was a connection between the question and the following lecture. Therefore there was an association between ideas in the former and the latter lessons._” (S5)

Beside the above teaching procedures, students were also aware of the function of teacher questions in helping a teacher to employ specific teaching strategies. Among these teaching strategies, explaining, summarizing and modification of lecture content were the most frequently mentioned. Half of the students expressed this awareness in their responses. The modification of lecture content was described by student 3 as follows:

_The teacher can gain some ideas from students’ answers and can add them to her lecture._

Four students were aware of that a teacher could use a question to highlight particular lesson content and to stimulate processes related to problem solving, such as identifying features, raising issues, developing explanations, or actually solving a problem while teaching.

_This (asking a question) is a problem-based teaching method. The teacher raised problems for learners to think and clarify.” (S8)_

Students presented an extensive list of learning processes and learning strategies that could be used by the students in response to a teacher question. All students were aware of that a question could help them to recall knowledge. Three other learning activities that could be undertaken by students were identified by most students: application of knowledge, linking of new knowledge to life experience, and engaging in discussion with other students or with the teacher. Half of students reported that students could respond to a question by systematizing content, generalizing, analysing, comparing or highlighting lesson content. Activities concerned with differentiating, illustrating and synthesizing were reported by fewer students.
Among the possible cognitive effects that students associated with teacher questions was students’ preparation of their brains for learning, including the following explanation by student 5 of this effect in cortical terms:

*Students have to activate their brain, so that when knowledge goes into it, there will be more wrinkles in the brain, and then students will answer the issue more easily in the future.*

There was quite frequent discussion of a variety of cognitive functions associated with questions, functions that were related to both the cognitive activity of the teacher and that of the student. In this group of students there was knowledge of a wide ranging set of ways to transform information being presented in a lecture. As a group the students had more to say about the effects of questions on student cognitive activity than for teacher cognitive activity. When the list of learning strategies noted by students was considered it was apparent that not all students discussed strategies that covered the whole range of ways in which information could be transformed. Although all nominated recall as a process affected by questions, fewer described more complex ways of transforming information, such as generalisation, differentiation and synthesis.

**Students’ knowledge of metacognitive activity**

The students noted that teachers could use questions for monitoring and regulation of their teaching actions. Checking by the teacher of students’ knowledge states was a frequently mentioned function for teacher questions. Most students identified checking of students’ understanding or acquisition or knowledge.

*The teacher asked this comprehensive question to check if students could understand theoretical knowledge through doing a practical exercise...The teacher could check her own teaching, and teaching methods using the student’s answer. (S10)*

As exemplified in the latter section of this quote, students were also aware that teacher questions could help teachers to evaluate (7) and regulate their own teaching (9). Less frequent was discussion of the teacher’s use questions for general evaluation, for giving and receiving of feedback, or checking of students’ cognitive level, or use of questions to gain information about attitudes, interest or opinions. Teacher questions were also seen to have metacognitive functions for students, helping them to evaluate (8) their learning, or to check their understanding to determine if they needed to ask for assistance (6). Eight of the students also described ways in which the
teacher’s questions could affect regulation of their learning, as shown in this statement by student 10’s linking of this regulation with the attributional content of the lecture.

*Students could classify their own learning causes and then self-regulate their own learning activities.*

**Summary**

The analysis in this section showed that, as a group, these students had a wide range of knowledge about how a teacher could use questions in the lecture situation. They knew that teachers could use questions to address both their own teaching needs and the learning needs of their students. The students’ responses also revealed a similar range of knowledge about how students could use the questions for their own learning. Across the two major categories of pedagogical knowledge considered here, GPK and knowledge of learning, students spoke most about cognitive activity. Their discussion of motivational knowledge did not make reference to some of the categories of knowledge that would give them useful ways to address motivational issues arising in their own learning. It was also the case that their discussion of cognitive activities was less concerned with complex elaboration activity than it was with simpler elaborative strategies. It is also apparent in Table 1 that there was variation within the student group in the topics discussed and this variation is considered in more detail in the following sections.

**Analysis Of Code Frequency**

At this point in the project a number of comparisons of the quantum of codes from the interview data have been completed. The first of these was concerned with the differences in response frequency associated with the different types of questions. Comparison across groups were also of interest. In these analyses it is of interest to consider both the comparisons across the two student groups and that between the student and teacher groups.

**Different types of teacher questions**

In our study, students were asked about the functions of three types of teacher questions: recall, understanding and application. The analysis of the interview data showed no differences in frequency of the subcategories of pedagogical knowledge codes across the different question types.
Variation in frequency of pedagogical knowledge across student and teacher groups

The frequency of responses for the student and teacher groups for the subcategories of the GPK and Knowledge of Learning categories is shown in Table 2. Although there was a greater level of output from the teacher group in all of the subcategories, the variation in all groups was substantial and none of the differences between groups was statistically significant at the .05 level. The variation with student profile was considerable with some students generating many times more codes than others, particularly with regard to cognitive and motivational activity.

The lack of difference in frequency of responses across the year levels is of interest. Frequency of codes does not reveal what is included within the codes, but the quantitative characteristics of a knowledge base are still of importance and are not entirely unrelated to the quality of that knowledge base. Those students who have more of relevance to say about a feature of learning might, within certain limits, be expected to be in a position to establish a richer set of connections between knowledge components. The very similar profiles of the year 1 and year 4 students provides stimulus for a more detailed examination of what students included in their responses. A beginning in this area was made through examination of the structural features of the concept maps of the student and teacher groups.

