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ABSTRACT

In an effort to further explore the experience of understanding from the university perspective, this study examined how British students' understanding was refined and committed to memory during preparation for final examinations. After piloting an interviewing procedure, in-depth interviews were conducted with eleven students from psychology (including two pre-med students taking a year out) and zoology. Through a flexibly structured interview schedule, students were taken through their revision strategies, with a particular focus on how they developed understanding and used visualization in its recall. Another 11 psychology students were asked to provide written responses describing their experiences of understanding. As the results of this first study related only to the context of revising for examinations, and as the sample was restricted in both size and range of discipline, the work is currently being extended through two hour-long interviews with twelve final year historians. The current study concerns understanding not just during revision, but also through writing essays as course work (term papers) and in Finals. The analysis found that the experience of understanding involved strong feelings of coherence and connectedness, together with confidence about explaining or using the knowledge acquired. Students differed in terms of the breadth of their understanding and in the depth or level of understanding which was a function of the effort put into making connections within the material and with related ideas and experiences. Only two students studied without any use of structure. Several students relied on the structure they had in their lecture notes. Other students developed structures designed to fit perceived requirements of previous years' examination questions. Only two types of structures drew on wide, active reading and involved an independent transformation of what was being learned. The five different kinds of structure, allied to parallel variations in breadth and depth, were described as "forms of understanding" (Entwistle & Entwistle, 1991) and depended on differing approaches to learning and studying. (Contains 24 references.) (JB)

Experiences of Understanding and Strategic Studying

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Introduction

This study has its origins in a continuing series of projects on student learning in higher education, carried out first at Lancaster (Entwistle & Ramsden, 1983) and subsequently at Edinburgh (Entwistle, 1987, 1991; Entwistle & Tait, 1990). Since 1976, the focus of the research has been derived from the distinction between deep and surface approaches to learning, as described initially by Marton and his colleagues in Gothenburg (Marton & Saljo, 1976, 1984). These approaches to learning depend on the student's intention - either to seek personal understanding in an active way or simply to reproduce the content to cope with assessment requirements.

Table 1 Defining features of approaches to learning

Deep Approach	*Transforming*
Intention - to understand material for oneself Being actively interested in the course content	
Relating ideas to previous knowledge and experience Looking for patterns and underlying principles	
Checking evidence and relating it to conclusions Examining logic and argument cautiously and critically	
Surface Approach	*Reproducing*
Intention - to cope with content and tasks set	
Studying without reflecting on either purpose or strategy Treating the course as unrelated bits of knowledge	
Finding difficulty in making sense of new ideas presented Memorising facts and procedures routinely	
Feeling undue pressure and worry about work	
Strategic Approach	*Organising*
Intention - to excel on assessed work	
Being alert to assessment requirements and criteria Gearing work to the perceived preferences of lecturers	
Putting consistent effort into studying Finding the right conditions and materials for studying Managing time and effort effectively to maximise grades	

The original research involved students reading an academic article and being asked questions about it - a naturalistic experiment. Subsequent research examined studying within its everyday context and suggested that an additional category was necessary - a strategic approach related to studying rather than learning and depending on an intention to excel in assessed work. Table 1 above summarises the characteristics describing these three approaches.

Each different intention leads to distinctive learning processes. The deep approach, with its intention to understand, depends on attempts to integrate, and so *transform* what is being learnt, within a personal framework. In contrast, the surface approach relies mainly on rote learning, or the assimilation of unelaborated information, to *reproduce* the material. The strategic approach may draw on either deep or surface approaches to learning, depending on whether the teaching and assessment procedures are perceived as requiring the demonstration of understanding, or factual and procedural recall. However, its main characteristic is the emphasis on *organising,* both in terms of study methods and time management.

