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The Significance of Knowledge in Learning: A Psychologically Informed Analysis of Higher Education Students' Perceptions

Effie Maclellan
University of Strathclyde, e.maclellan@strath.ac.uk

Rebecca Soden
University of Strathclyde, r.soden@strath.ac.uk

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Keywords
Scholarship of teaching and learning, SoTL

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Effie Maclellan University
of Strathclyde Glasgow,
Scotland
e.maclellan@strath.ac.uk

Rebecca Soden
University of Strathclyde
Glasgow, Scotland
r.soden@strath.ac.uk

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Introduction

The economic importance now placed on the ability to be able to work in fast-changing employment contexts (Casey, 1999) and being able to solve problems that are yet to be spawned in our ever-changing world (Bowden & Marton, 1998), means that the type of product that fuels our modern economy is no longer material but, rather, intellectual. We are now in what Bereiter (2002) describes as the knowledge age. This reality implies that higher education should prepare students to be, primarily, knowledge workers. Being a knowledge worker means, in Reich's (1993) language, being a symbolic analyst; a role in which the worker represents some perceived reality, mentally, and then experiments with it, rearranges it, juggles with it, communicates it to others, transforms it and then represents this intellectual endeavour in some real-world manifestation. So, for example, the student teacher needs to distil and synthesise the latest research evidence on motivation for learning and blend it with his/her own intuitive ideas. This synthesis enables the student teacher to generate principles that will inform his/her classroom practices for motivating learners. Such theoretically-informed practices allows classroom teachers (and others) to be explicit about what they mean by motivation, to endorse what they see as useful and to discard what they see as unhelpful in providing motivating learning environments. The essence of being a knowledge worker is being able to operate in a world of ideas: with what Bereiter (2002) refers to as conceptual artefacts which, although the product of human endeavour, are both improvable and independent of their creators (p.64). Bereiter emphasises that

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being engaged in constructing or building intellectual property (that is, being a knowledge worker) is distinct from, but may include, learning. It was against this background that a small scale study was undertaken to explore the significance of knowledge-building in students' learning.

Theoretical Underpinnings of the Study

In reaction to research that renders exclusively behaviourist explanations of learning as unsatisfactory, there has been increasing interest in constructivist explanations, which privilege what might be happening in the learner's head and are, nowadays, commonly understood in terms of

- involvement in the learning process, often in collaboration with others;
- being active in constructing and organising one's own knowledge through comparing extant knowledge with new ideas and resolving the tensions created by conflicting or contradictory information;
- regulating one's own cognitive processing.

While constructivist explanations may account for how knowledge is experienced, the process of construction is triggered by the "cognitive or epistemic goals that arise from the learner's cognitive needs that cannot be achieved by relying on available knowledge" (Järvelä & Niemivirta, 2001p.107). In other words, the learner's desire to ameliorate a perceived deficit in knowledge initiates the learning process (Wosnitza & Nenniger, 2001). It seems important to remember, therefore, that for all that learning may be a social process; its purpose is the improvement of the knowledge base *of the individual mind*. Learning is activity that is directed at gaining personal knowledge or competence (Bereiter, 2002, p. 255). To be effective, the learning needs to hook into "prior knowledge, long-term memory, or personal experience" (Kintsch, 1998, p.330), in which case it is a product of newly acquired information (from text or other source) and the knowledge that is activated by the new information (Kintsch, 1988).

There is a distinction to be made between the purpose of learning (which is the improvement of the individual mind) and the purpose of knowledge-building. Knowledge-building is the creation of products which Bereiter (2002) calls conceptual artefacts. These artefacts are knowledge objects (Entwistle & Marton, 1994) which exist in the experience of individuals, as a result of their attempts to integrate a substantial accumulation of information into a personally satisfying organised structure. Knowledge objects are not bodies of knowledge which can be readily conveyed to others. Rather, they encapsulate extant understandings which can be revised and updated through the cognitive resources of the whole community. They have histories of having been created, developed, and further articulated by people who use them to create new artefacts. They are conceptual in the sense of being abstract and non-material in nature but they allow

- alternative explanations to be generated;
- existing explanations to be reviewed and critiqued;
- proposals for testing explanations/hypotheses to be generated;
- new ideas to be derived from already established ideas;
- problems and problem solutions to be posed (Popper, 1972).

