TEACHERKNOWLEDGE IN ACTION: THE THEORETICAL BASE OF EFFECTIVE TEACHING

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Abstract.

Based on the findings of a previous investigation (Meade & McMeniman, 1992), this study sought to establish whether Shulman_(1987) categories of the teacher_knowledge base were adequate for the examination of teachers≠heories in action. Through the use of interview and video stimulated recall techniques, the theories underlying the classroom actions of one effective teacher of upper secondary science were analysed. Althoughuse was made initially of Shulman_categories, the data collected indicated that this categorisation needed a number of refinements and extensions to represent adequately the data. This was effected through the development of a categorisation based on an analysis of the current literature in effective teachingingeneral,andeffectivescienceteachingin particular. Results of the study indicate that, in order to examine the theoretical base of effective teaching, Shulman_categorisation can be usefully extended by reference to both the literature on effectiveteaching and the literature on domain-specific effective teaching. Further, this study concluded that, at least inrelation to this one effective teacher, teacher classroomactions are strongly theoretically-based. The results of this study challenge the assertion by some that teacher actions are atheoretical , and raise a number of newresearch questions for furtherinvestigation.

Introduction

This study developed from a previous investigation (Meade & McMeniman, 1992), where the focus of the research was methodological in nature. Briefly, this earlier study was concerned primarily with the evaluation of the use of stimulated recall methodology in allowing greater and more reliable access to the pedagogicalbeliefs underlying teacher actions in classrooms (Keith, 1988). Evidence for that study shows that stimulated recall is a useful methodology for tapping the implicit theories ofteachers. Moveover, it is particularly salient for examining the relationships between teacher beliefs and actions. Beliefs and actions in this earlier study werecategorised using Shulman's_(1987) categorisation of theteacher's_knowledge base.

The earlier study established the robustness of stimulated recall methodology while the current study seeks to examine in detail the theoretical base known to be critical in effective teaching in-action. Specifically, the present study seeks to answer the

following question:

Are the classroom actions of effectiveteachers atheoretical?

In this research question,"atheoretical" is used in the sense that the teacher actionsare divorced from the relevant body of professional scholarly literature.

Method

The methodology of data collection is described in detail in Meade and McMeniman(1992). Briefly, one effective teacher, Jack, whospecialised in upper secondary science was invited to

participate in an intensive case study. A complete unit of work in Year 11 chemistry was investigated using stimulated recall methodology. The unit consisted of three one and a half hour chemistry lessons concerned with the teaching of the periodic table. Each lesson was videotaped using two cameras and a vision mixer which allowed the researchers to track both the teachers and the students in any area of the classroom. The video tapes were shown to the teacher in the presence of the researchers after each lesson and the stimulated-recall interview was conducted following the convention of Nespor (1985).

Both the lessons and stimulated recall data were transcribed and analysed by coding: (i)verbatim class teacher-talk, and (ii) statements or "thought" on how teachers and learners go about effective teaching and learning, and reflections by the teacher on his classroom actions. Following the convention of many studies concerned with teacher effectiveness, the data were coded byusing Shulman_(1987) categories of the teacher_knowledge base (see Table 1).

TABLE 1 SHULMAN_(1987) CATEGORIES OF THE TEACHER'S KNOWLEDGE BASE

Code	Category
1	Contentknowledge
2	General pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organisation that appear to transcend subject matter
3	Curriculum knowledge, with particular grasp of the materials and programs that serve as "tools of the trade" for teachers
4	Pedagogical content knowledge, that special amalgam of

content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding

5 Knowledge of learners and their characteristics

6 Knowledge of educational contexts, ranging from the workings of the group or classroom, the governance and financing of schooldistricts, to the character of communities and cultures

7Knowledge ofeducational ends, purposes, and values, and their philosophical and historicalgrounds

Shulman, in attempting to categorise more explicitly and adequately the teacher's knowledge base, has as his primary concern those bodies of knowledge critical for teaching. His particular interest is in testing empirically whether "pedagogical content knowledge that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding", is the major indicator of effective teaching(Shulman, 1987:8). The data in this study confirmed that pedagogical content knowledge featured strongly in Jack's knowledge base profile (see Table 4 later in thepaper).