The central place given to understanding in this description of student learning has recently led to attempts to explore the nature of academic understanding, as experienced by students, through a series of small scale qualitative studies. It is surprising just how little work has been done on this topic, given the centrality of the concept within education. A paper by Nickerson (1985) reviewed a series of studies from cognitive psychology, based mainly on analyses of problem solving, and provided a valuable description of understanding from this perspective. More recently, there have been attempts to explore the experience of understanding from the pupil's perspective (Burns *et al.,* 1991; Perkins & Blythe,1994) and to suggest implications for teaching. The research presented here fits into this latter perspective.

Background and methodology

In British university education, students are most consistently expected to demonstrate thorough conceptual understanding during their final Honours year, and particularly in their final examinations. The traditional pattern of degree courses leaves students up to eight weeks after lectures have finished for the revision of material covered in the whole of the final year's courses. Not only does this impose a substantial burden of memorising, but the examination papers also demand conceptual understanding. Thus, students have to revise an extensive body of notes and also ensure that they understand them. It was for this reason that it was decided to examine how understanding was refined and committed to memory during revision for Finals.

After piloting an interviewing procedure, in-depth interviews were conducted with eleven students from psychology (including two medics taking a year out) and zoology. Through a flexibly structured interview schedule, students were taken through their revision strategies, with a particular focus on how they developed understanding and used visualisation in its recall. Subsequently, another eleven psychology students were asked to provide written responses describing their experiences of understanding. These data were subjected to rigorous qualitative

analysis to determine the categories which best described the commonality and variety of students' activities and experiences. The general procedure involved attributing sections of each interview transcript to provisional categories, which were then progressively refined. Complete interview transcripts were also examined repeatedly to determine how each student had gone about revising. Putting the two analyses together produced a set of categories, the meaning and coverage of which were illustrated by extracts and summarised in the light of the holist analyses of individual students. This procedure is similar to what Marton (1993) has described as *phenomenography.*

As the results of this first study related only to the context of revising for examinations, and as the sample was restricted in both size and range of discipline, the work is currently being extended through two hour-long interviews with twelve final year historians. The current study concerns understanding not just during revision, but also through writing essays as course work (term papers) and in Finals. The preliminary results from this ongoing study are broadly in line with those previously reported (Entwistle & Entwistle,1991a, b; 1992), but also extend them.

The experience of understanding

The first analysis of the data focused on commonalities in what students perceived as the nature of understanding. The top part of Table 2 summarises various aspects, repeatedly mentioned.

Table 2 Aspects of the experience of understanding

The Nature of Understanding
Feelings of satisfaction
Meaning and significance
Coherence, connectedness, and 'provisional wholeness'
Irreversibility
Confidence about explaining
Flexibility in adapting and applying
Individual Forms of Understanding
Breadth of understanding
Depth or level of understanding
Structure used to organise the material being learned
a. little or no structure being imposed on the facts learned
b. relying exclusively on the lecturer's structures
c. producing prepared answers to previous years' questions
d. adapting own understanding to expected question types
e. relying on an individual conception of the topic

The students emphasised that the experience of understanding involved strong feelings of coherence and connectedness, together with confidence about explaining or using the knowledge acquired. While students described a feeling of wholeness in their understanding, they also recognised that it was 'provisional'. They recognised that it was complete only in relation to the material they had covered and to the specific demands of the course on which they were to be

examined (Entwistle, A. & Entwistle, N. 1992).

The main differences among students are shown in the bottom half of Table 2. Firstly, students differed in terms of the breadth of their understanding - that is, how much additional material they had sought to integrate into their understandings. Secondly, they differed in the depth or level of understanding, which was a function of the effort put into making connections within the material and with related ideas and experiences. Thirdly, students differed in the ways they structured their understandings. Only two students talked about revision without any use of structure, and both were referring to their experiences in pre-clinical medical examinations. Several of the students were content to rely on the structure they had in their lecture notes. These students had generally not read widely to supplement the lectures, and were left with a narrow and inflexible form of understanding which depended more on the lecturer than on their own efforts. Other students were so concerned about the coming examinations that they developed structures designed mainly to fit the perceived requirements of previous years' examination questions. There were only two types of structure which drew on wide, active reading and involved an independent transformation of what was being learned. Students in the penultimate category shown in Table 2 reorganised the structures of their revision notes to gear them more directly to question types found in past papers, while students in the final category were prepared to answer questions on the basis of a more independent, and more general, framework of understanding.