Examples of conceptual artefacts would be policy documents which reflect values and aspirations or strategic plans which reflect institutional reform. The internal coherence of such artefacts derives from the cognitive activities listed above having been carried out in whole or in part. So a policy on anti-bullying could be derived from consideration of the ways in which an existing policy was inadequate, from an evaluation of the evidence base for the existence of bullying, and/or from a review of the efficacy of anti-bullying policies in analogous contexts. Knowledge-building thus focuses on advancing and articulating conceptual artefacts and adding to their value.

Although there is a distinction between learning and knowledge-building, it is acknowledged that in ordinary discourse the distinction between the two is not clearly made (Bereiter, 2002). While the main thrust of a person's endeavours may be to engage in knowledge-building, people may well digress from their principal task to engage in some learning that furthers the principal task. So, for example, the person may wish to ascertain the views of some sub-set of the population on attitudes to television. But if such persons are unfamiliar with aspects of research design, they will need to make a digression from their overall goal of ascertaining attitudes (the knowledge-building task) to more immediate tasks of learning how to sample, how to construct questionnaire items, how to generate an attitude-measuring instrument that will yield valid and reliable data and so on. Similarly persons may begin a task for the purposes of learning and through this be stimulated to shift into knowledge-building mode. It is in this way that exposure to the curriculum can precipitate domain interest in students that causes them to restructure or elaborate their knowledge or extend their knowledge into other pursuits.

For persons whose main focus *is* learning, however, the distinction is less immediately evident though, nonetheless, important. It is the deliberate activity for building knowledge which should be a more prominent feature of the formal educational system because it is in, and through, the conventional mechanisms of knowledge-building that people advance their understanding of the topics they are studying, and appropriate the genres in which meaning is made (Wells, 2002). Unless engaged in knowledge-building, students are unlikely to escape from naive empiricism in their scientific thinking (Bereiter, 2002). In arguing for the value of knowledge-building both Bereiter (2002) and Newman & Archbald (1992), who argue for students to be engaged in authentic achievement, recognise that students within the formal educational system are not being expected to be especially original but that they need to learn to use the tools of disciplined inquiry (Newman & Archbald, 1992) which include using a prior knowledge base, striving for in-depth understanding rather than superficial awareness and expressing one's ideas and findings through elaborated communication**.** It is through these aspects of disciplined inquiry that students can engage in problem solving and other constructive thought that goes into the creation of the conceptual artefact for subsequent use.

However, the value of knowledge-building is premised on a view that what constitutes knowledge, where knowledge is located and how knowledge increases (Fitzgerald & Cunningham, 2002) are contestable issues. A constructivist explanation of learning would acknowledge that there can be a range of realities, that knowledge is located at different sites and that it is constructed through the mutual and reciprocal activities of particular social groups. In other words, knowledge-building is understood as developing interpretations constructed through discussion, that the authority for such

knowledge resides in the arguments and evidence cited in its support, that everyone has expertise to contribute, and that the emphasis is on understanding the powerful ideas that spawn networked meaning. Within a constructivist perspective, therefore, the students' personal epistemological stances would be of fundamental importance, since this would be the baseline on which subsequent learning was built. Notwithstanding the developmental trajectory of epistemological development proposed by Perry (1970) and elaborated by others (Belinsky et al, 1986; Boyes & Chandler, 1992; King & Kitchener, 1994), Hammer & Elby (2002) argue that personal epistemologies are both context and domain sensitive and that, by implication, the identification of epistemological stances in relation to education should, in addition to large-scale questionnaire surveys, include open-format interviews and classroom observations that are contextualised in the specific pedagogical domain for which the information is pertinent. The recognition that epistemological stance does not equate with stable, context-independent misconceptions was an underpinning value of the method of investigation.