Although Shulman's_categorisation is a useful generic tool, this study found that it is insufficiently refined for

adequate representation of the data in this investigation. In particular, it is not refined enough to provide an answer to the research question in this study, "Are the classroom actions of effective teachers atheoretical?"

Thus, the firststage in this study was to explore alternative categorisations. To this end, the researchers developed a categorisation based on the theoretical literature in general and effective science teaching in particular (see Table 2).

The categorisation in Table 2 resulted from: (i) an exhaustive empirical classification of the theoretical literature; and (ii) a number of trials where the classification was matched for adequacy against the data. This iterative procedure engaged the researchers in progressively eliminating overlap among the four major categories and twelve sub-categories.

The literature can be distilled into three major categories of effective teaching (teacher use of student-centred teaching and

learning processes; teacher personal characteristics; and teacher useof strategies to promote student metacognition), and one domain-specific category (teaching for conceptual understanding). The three general categories and the domain-specific category are seen as complementary and co-extensive. This is reflected in the theoretical references in Table 2, many of which feature in both the general theoretical literature as well as the science-specific literature.

The second stage of the study involved selection from the data bases, namely, the three lessons, and the stimulated-recall interviews after each lesson. As the study was concerned primarily with teachers' implicit theories, data selection was restricted to those aspects which related specifically to the teacher's_implicit theories of teaching and learning.

Throughthe use of a text analysis package (Richards & Richards, 1991) and researcher judgements on what constituted a full teacher statement revealing theory in action, the relevant qualitative data were categorised according to both Shulman_categorisation (Table 1) and the theoretical literature categorisation (Table 2). It is important to note at this point that the stimulus for discussion began with teacher classroom actions in context. This is one of the strong points of stimulated-recall methodology in that it successfully avoids the "pious bias" of self-report data devoid of context, and the associated problem where the researcher _"leads the witness" in discrete interviews unrelated to observed classroom actions.

TABLE 2 CATEGORISATION OF THEORETICAL LITERATURE ON EFFECTIVE TEACHING/EFFECTIVE SCIENCE TEACHING

Code	Category
	A: Teacher use of student-centred teaching and learning processes:
A1	Learning ismade sensible & relevant to students (Paris & Winograd, 1990)
A2	The curriculum is responsive to students' developmental levels, students' learning processes and desired learning outcomes (Langer & Applebee, 1986; Paris & Winograd, 1990; Roth & Anderson, 1988; Tobin& Fraser, 1988; Yager et al, 1988)
A3	Class climate fosters positive teacher/student relationships (Fraser,1988; McMeniman, 1989; Mitchell, 1989)

B: Teacherreflection and openness to change:

B1 The teacher critically reflects on the effectiveness of teaching and learning processes (Richardson, 1994; Schon, 1983, 1987)

B2 The teacher is open to change and innovation in teaching (Fullan, 1993; Roth & Anderson, 1988; Tobin & Fraser, 1988; Tobin, Kahle & Fraser, 1990)

C: Teacher useof strategies to promote student metacognition:

C1 Students are encouraged and challenged to be strategic in their learning,i.e., have an awareness and control of their own thinking (Biggs, 1991; Evans, 1991; Mulcahey et al, 1991; Paris & Winograd, 1990)

C2 Students are engaged by teachers in quality dialogue (Gunstone, 1991; Palincsar, 1986)

C3 Students are led towards discovery and deduction (Mulcahey et al, 1991;Pines & West, 1986)

D: Teaching for conceptualunderstanding in science:

D1 Teaching concepts relationally and teaching for conceptual change (Biggs & Telfer,1987; Driver & Oldham, 1986; Duit, 1991; Glynn et al, 1991; Prawat, 1989; Smith, 1990)