The five different kinds of structure, allied to parallel variations in breadth and depth, were described as *forms of understanding* (Entwistle & Entwistle,1991) and depended on differing approaches to learning and studying. The first two categories appeared to involve surface approaches, to differing degrees, while the third category was predominantly strategic. The remaining two categories drew on a deep approach, differing only in the extent to which they also involved a strategic component.

Knowledge objects

The interviews had explored in some detail the ways in which students had used visualisation in the process of bringing material to mind as it was required. These sections of the interview had not been included in the initial analyses, but proved particularly illuminating in relation to the internal organisational structure which students experienced as part of their understanding. Discussions of the transcripts with Ference Marton - triggered by one particular extract - led to a phenomenographic reanalysis of these sections of the transcripts (Entwistle & Marton, 1994). The extract which suggested this particular analysis came from a zoology student who was able to reflect on the processes of visualisation being used. In this extended extract, the student talks first about revision strategies and then about experiences of taking Finals.

> Well, you have to remember that I had lecture notes which were condensed in their own right (during revision). Then I had notes made from books, and these were all condensed separately... Similarly, I had condensed essays, and going back to second year essays and restructuring them, I made essay plans... In effect, each plan was an essay, but also it was my understanding put in my own particular structured approach..

(When it comes to exams), basically, if I work through any question from a logical standpoint, I have a range of options... Following that logic through, it pulls in pictures and facts as it needs them... Each time I describe (a particular topic), it's likely to be different... Well, you start with evolution, say,... and suddenly you know where you're going next. Then, you might have a choice ... to go in that direction or that direction... and follow it through various options it's offering... Hopefully, you'll make the right choice, and so this goes to this, goes to this, and you've explained it to the level you've got to. Then, it says "Okay, you can go on to talk about further criticisms in the time you've got left".

(Starting a question), I just clear my mind and something comes... You know it's visual in some ways, but it's also just there without necessarily being visual... (It's not as if) you remember a page, and the page is locked in your memory. What I'm saying is that the ideas are locked in your memory and they display as a page when you're thinking about it, but not necessarily when you're putting it down... You can sort of by-pass the conscious perception of your memory: it may not be a visual memory, but it may have to be perceived as a visual memory... I think, in a stress situation like an examination, you don't actually reach for it, it comes out automatically. That may show that it's not actually a visual memory, as such, but a visual expression of 'central memory'...

Take this graph *[shows diagram]*, you may recall it in many ways. You may remember it from having drawn it, from having thought about it; but to actually reproduce it on paper, you may not have to go through the visual process of remembering what it looked like on the page... You may say you've got a visual memory of it if you have to search for it, but otherwise it just appears, and therefore it's just a memory which may or may not be expressed visually... There's no differentiation between things that have been learnt visually, mechanically or in an auditory way; they feel exactly the same... I don't perceive it in any particular way, I just know it. I don't actually hear it, see it, write it; it's just present. And I know it's present without actually identifying it.

The subsequent analysis of the whole set of interviews suggested that this experience was not uncommon, although the majority of students found difficulty in articulating their experience. Piecing together the range of incomplete descriptions, we concluded that students were experiencing their understandings as having some internal form and structure - almost as entities in their own right which came to control their thinking paths. The term *knowledge object* was used to describe the essence of the quasi-sensory experiences of aspects of understanding. Students described impressions of a tight structure of which they were aware in a visual, but not wholly visual, manner. Key points within that structure were used to trigger details they had revised, but which were not immediately available in memory. In the words of another student, describing revision of a diagram he had been revising:

I can see that virtually as a picture, and I can review it, and bring in more facts about each part... Looking at a particular part of the diagram sort of triggers off other thoughts. I find schematics, in flow diagrams and the like, very useful because a schematic acts a bit like a syllabus; it tells you what you should know, without actually telling you what it is. I think the facts are stored separately, ... and the schematic is like an index, I suppose.