Thus far the argument is that knowledge-building is important but that its relationship with learning is not well understood, particularly in pedagogical contexts, where the focus is on learning. It is an empirical question whether knowledge building and learning are being conflated in pedagogical situations but if substantiated could have significant implications for higher education in which the (currently popular) construct of student-centred learning appears to rely more on rhetoric than it does on evidenced-based pedagogical practice. The study reported here was an initial attempt to unravel students' perceptions of knowledge-building within a prescribed domain of knowledge. Specifically students were invited to consider which features of lectures, tutorials and student preparation enabled them to develop usable knowledge of motivational theory. The investigation was not conceptualised as in any way comprehensive, with the findings being data to precipitate further interaction between researchers and students. However, the initial findings are all that are of concern in this article.

Method

Design

Structured interviews were carried out with 25 second-year undergraduates registered for a psychology module on motivational theory to explore their perceptions of knowledge-building. Perceptions were accessed indirectly through asking students to consider the ways in which lectures, tutorials and their own preparation for the module on which they were registered enabled them to develop usable knowledge. Plainly there are more direct ways of accessing students' perceptions of the nature of knowledge and knowing but important parameters of the study included the need to engage student interest and to characterise the engagement in terms not outside their experiences as students (on the assumption that such interest would yield more relevant data). Three broad issues were identified to structure the interview, with five subsidiary topics for each issue (see Table 1). Interviews were tape recorded and transcribed, with participant agreement. Transcriptions were content-analysed to capture substantive meanings.

Instrumentation

The interview centred on three interrelated issues and in responding to them the participants were invited to contextualise their comments in the psychology module for

which they were currently registered, entitled The Construct of Motivation. The issues were

- The sorts of tutor/student and student/student dialogue during tutorials that best helps to advance knowledge and understanding
- The sort of lecturer talk during lectures that most helps to advance knowledge and understanding
- The sorts of tasks, before, during and after lectures and tutorials that best advance knowledge and understanding.

The justification for these issues resides in the literature. Tutorials and lectures are significant structural mechanisms in promoting knowledge-acquisition and influencing conceptual learning (Anderson, 1997; Brookfield & Preskill, 1999, Rowland, 2000) in formal, higher education. Students' views of the role of their own behaviour are supported in the literature which finds that behaviourally proactive self-regulation of learning significantly influences academic achievement (Zimmerman & Schunk, 2001).

The issues were presented to students as open-ended enough to allow a wide range of views but also to signal to students that they were to focus on knowledge and learning rather than on adjunct features such as time management or study skills. This constraint seemed justified by the focus of the study. Further, the interviews were supported through five subsidiary questions for each issue (see Table 1). They were structured round the examples of cognitive activity that are thought to generate conceptual artefacts (Bereiter, 2002; Popper, 1972) and from the literature that points to the cognitive processing that is involved in fostering understanding, changing conceptions and developing thinking (Tynjälä, 1997; Tynjälä et al, 2001). It was reasoned that students who rejected, or were dismissive of, the content of these subsidiary questions were experiencing little or no epistemic doubt (Bendixen, 2002). The possibility of doubting one's beliefs about the nature of knowledge and knowing is considered pre-requisite for conceptual change.