D2 Taking students' prior knowledge into account (Biggs & Telfer, 1987; Driver & Oldham, 1986; Johnston, 1991; Pines & West, 1986)

D3 Teaching students to reason scientifically (Glynn et al, 1991; Roth & Anderson, 1988); Emphasising process (Biggs & Telfer, 1987; Glynn et al, 1991; Prawat,1989)

For the purposes of this paper, not all the teacher statements revealing his personal theory were utilised. Rather the researchers selected those statements which represented most adequately the teacher_theory-in-action. From the complete set of transcripts, the selected statements formed the following frequency pattern in Table 3.

As argued in the earlier 1992 paper, the data in Table 3 support the finding that the stimulated-recall data are particularly salient inrevealing teacher theories underlying classroom actions.

TABLE 3 - FREQUENCY COUNT OF SELECTED TEACHER STATEMENTS REVEALING PERSONAL THEORY IN ACTION

Table 4 shows the results of the categorisation of the same data

using both the Shulman and the theoretical literature categorisations. The data in Table 4 support the findings of the earlier study in that effective teachers, under the Shulman categorisation, possess the unique or distinctive skill of "blending" content and pedagogy into an understanding of how particular topics, problems, or issues are organised, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction, that is, pedagogical content knowledge. This is the skill which differentiates teachers from other professionals. This supports the conclusion in another recent study into science and the problems associated with higher-level cognitivelearning (Tobin et al, 1990-:223):

Discipline-specific pedagogical knowledge and pedagogical knowledge together are seen as crucial ingredients of successful teaching. Neither is sufficient alone, and each is required if students are to attain the elusive goal of higher-level cognitive outcomesin science.

As indicated previously, scrutiny of the Shulman categorisation in Table 4 does not enable the researchers to fully answer the research question of this study. Rather it is the theoretical literature categorisation which enables adequate representation of the theoretical base of this teacher's_classroom actions. For example, Jack consistently encourages and challenges students to be strategic in theirlearning (C1 x 8) -

Lesson 1

In this exercise I want you to be thinking classification. Thinking putting things in groups and I want you, while you_ doing it, to be thinking why am I making this decision and why is it that I groupthese things this particularway.

Moreover, he teaches science concepts relationally and teaches for conceptualchange (D1 x 4) -

Lesson 3 Stimulated Recall

Yes, previously the periodic table has just been something to look up the atomic mass on and they very quickly caught on that

ioniccharge ran down the columns. Hopefully now the periodic table will be a little bit more meaningful and later on when we come back to carbon chemistry the P orbitals are not hydrodised and that type of thing. Which is why I'm_happy just to leave it there and I don't feel the need to have to go back and do a complete exhaustive treatment of the electronic structure. Tomorrow when I bring in some more abstract characteristics of the elements, hopefully they'll start to see that you can have trends running across the table and you can have characteristics running down thecolumns.

In his teaching, Jack also makes learning experiences relevant to students (A1 x 4) -

Lesson 1Stimulated Recall

I expected this to be one of the roughest parts, trying to bring them into thinking about the topic and trying to arouse some sort of need or desire to know why these things were put in groups. I expected this part to be fairly difficult, which is why I gave a

fairly extended exercise where they could actually try for themselves and feel the thinking of putting it into groups, so I don't know how this part went, but it was some sort of an attempt totry to get them to doit.