The analysis of the transcripts eventually suggested the four defining features of a knowledge object, shown in Table 3. The first three of these aspects were discussed fully in a previous report on this study (Entwistle & Marton, 1994). Here, the focus will be on the ways in which knowledge objects seem to control the explanations which students are able to provide of their understandings (see the second paragraph of the extended extract above).

Table 3 Characteristic features of 'Knowledge Objects'

Awareness of a tightly integrated body of knowledge
Visualisation and 'quasi-sensory' experiences
Awareness of unfocused aspects of knowledge
Use in controlling explanations

In discussing their examination techniques, students described how they adapted their understandings in a consciously strategic way to what they perceived to be the demands of the examiners. Their explanations seemed to be controlled not only by the organisational structures or knowledge objects developed during revision, but also by the form and wording of the particular question set, by the examination context and perceived requirements, and partly by the audience - the examiners who would be reading the script. Two students from the initial sample illustrate this strategic behaviour quite well - the awareness of the context as well as the subject matter content.

In an exam, you have to have background knowledge of the subject, and an ability to interpret the information in your own way... You don't sit down and think "How much can I remember about this particular subject", you try and explain your ideas, using examples which come to mind... You can't use all the information for a particular line of argument, and you don't need to; you only need to use what you think is going to convince the examiner.

I knew much more than I could possibly have written down in an hour, and what happened was that I wrote down the basics... (which would) hold up the argument... and then (whatever) came into my head, ... extra pieces of information or arguments ... I had read elsewhere... The more I have done exams, the more I'd liken them to a performance, like being on a stage; ... having not so much to present the fact that you know a vast amount, but having to perform well with what you do know...

The controlling influence of the knowledge object can be seen in an extract from our current work with historians. The integrated knowledge produced through intensive and lengthy revision offers a structure which is sufficiently strong to provide a generic framework for an answer, yet allows sufficient flexibility for that answer to be tailored to a particular question. In other words, repeated explanations of a topic are likely to have the same general structure, but to differ according to the specific demands of the question, situation, or audience.

> I had tried to structure my revision so that I could understand what was going on... So, although I had this structure when I went into the exam, I still wanted it to be flexible, so that I could approach the question (itself)... Generally, I knew what I was trying to get down, and it was a matter of getting down the basic points and then backing them up. At the time, as I was writing, I was just using anything that came into my mind (and fitted in). I had learned a good deal of detail, and yet I could use (only) a small percentage of it... (As I wrote) it was almost as though I could see it all fitting into an overall picture. I think you're almost developing what you know, and are playing it in a slightly different way. I think that's what they're looking for; that's why the question always has a slightly different twist. It's really a matter of trying to recall something you've learned, and understanding how it fits in.

Knowledge objects in course work essays

The experience of what we saw as knowledge objects had been described by students after they have worked intensively on the material during revision. So, are knowledge objects simply a product of that atypical, strenuous effort preceding Finals? Or are they also found in more usual circumstances during studying, for example when writing course work essays or term papers. In our current project, we interviewed historians, and have also collected samples of their written work - essays written as assignments and also answers to examination questions. At this stage, we have looked in detail only at the interviews on course work essays, and in particular at apparent links between the ways in which students organise their essays and evidence for the existence of knowledge objects in essay writing.

In researching and writing essays, students describe a process similar to revising for examinations, in which they first look at their lecture notes and make notes from books and articles. They then condense the notes down to a manageable volume by selecting those which seem relevant to the question, and may group them systematically into a series of headings. Students were again found to differ markedly in the breadth and depth of the understanding they sought to establish in writing the essay, and also in the way they structured their essays. Students' comments on their writing processes, and the differences between students in the quality of their writing, were similar to those previously described in the literature (Hounsell, 1984; Bereiter & Scardamalia, 1987; Biggs, 1988). In this analysis, however, it is not the general

processes which concern us, rather it is the ways in which students try to organise their ideas prior to, and during, writing and the extent to which such organisation can be explained in terms of the existence of knowledge objects.