Table 1: Subsidiary Topics for Issues

Issue 1	**The sorts of tutor/student and student/student dialogue during tutorials that best helps to advance knowledge and understanding**
	• the opportunity for extensive dialogue • the need for students to justify their views • the extent to which tutors intentionally challenge students with complex tasks • the need to be critical of ideas through the use of arguments and evidence • the extent to which students initiate and guide the learning of themselves and others
Issue 2	**The sort of lecturer talk during lectures that most helps to advance knowledge and understanding**
	• requiring student to note similarities with, and differences between, new and old knowledge

	• helping student to understand the arguments and evidence for different points of view • requiring student to personalise new knowledge (through summarising it in my own words, applying it to a situation I know or thinking of a real-life instance of the new knowledge) • explaining a professional situation through a particular theoretical perspective • using previously identified errors to improve student understanding
Issue 3	**The sorts of tasks, before, during and after lectures and tutorials that best advance knowledge and understanding.**
	• engaging with tasks and problems that are ill-defined and initially difficult • planning own learning in the light of current understanding • asking, and persisting with, questions that help me to really understand • having the autonomy to negotiate/determine tasks/ways of working • preparing myself to contribute to the issues to be addressed in class

Participants
The invited participants (n = 25) had been randomly selected from the University's cohort of second-year Bachelor of Education students. Most were 19/20 years of age though two or three of them were more than 35 years of age. The entire cohort (n = 120) of students, from a Scottish university, had been participating in a series of small scale action research projects designed to inform learning and teaching policy/developments within the university's Education Faculty and so were not unfamiliar with the concerns of the researchers to elicit student perceptions. Since they were also registered for an introductory module in research methods, their participation in such research offered opportunities for them to enhance their understanding of how research is conducted. It was reasoned that teacher education students' experience of participating in lectures and tutorials would be a fertile area from which to infer their beliefs about the role of knowledge in learning, partly because of its intrinsic interest to the participants (assumed from the fact that they were undergoing a degree level course in primary education) and partly because of their extensive personal experience of the formal education system.

Analysis
Content analysis was conducted through reading and re-reading transcripts to get a sense of what seemed to be suggested. Thereafter the recording units (Krippendorff 1980) were determined semantically (Tesch, 1990). These were segments of text, comprehensible by themselves and containing one idea, episode or piece of information (Tesch, 1990p. 116). Meaning units could be found either standing alone as in the statement, the tutor should take more responsibility for what goes on in the class, or embedded in more extended text which needed disaggregation as in

> *It is helpful when the tutor explains the reading and lecture materials* (first semantic segment) *because that helps me to make sense of the ideas in the module* (second semantic segment)*. When I do the background reading, it doesn't usually mean very much* (third semantic segment)*. But the tutor's knowledge is much more than mine so it's best to listen to the tutor and then do the reading again* (fourth semantic segment).

Meaning units which implied some view of the role of knowledge in learning or in individual behaviours were categorised according to the subsidiary topics. There was then a further categorisation to determine whether participants agreed or disagreed with, or were ambivalent towards, the essential premise of each topic. This procedure accounted adequately for the data. The resulting tabular information may give the impression of a quantitative study but is better understood as offering a summary of the overall pattern of interview responses. After initial classification of meaning units (Tesch, 1990) in the transcripts, a reliability check was conducted by asking two other coders to code randomly selected meaning units. The reliability levels achieved were acceptable (Kappa coefficients ranged from .82 to .92). A research assistant used the final category system to code all the responses and a check on her coding indicated reliable coding over a two-week period. (Cronbach's alpha = 0.70).

Results

The study was eliciting student perceptions of knowledge-building.

Table 2: Role of Dialogue in advancing knowledge and understanding

Elements of dialogue during tutorials	that are helpful to me	that I'm not sure about	that are not helpful to me
(i) providing ample opportunity for dialogue	20	5	0
(ii) requiring me to note similarities with, and differences between, new and old knowledge	0	7	18
(iii) intentionally challenging me with complex1 tasks	1	5	19
(iv) requiring me to justify my views	5	10	10
(v) helping me to acquire new information	18	6	1