TABLE 4 FREQUENCY COUNT OF
CODING OF TEACHINGSTATEMENTS REVEALING PERSONAL THEORY IN ACTION

Jack demonstrates also that he reflects often on his practice and that he changes his teaching as a result of this reflection (B1 x 2, B2 x 2)-

Lesson 2 Stimulated Recall

I think it's_taken a while for me to move into a mode where I can teach like that, and that's_been over several years and several groups. Starting off when I first came to the school, which was about five years ago, we had a very traditional course where I presented the material, modelled the problems, and they were expected then to be able to reproduce both the knowledge and the problemsolving. Moving from that to this strategy where I still will guide them through the content, but certainly I don't feel I have an obligation to cover every point of the content if it is sort of covered in the text, and they know that the content that they'll be assessed on is based on the text and that it's_up to

them to be working through that, and so I would still feel an obligation to model problem solving and to model the skills that they might require to balance equations or do that sort of thing, because I don't think they can intuitively pick that up from the text, but if there are certain ways of thinking about a problem, thenwhen I'm_solving the problem I try to focus on that, I try to talk through what's_going on in my head while I'm_doing it and realising that there's_probably several ways to think about it. I might actually do a set of problems, and each time try to think it through a different way in the hope that they'll pick up one of the strategies that works to solve the problem.

The twenty-seven teacher statements and their relevant codes which feature in this study are shown in Attachment A.

Discussion

In the earlier study, the focus was on a methodology suitable for examining theteacher_knowledgebase. Theappropriate categorisation instrument for that study was Shulman_categorisation of the teacher's_knowledge base. The shift in focus in the present study to an examination of whether teacher classroom actions are atheoretical has necessitated the development of an instrument which is derivative of the theoretical literature relating to effective teaching and effective science teaching. The researchers decided to use both the Shulman and theoretical literature categorisations in order to see whether the two instruments are juxtaposed or complementary and whether one instrument is superior to the other in judging the theoretical basis of effective teaching.

Our conclusion is that Shulman_instrument is generic in the sense that itdescribes the knowledge bases of all teachers and that the research question could have been answered without reference

to Shulman.

The summative data in Table 4 raises a number of new questions and observations. As depicted in Figure 1, this teacher demonstrated all of the major dimensions of the theoretical benchmarks. This then begs the question: What would the profile be of a teacher whose actions were atheoretical? Our argument is that some teachers would not score on all categories: for example, one can imagine a somewhat ineffective teacher as one who scores on category A (teacher use of student-centred teaching and learning processes) only , and rarely if at all on Category B (teacher reflection and openness to change), Category C (teacher useof strategies to promote student metacognition) and Category D (teaching for conceptual understanding in science).

FIGURE1
CODING RESPONSE OF THEORETICAL LITERATURE BY CATEGORY

Category	Did Jack'spersonal theory-in-action response reflect this category?	
	Yes	No
A: Teacher use of student-centred teaching and learning processes	Y	
B: Teacher reflection and openness to change	Y	
C: Teacher use of strategies to promote studentmetacognition	Y	
D:Teaching for conceptual understanding in science	Y	

Stillanother example of a teacher whose actions are atheoretical is any profile with the omission of either or both category C and category D. The researchers also take the position that an effective teacher whose actions are theoretically,-based is one who is reflective and open to change (Category B). We would also argue that it would be highly unlikely to find a teacher who scores on B, C and D and does not score on A. The implications of these speculations are that these categories interact. A significant amount of literature deals often with only one or a small number of the categories in Table 2. The indications in this study are that there are a number of categories important in effective teaching and that these do not operate in isolation. One extension of our present in2s___on would be to undertake an examination of the synergy among these respective categories.

A further development of this study would be to investigate the extent to which Category D changes according to the domain of knowledge under study. Allied to this is whether categories A, B and C do indeed remain intact regardless of which domain of knowledgeis involved, and whether the effective teaching categories and the effective domain-specific category are co-extensive.

Within the sameState system as the current study was conducted, a longitudinal investigation of the classroom actions of beginning teachers (Kane, 1993) showed that those latter actions were indeed atheoretical. A useful extension of both studies would be

to investigate the degree to which the instrument used by supervisors in schools to judge the effectiveness of beginning teachers, possesses common elements relating to the four major categories in the theoretical literature developed for this study. Apreliminary investigation within the researchers' own University showed the evaluation proforma for the practicum for beginning teachers utilises criteria which are generic and reflect Shulman's categories of the knowledge base with insufficient attention being given to domain-specificcriteria.

