Science Education Students taking

ownership of their learning

Abstract

The acquisition and retention of knowledge doesn’t just happen, it is an active process and one that needs to be worked at. In order for knowledge to be meaningful and useful, we need to take ownership of our learning. Indeed this features significantly in the new standards framework. With this in mind, a small pilot study was conducted into enabling trainee teachers to take ownership for their own learning.

Secondary students in the conceptual development year of their undergraduate or post graduate training were asked to use a focussed learning log to assist with their studies. The log was to be used before and after the taught sessions alongside session plans and copies of support literature in the form of summary notes and power point presentations. The aim of the log was to identify their initial level of knowledge and before each taught session conduct some self-study in preparation for the session. They would then revisit the log after the taught session and identify areas for continued development as well as possible new questions and issues, which could be followed up at a later date.

This paper reports on the initial outcomes of this exercise, the perceived value from the student’s perspective of the approach used and paves the way for a more in-depth project into ownership.

Introduction

Media headlines state repeatedly that exams are getting easier and pupils are leaving school and indeed university with a string of qualifications behind their names but lack the necessary skills and attributes to enable them to use them effectively in business. The current changes at KS3 will place greater emphasis on using the curriculum to ‘… enhance general skills such as initiative and enterprise that will in turn encourage independent learning – better preparing pupils for GCSEs, the new diplomas and ultimately the world of work in the 21st Century’ (Science Learning Centres, 2007). The changes aim to give teachers a greater level of autonomy in their teaching and the potential to foster school focus curriculum development. However, research indicates that student teachers at both undergraduate and post graduate levels often lack any real degree of autonomy in relation to their own learning and that this is reflected in their teaching (Lakin, 2002 and Lakin, 2004). Through school and then often in Higher Education, our assessment led culture gears them up for a product oriented education system which they adhere to rigidly and is often reflected in the way these students transfer their own knowledge and understanding to the children they teach (ibid). Feedback from dissemination seminars indicates that this passive style of learning, despite our best efforts at active participation, is common place across several HEIs, within teacher education and elsewhere (Lakin: ASTE, CDLT and SMC, 2007).

The new TDA standards for NQTs and existing classroom teachers echo progressively throughout the documentation that teachers should enable learners to:

* reflect on their learning
* identify the progress they have made
* identify their emerging learning needs
* become successful independent learners (TDA, 2007:C33)

But what of the student teachers themselves, are they independent learners who can reflect upon their learning and identify their emerging learning needs? Evidence elsewhere (Ward and McCotter, 2004) suggests this is not always the case and go on to identify different levels of reflective practice indicating that some students may struggle to progress beyond the early stages of ‘shallow learning’; learning that is associated with the regurgitation of facts and processes that become seemingly mechanistic and lack ownership on the part of the learner (Copping, 2007). It is concern for this lack of development that leads to the development of this research project; the key aims of which are to present opportunities for students to:

* appreciate and take an active role in the learning process
* be critical, reflective thinkers able to identify gaps in their own subject knowledge & understanding and to identify how they can ‘fill’ those gaps
* inform their teaching and their pupil’s learning

These aspirations not only pave the way for progression within the TDA Standards but also relate directly to the attributes and academic rigour associated with Masters level study (an important factor considering this is increasingly the established route for teacher training throughout the UK).

Methodology

An opportunist sample was drawn from two cohorts of students, one in the first year of a two year PGCE programme, the other in the second year of a BSc QTS programme. Both followed the same Biological Principles modules (n = 12 students comprising 7 PGCE students and 5 BSc QTS students). The two cohorts were together for the first module running in the autumn 2006, but they took the second modules separately in the spring / summer 2007 owing to other commitments within their various programmes. This paper will focus on the findings from the first module which both cohorts were assessed on in similar ways. At the beginning of the module it was explained that there would be a strong focus on independent learning and with a specific emphasis on the student taking ownership for their learning. In order to support and assist the student in this support, information was made available: this included an outline scheme of work for the module, detailed lesson plans with clear intended learning outcomes available approximately 5 days before each session, the accompanying power point presentation and any other relevant material or suggested reading. A learning log template was made available for the students to use before and after each session. All resources were made available via a Blackboard (virtual learning environment) site. Problem solving tasks were also made available at the end of each teaching unit as a means of summarising and revisiting key aspects of the unit. The module broadly followed the SNAB’s ‘A’ level Biology themes (SNAB, 2005) and set the principle biological concepts in a contemporary context.

After 6 weeks the students were given an initial questionnaire which sorts information on the amount of time they spent on biology self-study per week, the information sources used, how useful they found the information on Blackboard and suggestions to make their self-study more effective. A further questionnaire was issued after the examination period in January and before the start of the second module. This focused on the effectiveness of their revision. Information was sought concerning the amount of time they spent on revision prior to the examination period, the sources of information they used for revision purposes and the perceived value of their revision process. They were also invited to comment on the teaching and learning approach used throughout the module. This was related to the outcomes achieved through the examination process. Two further questionnaires were issued during and at the end of the second module. All questionnaires were anonymous.