Table 3: Role of Lecturer Talk in advancing knowledge and understanding

Elements of lecturer talk	that are helpful to me	that I'm not sure about	that are not helpful to me
(vi) require me to personalise new knowledge (through summarising and/or applying it)	1	10	14
(vii) help me to understand the arguments and evidence for different points of view	22	3	0
(viii) require me to use arguments and evidence for my point of view	1	17	7
(ix) involve us all in initiating and guiding learning	5	12	8
(x) use previously identified errors to improve understanding	17	8	0

Table 4: Role of Individual Behaviour in advancing knowledge and understanding

The sorts of tasks, before, during and after lectures and tutorials	that are helpful to me	that I'm not sure about	that are not helpful to me
(xi) engaging with tasks and problems that are ill-defined and initially difficult	3	4	18
(xii) planning learning in the light of current understanding	17	6	2
(xiii) asking, and persisting with, questions that help me to really understand	2	9	14
(xiv) having the autonomy to negotiate/determine tasks/ways of working	9	11	5
(xv) preparing to contribute to the issues to be addressed in class	3	13	9

In terms of the types of dialogue/talk most students agreed that the advancement of knowledge and understanding was facilitated when lectures and tutorials

- provided ample opportunity for dialogue;
- helped them to understand the arguments and evidence for different points of view;
- helped them to acquire new information;
- used previously identified errors to improve understanding

Similarly, most did not agree that the advancement of knowledge and understanding was facilitated when lectures and tutorials:

- required students to note similarities with, and differences between, new and old knowledge;

- intentionally challenged students with complex tasks;
- required students to personalise new knowledge (through summarising/applying it)

And finally there was ambivalence about whether lectures and tutorials should

- require students to use arguments and evidence for their points of view;
- involve all participants in initiating and guiding learning

In terms of students' own behaviour, most

- agreed that they should plan their learning in the light of current understanding;

- disagreed that either they should engage with ill-defined problems or raise substantive questions;
- were ambivalent about preparing themselves to contribute to the issue to be addressed in class or having the autonomy to negotiate/determine tasks/ways of working

Student views were illustrated in the following selection of typical comments:

- *It is helpful when the tutor explains the reading and lecture materials because that helps me to make sense of the ideas in the module. When I do the background reading, it doesn't usually mean very much. But the tutor's knowledge is much more than mine so it's best to listen to the tutor and then do the reading again.*

- *The tutor says we need to read about real applications of the different theories so that we know what the evidence is. But I don't have time to follow up the suggestions for further reading. It's easier if she just tells us what the evidence is.*

- *The work shouldn't be so challenging that we do not clearly understand what we are doing. It is the tutor's job to help us, not to give us difficult tasks.*

- *Getting ideas from other students is fine up to a point but the tutor needs to tell us that we are on the right lines. When the tutorial develops the material in the lecture I feel I am making progress, but the tutor should not give as much responsibility to the class to decide what to do.*

- *I would rather that we discuss the main ideas in the lecture and study them more rather than just talking about the text. Discussing the text is fine because it makes the content clearer but we need to be able to see how the text fits in to the lecture. Our own ideas don't help us to get the 'bigger picture'. We need clear guidance on how the different theories apply in practice.*

- *I'm here to develop my understanding, not to change it.*

- *The tasks we are supposed to do between/instead of classes need us to get together in groups. But some people don't bother to do them. And I don't like speaking out in the group. The tasks seem to need a lot of time and I find it better to use the time to swot up the lecture notes.*
- *It's the tutor's job to bring questions for us to discuss, not the students. When I have a question to ask, I want to be able to ask the tutor who can then tell me the right answer. I don't think that kind of question is for discussion by the class. How could the others help me?*

The following selection of comments was reflected in only a very small number of the responses:

- *It's good when somebody starts us off with a question and the tutor leaves us to discuss it.*

- *I've found it really motivating to be expected to make a contribution to the class and to be ready to do so I need to be prepared.*

- *I never realised until now how messy learning can be. It makes me think about when I'm a teacher. I'd better not be too ready to give the kids the answers the moment they ask.*