Biggs (1988) saw the process of composing essays as a 'mysterious business' and sought a tentative explanation in the alternation of thinking between left and right hemispheres of the brain.

> Rico and Claggett (1980) argue that creative ideation is a right hemisphere and essentially non-verbal process, quoting C. S. Lewis's claim that all his novels began with "seeing pictures in my head"... Glassner (1980) took measures of hemispherical activity during writing and found (thinking and planning) to be right dominant, and transcription-related activities to be left dominant... (However), it could be that the only way that we can describe the (writing process) is allegorically. Hence, perhaps, the mystery: the need to invoke a demon to explain what cannot in principle be explained in words... Through a mysterious interfacing of thought with transcription processes, text emerges (p. 206).

To explore this 'mysterious interfacing' of thought and writing, we have to look, first, at some of the more concrete aspects of structure - the use students make of plans and their experiences of how those plans take shape. Differences in planning and revising have recently been described in relation to graduate students writing theses (Torrance *et all*, 1994).

> Our cluster analysis identified three groups - Planners, Revisers and Mixed Strategy writers. The Planners preferred to decide content at the beginning of the writing process and subsequently made few content related changes. The Revisers preferred not to decide content in advance of writing but tended to develop content as they wrote. The Mixed Strategy writers attempted to decide content in advance of writing, then changed content during subsequent revisions... It is possible that the relative success of the Planners resulted directly from the think-then-write strategy that they tended to adopt... However, findings relating to the other two groups ... suggest that deciding content before starting to write, helpful though it may be, is neither a necessary nor sufficient condition for writing success. (in press)

In our current sample of historians, similar differences in the extent of prior planning existed, and our Planners were also among the most successful students. The plans were written down, but in varying degrees of detail. Some were extensive, but others were no more than brief headings or key words. During the preparatory reading, those students who had engaged fully with the topic seemed to be organising the material as they read, and shaping it to meet the requirements of the task and also to reflect the range of issues emerging from their reading. For many of these students, the planning process was iterative, and much of the shaping was apparently carried out subconsciously during a period of gestation, until the student felt ready to write. Extracts from interviews with two of the history students show how they described this planning phase.

By the time that I've dissected the question and I've read the notes, I know what I want to conclude at the end, and so I'm leading up to that and the structure comes from there. Structure may be too grand a word for it; it's an idea or a basis on which to start the essay. The actual structure of the essay itself may well change a bit as I write. But with that idea, you know you can start and make progress, even though you don't know exactly what you're going to put in later... So the structure is there - (I have) a fairly good idea of what it's going to end up like,... but it's fluid, in the sense that I do change certain things within it. I don't write the structure down; I just keep it in mind. I can do that all right over the two or three days it usually takes to write the essay.

When I read the question I automatically have ideas, and even just from the reading alone, I pick up keys. Sometimes it's quite unconscious; you think "Oh well, that would make sense here". So, from that point of view, the structure really comes out of the reading that you do - there is a natural flow that just tends to come out of the reading... I always have to plan my structure on paper. It's quite detailed and I follow it quite closely. The funny thing is I think that when you formulate your plan you're so focused that things seem to follow quite naturally; there are themes that you pick up... I try different sorts of plan. Sometimes they're sort of flowcharts and others they're just headings. I maybe do one that's straightforward and another of the flowchart, and then see how they fit in together. It's something that's developed since I've been here, because all the time we're encouraged to link together our subjects, and from that you're more aware that you must link together themes as well.

When students were asked to reflect on the feeling of structure they had experienced prior to writing, some suggestions of knowledge objects could be seen in their descriptions. For example, in describing the planning process, one student explained:

You've usually got a sort of mental picture in your head, the headings that you're going to have, and then you can sort of plan it... It's sort of the general picture...