By way of summary, the researchers in this study found the need to develop a new instrument based on the domain-specific and general theoretical literature on effective teacher in order to answer the question, "Are the classroom actions of effective teachers atheoretical?". In particular, this study found that Shulman's content pedogogical knowledge needs to be greatly elaborated in order to explore the theoretical base of teacher action inany domain.

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ATTACHMENT A
CODING OF VERBATIM TEACHER STATEMENTS
REVEALINGPERSONAL THEORY-IN-ACTION

Lesson 1 Stimulated Recall
Yes, Ithink it would be true to say that I usually start off with some sort of advance organiser, something to give them a framework around and, it may be just looking through pictures in the chapter, or in that case it was just giving them a chapter where they could have a look through.
ShulmanCode 2 (Table 1); Theoretical Literature codes A1 and A2 (Table 2)

Lesson 1 Stimulated Recall
Necessarily, first year teachers are probably preoccupied with their content delivery and probably over emphasise that in their approach,whereas in the senior school, now I would see it from the students' point of view it's_developmental that they gradually are weaned off the teacher and so that by the end of theirsenior course they are able to approach the text as a document that contains the content that they need and they would see the teachers as a person who can interpret thatand a person who can model the problem solving that they need to wade through it. A first year teacher, of necessity, is still trying to feel what the learning process is like for students, and while they_ doing that they wouldfocus on the content.
Shulman Code 2 (Table 1); TheoreticalLiterature code A2 (Table 2)

Lesson 2 Stimulated Recall
Ithink it's_taken a while for me to move into a mode where I can teach like that, and that's_been over several years and several groups. Starting off when I first came to the school, which was about five years ago, we had a very traditional course where I presented the material, modelled the problems, and they were expected then to be able to reproduce both the knowledge and the problem solving.

Moving from that to this strategy where I still will guide them through the content, but certainly I don't feel I have an obligation to cover every point of the content if it is sort of covered in the text, and they know that the content that they'll be assessed on is based on the text and that it's_up to them to be working through that, and so I would still feel an obligation to model problem solving and to model the skills that they might require to balance equations or do that sort of thing, because I don't think they can intuitively pick that up from the text, but if there are certain ways of thinking about a problem, then when I'm_solving the problem I try to focus on that, I try to talk through what's_going on in my head while I'm_doing it and realising that there's_probably several ways to think about it. I might actually do a set of problems, and each time try to think it through a different way in the hope that they'll pick up one of the strategies that works to solve the problem.
Shulman Code 2 (Table 1); Theoretical Literature codes B1, B2 and C1 (Table2)

Lesson 1 Stimulated Recall
I think it's _becoming increasingly important and we've got a movement here at the moment in our curriculum to actually identify cognitive skills, when and where we do them, so the 49 skills that have been listed ascore. There's_a push now that will actually be saying "takenotice of what you're doing now, you're hypothesising. Take notice of what you're doing, you're extrapolating", so I'm_stilldeveloping that and that's_going to be ongoing over the next few years but the agreed push within the school is that wewill start to do that.
Shulman Code 3 (Table 1); TheoreticalLiterature code C1 (Table 2)

Lesson 3 Stimulated Recall
On topof that I believe that a cyclic curriculum is by far the best, and that at the end of Year 12 they should be leaving with a body of knowledge identified with chemistry and they shouldn't be leaving with 8 units of chemistry of which they have probably forgotten 4. So that's_very important the why this course, over others, was selected, because the concepts of chemistry that I'm_building are completely revisited and a student really needs to have those basic concepts which I consider are more important than peripheral contentmatters.
Shulman Code 3 (Table 1); Theoretical Literaturecode D1 (Table 2)

Lesson 1 Stimulated Recall
OK, the main ideaof that exercise was to parallel the grouping of the elements and so by leaving progressive revelations was the idea that they would have to keep changing their thinking throughout the exercise and I think it worked fairly successfully.