The results draw attention to some sharp differences in views. In particular, the dominant views reflected beliefs that

- The dialogue/talk should help students understand the arguments and evidence for different points of view, but ambivalence about the need for students themselves to use arguments and evidence for their points of view;
- The dialogue/talk should provide ample opportunity for dialogue, but scarcely a mention that students intentionally be challenged with complex tasks;
- The dialogue/talk should help students to acquire new information, but scant understanding that students should try to personalise new knowledge;
- Students should plan their learning in the light of current understanding and use previously identified errors to improve understanding, but ambivalence about both preparing themselves to contribute to the issue to be addressed in class and to having the autonomy to negotiate/determine tasks/ways of working.

The dominant epistemic position was fairly naive. Learning seemed to be something that is ***done*** to students insofar as knowledge is provided or made available without there being any concomitant view that they might ***do*** something with the new knowledge.

Discussion

The study's findings are problematic. Most students did not view knowledge-building to be a part of their responsibility. This is consistent with the extensive literature which finds that students are skilled in negotiating with teachers to attenuate or eliminate cognitive effort and task ambiguity (Doyle, 1983; Doyle & Carter, 1984). While, as the literature reflects, it is inconsistent with a constructivist pedagogy for tutor mediation to simplify tasks so that they become sets of routine, algorithmic subtasks making no authentic demands of the students (Bransford et al, 2000; Ng & Bereiter, 1991; Wiliam, 1998), few studies grapple with the possibility that the prior knowledge base - on which the success of constructivist approaches depends - is of itself such a multi-faceted construct that its role in the construction of subsequent knowledge is more complex than has hitherto been recognised. Because some understanding of what is meant by prior

knowledge seems fundamental to appreciating the students' perceptions, the rest of the discussion will be structured round what might be understood and implied by prior knowledge.

Typically, cognitive and instructional scientists would describe knowledge as declarative (such as knowing a range of theories), procedural (such as knowing methods of enquiry), strategic (knowing how we learn and remember) or conditional (knowing when to apply our knowledge) (Haskell, 2001), but Alexander et al (1991) found the term knowledge to be construed in 25 different ways. Moreover, in trying to make sense of

the proliferation of terms for different aspects of knowledge, they found that the same aspects of knowledge were referred to by different terms, that different aspects of knowledge were referred to by the same terms, and that the interactions amongst different aspects of knowledge were either represented differently or ignored altogether. While recognising that there may well be reasons for such redundancy, Alexander et al (1991) point out that in addition to the variously understood nomenclature, different aspects of knowledge operate not in isolation, but interactively, and so attributing the effects of a study to one aspect of knowledge may result in findings being misrepresented.

Notwithstanding this caution, there would appear to be little, if any disagreement, that there is something called declarative knowledge which according to Bereiter (2002) "is knowledge that you can state or declare, thus exposing it to correction by verbal means" (p.133). Bereiter (2002) makes clear what he means, by specifying that declarative knowledge is the ability to state content and is not a set of propositions in the mind. Declarative knowledge is deemed to be the most crucial type for successful learning (Dochy, 1994) because it underpins the other types of knowledge (Haskell, 2001). For example, it can serve as the basis for enacting a set of 'rules' for carrying out some procedure (even if the 'rules' themselves cannot be 'declared'), stimulate knowledge of our mental processes and therefore our self-monitoring, trigger context-appropriate behaviour, and provide a framework in which to assimilate new or deeper knowledge.