Findings

Responses to the initial questionnaire indicated that the students were spending between one and three hours on self study per week in relation to the taught sessions (see graph 1 below). On average, approximately two hours per week revision was being carried out in the period prior to the exam. The two students who spent less than one hour per week on biology revision in the run up to the exams were both confident in their own knowledge of biology and therefore felt prepared for the exam. One of these students gained average marks for the cohort, but felt he could have done better if he had spent more time revising the work. He was however a regular attendee at the taught sessions and had been putting in at least 2 hours per week in self study. The other student failed his exam and stated that although he was a strong believer in self study he recognised the need to attend the taught sessions and put in the self study time during the module. It was apparent that he had not done this. Being frequently absent from the taught sessions he did not complete the initial questionnaire so there is no data available for him regarding self study time during the module.



(Graph 1)

When asked about the resources used for self study purposes both cohorts readily referred to the session information available on Blackboard (see Graph 2 below). The lesson plan and Power Point presentation served to focus the self study, whilst areas for development were supported predominantly by reference to ‘A’ level textbooks. Significant emphasis was given to on-line resources and although the topic information available on Blackboard included hotlinks to selected sites, the students tended to use ‘Google’ and ‘Wikipedia’ searches as their initial and main information sources. One student did make regular use of the New Scientist website as well as other e-journals available through the library. He did however acknowledge ‘Wikipedia’ was his preferred initial research tool and interestingly apologised unprompted, on the questionnaire for this.

When asked about the resources used for revision purposes the lesson plan and Power point featured significantly in the students’ responses (see Graph 2 below). This was to be expected as the students were informed that the examination would focus on the key terms and concepts identified in the individual lesson plans. I was however concerned at the emphasis placed by the PGCE students on ‘A’ Level text as the main revision resource. Reduced emphasis was placed generally on their own notes although two BSc QTS students indicated that this was their main revision source. The internet still featured significantly as a revision resource and at least one student from each cohort used this as their main source of revision. Those students who revised for less than 1 hr per week tended to use ‘A’ level text as the main revision resource and Wikipedia for overview.

(Graph 2)

A comparison was made between the exam results of previous cohorts sitting a similar exam over the past 3 academic years. Data for PGCE cohorts were available for the last 3 years but only 2 years worth of data for BSc QTS students were available. Although the findings are inconclusive it can be seen from the graph that there is a generalised shift towards the higher grade categories over the years (see Graph 3 below).

(Graph 3)

General feedback from the students concerning the approach taken and the emphasis given to self-study was positive. The availability of the session material well in advance enabled them to prepare and read up on the topic and made them feel more able to contribute during the sessions.

Discussion

Although the students welcomed the opportunity to take ownership of their learning this was a significant culture change from what they had been used to and indeed from the approaches used in other modules on the programme. There was a marked move away from the distribution of extensive handouts akin to the ‘A’ Level tomes they used at home, to the emphasis on discussion, dialogue and informed debate. This necessitated preparation on the part of the student, which they generally accepted. It also required them to work at their own level in their self-study time to produce their own notes and summary information. The findings of the research suggest however that some students struggled with this approach; questioning their perceived aim of the self-study time. The impression immerging from the data implied a view of learning that tended towards the gathering or harvesting of information. The sources they used were very specific i.e. ‘A’ Level text; factual sites from the Internet and copies of the session Power point presentations (these were aimed as stimulus for discussion rather than purely informative). The approach to learning echoes Bruner’s comments, ‘… that knowledge is too often construed as a product rather than a process’ (Bruner, 1966 p.72). This was even more apparent when considering the student’s attitudes towards revision. When asked about resources for revision purposes it was clear that the purpose of the revision activity was spurious; many of the students were using this time to ‘learn’ information. They aimed to ‘absorb’ as much information as they could before the examination, essentially ‘cramming’ ready to regurgitate facts in the exam; its retention was short lived. This was limited in its effectiveness because, as the students were aware, the majority of questions on the paper were testing higher level skills of description, explanation and comparison. There were only a limited number of factual recall questions and these required the student to demonstrate a deeper understanding of the fact rather than merely a definition. The emphasis was more on understanding than testing factual recall. Perhaps even more disconcerting was the lack of confidence they appeared to have in their own notes. Few used these for revision purposes, preferring instead to call upon an established ‘A’ Level text, or in one case, Internet sources only.

The approach used throughout the taught sessions was one of reflection and debate; students were encouraged to consider the ‘Big Picture’ view of the topic in question. For example, when considering the blood circulation in Humans, a graph of the Cardiac Cycle together with an ECG readout and phonogram were discussed. The link between the electrical stimulus, characteristic sound of the heart beat, the sequence of heart muscle contraction and the circulating blood were all taken into account. This was a move away from the more isolated, reductionistic approach that is too often afforded to the teaching of biology (Lakin, 2004). The students however had been so used to ‘regurgitation style’ assessment that initially they found it difficult to see beyond the detail. Photosynthesis and respiration were a case in point. These two vital life processes are invariably taught separately, from the very early introductions at upper Key Stage 2 to the more detailed accounts at post 16. Students seldom see the connection between them and often end up battling with a list of chemical formulae and equations that are essentially meaningless. When however they are viewed in terms of the overall aims of both processes it becomes apparent that in plants respiration is needed to support photosynthesis and vice versa. Given the time and encouragement to consider science on this level, the learning begins to fall into place. This was reflected in the assessment when students were informed that chemical detail and minutia were not the focus of the examination, more an insight into understanding, analysis and explanation. Throughout the module the students were encouraged to reflect upon their own learning. A confidence quiz helped with this. It also served to tease out those who felt confident about a particular statement, that was in fact incorrect; an issue that had come to light elsewhere (ibid).