Shulman Code 4 (Table 1); TheoreticalLiterature code C1 (Table 2)

Lesson 1 StimulatedRecall

Teacher: At this point they should have been making decisions about their ordering and their grouping. They should have been thinking about why they had put them in that order because the shapes that I gave out didn't match what they had. They couldn't hold to both size and colour any more. They had to make a decision between one characteristic over another characteristic. So I wanted to put that part in to actually make them think that it wasn't just a simple exercise, that they had to actually make some decisions about how they were going to group these things.
Shulman Code4 (Table 1); Theoretical Literature code C1 (Table 2)

Lesson1
Mendeleev's_table had gaps in it. That's_true, in fact that was one of the strengths of it, believe it or not, that he had gaps in his table. It ordered elements by atomic mass.

Several: No

Teacher: Right, that ones not true. How did he order them. Lionel?

Student: Atomic weight, wasn't it?

Teacher:_Hedidn't know about atomic numbers, he couldn't count protons.

Student: Chemical properties.

Teacher: Chemicalproperties - thanks Roger. He made the decision that chemical properties would be more important than the accepted atomic masses of the day and it didn't include the Noble gases, why Fred?

Student:_They hadn't been found.

Teacher: Yes, they hadn't been found. It's_an unreactive gas, you can't find them caught up as compounds with other substances, and so, they were still around, but no one had discovered them and the last one, OK, two elements have very similar properties, you'd expect these chemicals to be?

Student:_In thesame column, same rows

Teacher:_Hands up the row people. The same column. A similar property runs down the column, whatchanges along the row.

(Several answers)_Mass. Properties.

Teacher:_Mass changes, properties along the row in a periodic fashion that when you get to the end of the row, you go back to the start again and you go back in regards to that property.
Shulman Code 4 (Table 1); TheoreticalLiterature code C2 (Table 2)

Lesson 1 Stimulated Recall
Iexpected this to be one of the roughest parts, trying to bring them into thinking about the topic and trying to arouse some sort of need or desire to know why these things were put in groups. I expected this part to be fairly difficult, which is why I gave a fairly extended exercise where they could actually try for themselves and feel the thinking of putting it into groups, so I don't know how this part went, but it was some sort of an attempt to try to get

them to do it.
Shulman Code 4 (Table 1); TheoreticalLiterature code A1 (Table 2)

Lesson 3 StimulatedRecall
Researcher:_You were about to move in to your experiment. Was your experiment just a motivator?

Teacher:_ Itwas mainly a motivator because I thought by that stage that things were getting pretty long and there was no chemicals in this lesson and I would try to have something with chemistry in most lessons.
Shulman Code 4 (Table 1);Theoretical Literature code A1 (Table 2)

Lesson 2 StimulatedRecall
Ionisation energy gives you the simplest plot, and as you go on further the periodicity is still there but it's_actually, it might vary with the peak in the middle of the period rather than the end, and so hopefully they're able to see the pattern in these other ones.
Shulman Code 4 (Table 1); Theoretical Literature codes A1 and D1 (Table 2)

Lesson 1StimulatedRecall
Because I forgot that their periodic tablein the front of their text doesn't have the atomic masses underneath and what I really wanted on that question was to point on the periodic table and just see all the ones that came after it and it was only after I asked the question that I realised the particular copy they have in the frontof their text wouldn't have answered that question the way Iwanted it answered.
Shulman Code 4 (Table 1); TheoreticalLiterature code B1 (Table 2)

Lesson 1
In this exercise I wantyou to be thinking classification. Thinking putting thingsin groups and I want you, while you're doing it, to be thinking why am I making this decision and why is it that I group these things this particular way.
Shulman Code 4 (Table1); Theoretical Literature code C1 (Table 2)