It seems precisely this type of knowledge that the students in this study saw as useful when they endorsed the view that new knowledge should be made available to them. The student comments, reported above, clearly suggest that students were conscious of the limited nature of their knowledge base. However, although declarative knowledge implicates other types of knowledge, it does not follow that the acquisition of declarative knowledge will "automatically and immediately guarantee knowledge in other forms" (Alexander et al, 1991; p.323). In other words, while declarative knowledge may be a necessary condition for other forms of knowledge, it is not a sufficient one. Furthermore, Shuell (1990) makes the point that in the initial phase of learning anything new (which can be assumed to be the case for the participants in this study) the individual is confronted with essentially isolated bits of information, procedures and facts that have little, if any, conceptual meaning. In such circumstances "the learner does the only thing that is reasonable: memorises facts and uses pre-existing schema to interpret the isolated pieces of data" (p. 541).

It is only when learners have developed considerable specific knowledge of a domain that they can form some overview of what the knowledge domain is and consider their (mental) representations of previously acquired facts, information and procedures as entities to be scrutinised for similarity, difference and worth. Given that the length of time which would have to elapse for students to gain an overview of, rather than just an

introductory orientation to, the psychology of motivation is probably far in excess of the time allocated to the study of psychology in a modular teacher-education course, it is not surprising that the participants did not find the information processing demands implied by some of the module tasks in which they were expected to engage to be helpful. The observations of Shuell (1990) and Alexander et al (1991) would suggest that one reason for this was not that the students *did not want* to engage in such tasks, but that they were *unable* to do so because of an insufficiently developed base of declarative knowledge.

One implication is that any curriculum that the student follows should foster depth of learning, rather than superficial broad coverage, to allow the student time to build a coherent knowledge base (Bereiter & Scardamalia, 1989; Bereiter (2002). Given the interactions of different types of knowledge (Bereiter, 2002), supportive pedagogy would require progressively more complex declarative knowledge to be designed into course delivery across time, with concomitant planning for the development of procedural, strategic and conditional knowledge. Furthermore, preconditions for both the design and delivery of a curriculum would include autonomy to negotiate ways of working, engaging with ill-defined problems, raising substantive questions and coming to classes prepared: all topics in the interview to which the respondents were either resistant or about which they were ambivalent. What would be intended here are practices that underline the uncertain, tentative and constantly evolving nature of knowledge, such as having students grapple with ill-structured problems, or having them solve problems from multiple and diverse evidential bases. Soden & Maclellan (2005) found that pedagogical interventions privileging the systematic scrutiny of the assumptions, logic, coherence and clarity of accounts, together with the nature and interpretation of evidence supporting different accounts, increased student understanding of how knowledge might be contested, suggesting a need for further research on pedagogies to serve this end. However, the significance of the knowledge base has other implications for pedagogical practices in higher education.

Firstly, while there is little disagreement that the student's knowledge base plays a major role in that student's cognitive achievement, it cannot be assumed that the student's knowledge base is necessarily of high quality. This was illustrated by students who recommended that tutors should explain what authors meant or was saying in particular pieces of text. So impoverished was one student's knowledge base that she used some of the interview time to seek clarification on the pronunciation of some technical terms used in behavioural explanations of motivation. As the literature on expertise evidences (for example, Glaser and Chi, 1998), high quality prior knowledge is reasonably complete and correct, is available and accessible to the individual, is of a substantial amount, and is well structured. If any of these dimensions of knowledge in the student differs from what the tutor assumes to be the case, then the facilitative effect of prior knowledge may be affected (Dochy, 1994) and as Bransford et al (2000) highlight, it is precisely along these dimensions that novices and experts differ. Although primacy of prior knowledge is not in question, the lack of readily available instruments (Dochy, 1996; Kalyuga, 2006) to assess prior knowledge means that it is simplistic for tutors to assume that the prior knowledge for any learning is optimal.