Table 3

<table>
<thead>
<tr>
<th>Codes presented for different subcategories of Pedagogical Knowledge and General Pedagogical Knowledge of teachers, year 1 students and year 4 students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codes</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>General Pedagogical Knowledge</td>
</tr>
<tr>
<td>Motivation</td>
</tr>
<tr>
<td>Cognitive</td>
</tr>
<tr>
<td>Metacognitive</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Knowledge of Learning</td>
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<tr>
<td>Motivation</td>
</tr>
<tr>
<td>Cognitive</td>
</tr>
<tr>
<td>Metacognitive</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Analysis of concept maps

The results of the scoring of the concept maps on the five measures outlined earlier is shown in Table 4. The two initial quantitative measures reflect the results of
the code frequency analysis discussed above. The teacher group had higher more
nodes and links, though there was wide variation within all three groups. For the
comparisons of structural features of the maps the only statistically significant
difference was the higher percentage of more complex links in the maps of the teacher
group (F (2, 12) = 14.52, MSE = 344.44, p < .001).

The concept map analysis is of interest because it does provide information that
is not as crudely quantitative as the frequency analyses. The depth, branching and
complexity analyses provide information about the structuring of knowledge and of
the quality of the relationships that can be expressed between nodes. The findings
here are supportive of the frequency analysis reported above. Again we do not see
major differences in profile between the year 1 and year 4 groups. As would be
anticipated the teacher groups was able to generate a greater percentage of more
complex relationships.

Table 4
Concept maps of Pedagogical Knowledge of teacher, year 1 and year 4 student
groups

<table>
<thead>
<tr>
<th>Concept map</th>
<th>Year 1 M</th>
<th>SD</th>
<th>Year 4 M</th>
<th>SD</th>
<th>Teacher M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
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<td>32.4</td>
<td>113.8</td>
<td>46.5</td>
<td>143.4</td>
<td>43.5</td>
</tr>
<tr>
<td>Number of link</td>
<td>53.2</td>
<td>27.6</td>
<td>62.2</td>
<td>38.8</td>
<td>85.6</td>
<td>39.2</td>
</tr>
<tr>
<td>Branching</td>
<td>20.4</td>
<td>5.4</td>
<td>23.0</td>
<td>6.0</td>
<td>26.6</td>
<td>5.3</td>
</tr>
<tr>
<td>Depth</td>
<td>28.6</td>
<td>6.1</td>
<td>28.4</td>
<td>4.2</td>
<td>31.8</td>
<td>3.1</td>
</tr>
<tr>
<td>More complex links (%)**</td>
<td>49.1</td>
<td>7.0</td>
<td>50.0</td>
<td>5.8</td>
<td>65.4</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Note: ** p < 0.01

Conclusion

The analyses of the data completed to this point to the following conclusions:
1. The group of Vietnamese teacher education students do have knowledge about how
questions posed in a lecture can be used by both teacher and students. Their
responses about teachers’ use of questions do qualify as student pedagogical
knowledge. Their reports about the ways in which students could respond to the
teacher questions shows that as a group they also have knowledge about learning,
similar in range of content to Australian teacher education students discussed in
other papers in this symposium.
2. The coverage of students’ knowledge about questions could be described by use of
a framework based on Shulman’s analysis of teacher knowledge. However, in the
The task given to students in this study their coverage of these categories was uneven. The best estimates of their knowledge were those for PCK and knowledge of learning. The limited nature of our task acted to limit their opportunities to curriculum and content knowledge. We would suggest that the limitations of the task with respect to pedagogical content knowledge we not as significant and it is surprising that there was only one response related to this in a group that included final year students.

3. There was wide variation in frequency of students’ responses. The importance of differences in quantity of response should be kept in proper perspective, though we have argued that it is not totally irrelevant as an indicator of quality of the students’ knowledge in this area.

4. There was also considerable variation in the frequency of the knowledge related to the subcategories of PCK and knowledge of learning. Students were able to generate more knowledge about cognitive activity than about motivational or metacognitive activity. The failure to mention some of the features of motivational knowledge by this group is paralleled by a similar lack of knowledge in our Australian students. The lack of detailed knowledge about processes such as attribution constitutes a limitation for these two sets of students.

5. The lack of difference in the Year 1 and Year 4 student groups on code frequency and structural measures derived from the analysis of concept maps is of concern. If this is confirmed in further analyses it points to the possibility that students’ pedagogical knowledge and their knowledge of learning is not developing across the time of their teacher education program. In the small groups included her we do not see substantial change on quantitative and structural measures from the time of entry to the university. The Year 1 students were at the beginning of their university studies so the knowledge we accessed was knowledge that they had built up while in school.

6. Although the teacher group did tend to generate more responses in all categories the only structural difference was their more frequent expression of more complex relationships. For us this increases the need to continue to investigate the pedagogical knowledge of both teachers and students for it seems likely that this knowledge, along with knowledge of learning, is not being discussed in classrooms to the extent that would allow students to make optimal use of the instructional moves made by teachers.
References