Lesson 1
Now I can't get you to do an experiment to recreate the periodic table. But what I want to do is a little exercise with you, that will get youthinking along the same way that the people who put the periodic table together would have had to have been thinking about putting things in groups.
Shulman Code 4 (Table 1);Theoretical Literature codes C1 and D4 (Table 2)

Lesson 3 Stimulated Recall
That would be distinguished between vocabulary and that would, because what I would often do, iswhen I'm_introducing terms, particularly if there's_many termslike concentration, that has a specific chemistry meaning, thatis different to the meaning in strong and weak in chemistry,there's_a different meaning, and so in those sorts of cases Iwould deliberately get them to give me how they would normally define the word, and then I would come in with achemistry specific definition. So that would probably bethe context I would give that in. The other one might bethe approach to learning the symbols and the elements, in that I offer that as a new language to understand what's_going on.
Shulman Code 4 (Table 1); Theoretical Literature code C2(Table 2)

Lesson 1 Stimulated Recall

I was introducing the term "period" there, which they would not have heard before in this context. The other strategy of introducing a new word like that is that I would have clearly differentiated between a common usage and a scientific usage with a precise meaning. And I take time on doing that sort of thing when Iintroduce a term I generally try to make sure that if it does have a common usage, that that is explained and the students get the chance to offer a sentence or something like that and then I'll give the precise meaning that I want it to carry. In this case I drew the word out of the pattern there, so I didn't really feel it was necessary to talk about the other concept of period that they would have had which would have been a school period.
Shulman Code 4 (Table 1); Theoretical Literature codes C2 and D2 (Table2)

Lesson 2 Stimulated Recall

With this plotting exercise Imake two comments. I could've just put it up on the boardfait accompli. However, I actually wanted them to see that the pattern came out of the plot and I thought they would get a better idea that there really was some sort of patternemerging if they generated it themselves, rather than just seeing it up on screen or seeing it on a page. As well as that, that's_just another part of trying to increase their graphing skills which, walking around the class, still aren't that efficient.
Shulman Code 4 (Table 1); TheoreticalLiterature code C3 (Table 2)

Lesson 3 Stimulated Recall
Yes,previously the periodic table has just been something to look up the atomic mass on and they very quickly caught on that ionic charge ran down the columns. Hopefully now the periodic table will be a little bit more meaningful and later on when we come back to carbon chemistry the P orbitals are not hydrodised and that type of thing. Which is why I'm_happy just to leave it there and I don't feel the need to have to go back and do a complete exhaustive treatment of the electronic structure. Tomorrow when I bring in some more abstract characteristics of the elements, hopefully they'll start to see that you can have trends running across the table and you can have characteristics running down the columns.
Shulman Code 4 (Table 1);Theoretical Literature code D1 (Table 2)

Lesson 2 Stimulated Recall
This lastlittle bit on the compounds doesn't directly derive from the work that they did before, but I wanted to slip it in there because that's_going to come in later, and it's_sort of a forewarning that even the compounds form a regular pattern. So, because we were looking at periods across the table I wanted to slip the actual chemical compounds that they form in there because today I'm_going to assume that that is sort of felt by them. That they will expect that there will be a periodicity in the compounds.
Shulman Code 4 (Table 1);Theoretical Literature code D1 (Table 2)

Lesson 1
And youpeople are fairly lucky living at the end of the century, you know about neutrons and protons. A hundred years ago scientists wouldn't have known about neutrons and protons. So for them it was acceptable to try to put the elements in order of atomic mass. They could work those out

experimentally. We can do it by the number of protons in the nucleus. This is why Mendeleev could accept the idea that there could be an element lighter than hydrogen. Now

we couldn't accept that because we can say hydrogen has one proton in it and you can't have an element with no protons it would be rather silly.
Shulman Code 4 (Table 1); TheoreticalLiterature code D3 (Table 2)