But it was when students were asked to think back to the content of an essay that they were better able to articulate their thought processes - perhaps because they were reflecting on a current experience, rather than on past thought processes which were taken for granted at the time. When asked about the content, several students talked about the need to use something like visualisation to 'get a handle' on what they had written.

Sometimes I can visualise parts of it. I can think about, perhaps, where certain things were, but I don't have the kind of memory where I can think back to a certain page and remember everything that was written down there... It must be that, in my mind, I'm just going back to the same structure that I had to begin with... (When I

think back now) the general points are there, and the actual details ... all come flooding back, as it were. The general arguments that I included tend to be remembered... I'd also remember what conclusion I came to, and I'd go back and think about how I structured the essay. Then I would try to pick out points I would have included... I would probably remember certain points, and then they may lead off to other points, and then they might start bringing things out. I wouldn't remember detailed things like quotes and data; I would have to actually sit down and learn those, but I think I would remember the general arguments.

This extract illustrates what was common to most of the students when they tried to remember what they had written. They soon brought to mind the structure of their essay, either from the title or by thinking about their conclusion, and then began to reconstruct the main argument of the essay, bringing in some of the main details or examples as their explanation developed. In this way, it again seemed that students were conscious of a tightly integrated and organised body of knowledge - a knowledge object - derived from the intensive work put into preparing and writing the essay. They seemed to use its flexible structure, then, to control their explanations and arguments as they were writing.

It should be stressed that such tight, integrated structures were found only among students who had engaged with the essay topic in a personal and active way, and had done substantial reading and organising of notes, before writing. Students who had treated the essay in an instrumental way - adopting a surface approach - had generally done less reading and given little attention to systematic reorganisation of their notes. They relied more on general logic, and an immediate reaction to the title, for answering the question set. They were unaware of the need to develop a form of logic from their reading which was specific to both the literature on the topic and also related to the underlying meaning of the title set. Furthermore, when asked to reflect on their strategies, they were often unable to describe more than the mechanics of the writing process. These differences between students will be explored more thoroughly in future analyses.

Discussion

There is an urgent need to concentrate research both on the students' experiences of understanding and on ways of encouraging the more active approaches to learning which lead to the more elaborated forms of understanding currently achieved by only a minority of students. Recent research on teaching for understanding in schools (Perkins and Blythe, 1994) has been paralleled by innovations in higher education (Entwistle, 1992). These approaches all require teachers to provide more opportunities for activities which provoke and demand thought, rather than implicitly encouraging the regurgitation of undigested information or use of routine procedures. Perkins and his colleagues argue that it is through *understanding performances*, designed to encourage independent thought, that students both display and develop their own understandings.

Here, we have been concerned mainly with one type of understanding performance - explaining through essay writing - and our analyses suggest ways in which students organise their understandings and control the form their essays take. As our research progresses, it is hoped that the systematisation of students' experiences in essay writing and revision can be used to provide advice to students on better ways of approaching these study tasks. Indeed, another project at Edinburgh is developing a computer-based advice system in hypertext which incorporates both such advice and comments of students on their study activities (Entwistle *et al*, 1994). Description of different forms of understanding also has direct implications for both teaching and assessment procedures (Entwistle & Entwistle, 1991).

It is important to stress that our findings do not depend solely on an acceptance of the existence of either contrasting forms of understanding or knowledge objects. The systematisation of students' reflections on their ways of writing essays and revising for examinations is of value in its own right. In judging the value of these concepts, however, it is necessary to look at more extensive evidence presented in the full reports (Entwistle & Entwistle, 1991a; Entwistle & Marton, 1994). Even in these reports, a good deal has to be taken on trust, given this type of qualitative analysis. It is really only through a detailed examination of the transcripts themselves that the experiences of students can be fully appreciated and interpreted. Acceptance of the interpretations presented here will ultimately depend on other researchers conducting and analysing equivalent interviews with students and deciding whether our conceptualisations are helpful. One test of the validity of qualitative analyses is that they describe a 'recognisable reality' (Parlett & Hamilton, 1972). On this basis at least, our experience suggests that the concept of 'knowledge object' has some value and we believe it will prove sufficiently fertile to justify its description at this stage of our research, even from admittedly small samples from just four disciplines.