Secondly, constructivism posits the co-construction of knowledge through building on a base of common knowledge. In other words, those participating must assume some knowledge that can be referred to without explanation or elaboration as a context for the arguments and evidence to be constructed. Without such an assumption, the co-

construction of knowledge is derailed from the outset. But the prior knowledge that is shared by all members of a class/group may be very small (Tobias, 1994; Nuthall, 2002), thereby raising questions as to precisely what and whose prior knowledge is the foundation for subsequent learning. Such shared prior knowledge as exists may be limited in scope, disconnected from well-integrated knowledge networks and distorted by inaccurate assumptions and naïve/misconceived ideas (Brophy & Alleman, 2002), and may be a very inadequate base on which to build. Because students in this study repeatedly wanted assurance that they were "on the right lines," and saw it as the

tutor's task to supply what was 'missing' from their own understandings, they viewed their peers' extant knowledge as being of limited value. Furthermore, they found pedagogical attempts to have students use each other as learning resources to be an inappropriate, time-consuming activity.

Thirdly, such knowledge students possess is mediated by their psychological responses to the totality of the learning experienced (Nuthall, 2002). As Prosser & Trigwell (1999) highlighted, students perceive the instructional material and their learning environment in individual (and even idiosyncratic) ways. Indeed, the individualistic, prior knowledge of students includes their motivational states (Boekaerts & Minnaert, 2003). The mediation of their own psychological processing means that students interpret information concordant with their personal goals and prior experiences and so they may fail to carry out tasks as the tutor intended because they do not interpret appropriate behavioural cues. This was particularly marked in students' expressed dislike of "having to speak to the group" in tutorials or in their conception of the learning task as "swotting up lecture notes" in preparation for assessment. In other words, the centrality of the student's role means that while the tutor may plan particular learning in pedagogically defensible ways (as was the case in the module referred to in this study where students were expected to carry out particular group tasks between formal classes), what happens in consequence is determined more by the students than by the tutor. Although not inconsequential, the influence of the tutor is at best indirect, raising the possibility that consequent learning is fragile and highly variable.

Taken together, the probability is that shared common knowledge in any group is very limited, that such knowledge will not be of high quality and that the student's own desires and intentions powerfully mediate in what students actually learn; the nature of prior knowledge is indeed a complex baseline on which to build subsequent knowledge or learning. Because of this it is unwise to assume that the co-construction of knowledge among students and teachers happens routinely. But we would not wish to over interpret the findings from one small and limited study. This study was doing no more than discerning knowledge-building perspectives in a contextually defined domain. Firstly, it would be important to know if the findings are typical of the wider student population. Secondly, and more importantly perhaps, would be the need to find out if students working in different knowledge domains responded similarly. The participants in this study were teacher-education students experiencing an introductory orientation to the psychology of motivation. It is not clear to what extent they viewed this module as being necessary or even important to their central focus of study. So the features of lectures, tutorials and student preparation that enable students to develop usable knowledge need to be determined alongside students' levels of interest in the knowledge domain being studied. A final avenue of investigation is the development of pedagogically useful instruments to ascertain levels and types of prior knowledge. Because there has been a shift away from teaching the disciplines that were thought to inform education (psychology, sociology, philosophy) and a co-occurring move towards a modular curriculum that often fragments disciplinary knowledge, much remains to be done to address the ‘prior knowledge’ fall-out from this approach. Work in this area (Dochy 1994; 1996) needs to be extended to reliably ascertain/measure students' prior knowledge and thereby have a valid basis on which to support students in their knowledge-building (Bereiter, 2002; Brophy, 2002).

Conclusion

The study reported here explored students' perceptions of the significance of knowledge-building. The composite picture from the sample of 25 second-year undergraduate students suggested that most shied away from cognitive engagement that knowledge-building demands. This can be partly explained by difficulties with the fundamentally important construct of prior knowledge. Because prior knowledge is inherently problematic and yet also very necessary for subsequent learning, its role needs to be understood as legitimate, complex and significant. The design of higher education courses should distinguish between learning and knowledge-building purposes and achievements. If knowledge-building is the mechanism through which criticality and transformative learning occur, students need to be socialised to explicitly integrate extant and new knowledge. This demands that we, as tutors, pay much greater attention to the many facets of prior knowledge implicated in the learning that we are trying to promote.

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