Metacognition; the ability to reflect upon one’s own learning has become widely recognised within teaching and learning generally and science and the environment, specifically (Fisher, 1995; Bruner,1996; Parker and Hess, 2001; Maiteny, 2002; Pollard, 2002; Ward and McCotter, 2004, Lakin, 2005) but as stated previously, this can take place at different levels (Ward & McCotter, 2004 and Copping, 2007). The effectiveness of this process appears to depend upon the level of reflection administered. A child at Key Stage 2 can reflect upon their own level of knowledge and understanding and possibly suggest in simple terms what they would need to do to progress to the next level of attainment. Likewise a child in Key Stage 3 and 4; but at what stage does this cease being the superficial ‘explain something rather than describe it’ to the more detailed progression leading to conceptual change? Something I would suggest that school pupils have significant difficulty in without the ‘expert scaffolding’ (Driver et al, 1985) of a practitioner. To achieve conceptual change, with or without the input of an expert practitioner, the learner needs to be actively engaged in the learning process. This in itself goes beyond the mere inclusion of active learning activities. As Ross et al explains,

‘… active learning doesn’t usually give autonomy over organisation of the learning to the learner: many active learning tasks are very directional and specific, but the main point is that they are impossible to do unless the children *think*.’ (Ross et al, 2004 p. 58)

For this to be productive, time is required for the learner to reformulate the ideas they are in putting; to assimilate them and take ownership of them. Until this happens the learner’s engagement is only superficial and deep learning (the acquisition of higher order skills such as analysing, interpreting and evaluating information rather than simply amassing, reproducing and describing it (Hill and Woodland, 2002)) and understanding are not achieved. Part of this process is to be able to recognise and fill the gaps in subject knowledge and understanding. *But how can the learner know, what they don’t know*? I would suggest that if the learner has the ability to tease out conceptual progression; identify the stages in the development of a concept, for example density or photosynthesis, the gaps in the subject knowledge begin to appear i.e. What do I need to know to progress from *understanding* that a green plant requires sunlight, ‘air’ and water to survive to *understanding and indeed, explaining* that it is in fact a combination of carbon dioxide and oxygen that is required along with the other requirements for a plant to survive.

Gaps in subject knowledge and understanding have long been recognised as an issue for ITE (Lakin, 2005) but equally, that we cannot hope to fill all these gaps during the PGCE year and that increasingly ownership for identifying and filling these gaps needs to be taken by the student teacher. They need to access reliable information at the appropriate level and with a clear enough explanation. The problem arises when they do not have the necessary skills to research information and select what is useful and what is useless, and recognise a suitable depth of information for inclusion.

Conclusion

So where does the student teacher go from here? The current proposed changes for KS 3 aim to limit content and put greater emphasis on skills, attitudes and attributes; this can equate to the development of critical thinking skills and indeed an understanding of the process of science and the nature of how science works. Osborne (2002) recognises that one of the key aims of science education is to develop a scientifically literate populace, who will have the critical faculties to begin to assess the significance of scientific evidence and ideas in modern day society. In order to achieve this not only must the content and approaches to science education be conducive with this but also opportunities need to be afforded that encourage the development of such skills and attributes. This will only occur when the learner takes ownership of their own learning and development; encouraging them to develop critical thinking skills and powers of reflection and deduction.

So it may be more than just coincidence that these skills are reflected explicitly in the new Standards forclassroom teachers (TDA, 2007) and indeed, not surprising that PGCE programmes across the UK are increasingly ascribing to Master’s Level as these same higher order skills underpin the academic rigour afforded by such studies.

This study, although small scale and inconclusive does suggest that there is considerable work to be done if our future teachers are to aspire to the challenges of contemporary science education and themselves strive to develop a scientifically literate populace capable of critical analysis and reflection as suggested by the current changes in science education.

**Recommendations**

The following key recommendations have arisen from this study and will inform the next stage of its development:

* The need for clear and accessible learning intensions and outcomes which focus the learner’s area of self study. Tunnicliffe and Ueckert (2007) stress that, ‘… if students are to connect ideas and develop deep understandings over time, it is essential that learning goals are coherent …’ (p.52). This in itself is just good educational practice.
* The curriculum should emphasise connectivity and inclusion to ensure the ‘Big Picture’ approach is attained rather than just isolated unconnected concepts.
* A review of assessment to ensure that it does not lead the learning but rather informs and enables it.
* Encourage independent learning whilst developing the higher order skills of reflective and critical analysis, thereby developing autonomous and progressive life long learners who can identify their own learning needs and areas for development. Once they can do this for themselves, affording similar opportunities for their pupils will follow.

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