We recognise one potential danger in using the term 'knowledge object'. It may convey not only an idea of relative structural stability, but also of a body of knowledge which a teacher could pass directly to a student. Yet, that would contradict the experiences of the students interviewed. Their descriptions imply an idiosyncratic construction of understanding, derived from a wide range of information and ideas. This content was reorganised by them, not just through linkages with prior knowledge, but also through their own distinctive way of thinking about the topic and the discipline. The concept of knowledge object, derived as it is from students' experiences, is in tune with current thinking about constructivism (Duffy & Jonasson, 1993), but fits rather uncomfortably with mainstream cognitive psychology which makes much play of mental representations and "encoded regularities in the form of categories" (Anderson, 1990), which are believed to underly consciousness.

Knowledge objects cannot be adequately described simply in terms of bundles of associations, pre-existing concepts inferred from past experiences, or facets of neurological structure. There is no merit, in our view, in seeing them as internal representations: they are experiential entities existing in their own right. From the reports of the students, knowledge objects exist, not

underlying, but in people's awareness. Sometimes they are in the foreground - they are focused on and figural. On other occasions they recede to background - they are peripheral and tacit. Donaldson (1992) has recently described variations in awareness in a similar way.

> We may know in a variety of ways characterised by differing degrees of awareness... Some kinds of knowledge are in the light of full awareness. Others are in the shadows, on the edge of the bright circle. Knowledge on the fringe of consciousness ... is always ready to move to the centre. It is accessible to us, even if we don't attend to it... Even as we ignore it, we really know it is there. (pp. 20-21)

It seems to be just that feeling that many of the students we interviewed were seeking to express.

Yet, does the notion of a knowledge object really offer anything new? The idea of a knowledge object can be seen to echo the original conception of schema, as described by Bartlett (1932). In his experiments, students were asked to make sense of a story. They did that by developing their own conceptions of its meaning - schemata which contained visual and auditory images organised into logical structures. These schemata followed the story theme, yet also reflected idiosyncratic reorganisations of the experiences of reading the story into individual structures of meaning. A knowledge object can be seen to have elements of similarity with Bartlett's original conception, but it is more extensive and integrated, and also more variegated and complex than his conception.

There may also be some similarity with the idea of a 'script', a term introduced by Schank and Abelson (1977) to describe how people anticipate what is required of them in everyday situations. The script indicates what to expect. In restaurants, for example, past experience organised into a script enables us to anticipate a particular sequence - head waiter, waiter, menu, ordering, food, bill, paying - and to act appropriately. The organisation of images, experiences, knowledge, and reflections into a knowledge object is immeasurably more complex and abstract, but it does still seem to provide a template for action in the form of speaking or writing.

Only time will tell whether similarities with these prior concepts outweigh the differences. Our concern has been to describe and systematise the experiences of students as they write essays and revise for Finals, and for that purpose the idea of knowledge objects has proved valuable. There are clear indications in our data that some students experience a feeling of tight integration and structure within their developing understanding, and that this feeling of structure plays an important part in both revision and essay writing, at least when students have adopted an active, deep approach to those activities.

We referred earlier to comments Biggs (1988) had made about the 'mysterious' writing process.

> It could be that the only way that we can describe the (writing process) is allegorically. Hence, perhaps, the mystery: the need to invoke a demon to explain what cannot in principle be explained in words... Through a mysterious interfacing of thought with transcription processes, text emerges (p. 206).

The idea of a knowledge object, with its tight but flexible structure, which seems to pull in details as required, may help to throw some light on the mystery. The concept may still be little more than a metaphor, but perhaps in naming the demon, we may encourage a different way of considering the interplay between thinking and writing. Whether it will prove fruitful to others, however, remains to be seen.

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