Lesson 3 Stimulated Recall
Ithink it's_the outside of the classroom part that the relationship with the students is very important and I'd want the students to think that I was interested in their development and that's_promoted with a good classroom atmosphere as well as taking a whole lot of opportunities outside of the classroom and I think this is something fairly unique to being able to teach in a high school environment as opposed to some other learning environments in that you get the opportunity to interact fairly intelligently with students outside of the classroom and that they see you as approachable and so they would see you as approachable outside of the classroom and they actually would approach you and in this context the relationships are built up over years. Now, in some of the behaviours that are in that class are known because of a continuation of knowing those students over time and the confidence that they feel in me is also built up over time.
Shulman Code 5(Table 1); Theoretical Literature code A3 (Table 2)

Lesson2
Teacher: And it_formula, Lionel?
Student: Um,
Teacher:Ammonia, in,
Student: Oh, bloody hell, how the hell shouldI know.
Teacher: Thank you Lionel for sharing that with us.
Can someone can do better?And Lionel would you like to share the formula of water with us.
Student: Oh, would it beH2O
Teacher: Oh, a star in your book Lionel.
Shulman Code 5(Table 1); Theoretical Literature code A3 (Table2)

Lesson 3 StimulatedRecall
Yes, I will occasionally if, there would be a specific reason usually why I would focus on a person, it might be that I think they might be the only one in the class that can give the correct response. Or it might be that, it might be a fairly simple response that you know, they might not have been participating much in the lesson.
Shulman Code5 (Table 1); Theoretical Literature code A2 (Table 2)

Lesson1 Stimulated Recall
I've started re-setting homework as apacing mechanism. In this style of course initially, when Iassume the students had greater

learning capacities I sortof set the work down on paper and assumed they would stickto that, but now I realise that for Year 11s at least I needto give them pacing and set the boundaries of where they are to be working. Some of them need to know when they're in trouble, when they're lagging behind.
ShulmanCode 5(Table 1); Theoretical Literature code A2 (Table 2)

Lesson 3 Stimulated Recall
I believe thatteaching and learning happens with individuals at different speeds. I believe that students need to grow into that learning experience and probably that was the assumption I didn't make at the start, when I started teaching this course, that they need to be led into being independent learners.
Shulman Code 5 (Table 1); Theoretical Literaturecode C1 (Table 2)

Lesson 1 Stimulated Recall
Words that youmight consider common, they [Vietnamese students] might not have heard used in that context and so that might throw them, so often my repeating instructions is repeating with paraphrase and sometimes just simpler or alternate words to try to pick them up and then largely I think it's_just a lot of going around and trying to pick up if they are working. You hope that they've caught on and if they're sitting there looking bemused then it's_a matter of trying to work out what they have and haven't understood. Often though, what you'll find is that, what I find is when you try to ask them for their understanding they'll keep saying yes, yes, yes and I've learned to interpret "yes" from a Vietnamese student to mean _"I'm paying attention to you, keep giving me information." So as long as I keep thinking that, that whenever they say yes to me, it means yes I'm_paying attention to you, then I can keep explaining.
Shulman Code 5 (Table 1); Theoretical Literaturecode C2 (Table 2)

Lesson 3 Stimulated Recall
Oh, I'd have to say not as much as I'd want and I think that together with the deliberate teaching of core process skills are on my agendafor the next 12 months and so in the next 12 months in lessons I'll actually be making statements like "Now we are extrapolating" and that will become part of the regular tools, so that there are 49 skills listed, and the goal of the school is that the students will be able to recognise when they_ doing those things, and so I'm_quite in favour of that and that's_probably something that I would've been moving towards, but now I've got something to hang it on and I think along with that, if I'm_saying to them now you're hypothesising, I'll want to be giving them strategies to do that, this is something I want you to recall and so, yes, I don't think I've

got enough deliberate strategies for teaching those things yet.
Shulman Code 7 (Table 1); Theoretical Literature codesB2 and C1 (Table 2)