How Could We Model Enquiry-Based Learning? Functional and Values-Based Perspectives on Student-Centred Education

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We would like to share with you some personal perspectives on Enquiry-Based Learning (EBL). This paper presents an evolving model of teaching and learning practices, which places different forms of EBL in relation to traditional teacher-centred methods. It attempts to capture the variety of EBL, allowing for a continuum from more tutor- to student-centred learning and teaching practices. We present models from two perspectives: a functional model from a practitioner's viewpoint, through to a learning developer's aspirational values-based model for change. The paper describes the original functional two-axis model of EBL (McMorrow 2008) and how teaching practices map on to it, including some projects supported by the Centre for Excellence in Enquiry-Based Learning (CEEBL). We show how this could evolve from two axes to three, and then acknowledge our on-going debate about an additional three-axes model, intended as a flexible overarching educational framework to recognise the connection between practice and values inherent in how we teach. The paper concludes by suggesting a possible synthesis of the three models and inviting input into its evolution.

CEEBL is one of 74 Centres for Excellence in Teaching and Learning (CETL) that were awarded funding by the Higher Education Funding Council for England (HEFCE) to promote excellence in teaching and learning in higher education. CEEBL aims to expand the University of Manchester's capacity for EBL at both undergraduate and postgraduate levels. Implicit in this objective is the goal of changing teacher-centred practices by extending and explicitly recognising existing EBL (student-centred) methods across the University.

EBL can be simply conceived as a way of conceptualising teaching so that activities become student-centred, focused on what the students do, with students having more choice and freedom to create knowledge. This approach is by no means new. Freire (1967) criticised the overly narrative nature of education, where students are turned into banking containers to be

filled with knowledge by the teacher. Instead, a co-intentional education was proposed, which frees students to recreate knowledge. Dewey (1938) also recognised the educational divide between traditional learning with students as receptors, with imposition from outside and above, versus progressive learning, where students learn through personal experience.

Everyone seems to have a different view of what EBL is. We present three models of EBL from two different but related perspectives and invite comment to an ongoing debate.

The Two Axis Functional Model of EBL:

Model 1

The two-dimensional model of EBL (Figure 1) builds on one originally developed empirically as a way of making sense of the great variety of projects supported by CEEBL (McMorrow 2008). It therefore represents a practitioner's perspective. It is functional in that it is grounded in practice. It attempts to capture the range of learning and teaching practices in terms of the degree to which two dimensions of EBL are devolved from tutor to student, and allow for a variety of different types of EBL:

- The x-axis represents a continuum between CONTENT being tutor-centred to student-centred in the material they learn.
- The y-axis represents the extent to which the learning PROCESS is structured by the tutor/facilitator, from a highly structured, (scaffolded or directed) learning process to a less structured, facilitated one.

This produces four quadrants (Figure 1). Traditional teacher-centred modes of teaching and learning lie in the bottom left, in the set-directed quadrant, with students in a responsive mode. EBL tends to be in the top right, flexible-facilitated quadrant, with students in a proactive mode. However, EBL can sit in the other two set-facilitated and flexible-directed sectors. Clearly, there are not sharp boundaries between these realms, so the axes are more usefully seen as continua. This acknowledges that teaching and learning practice can shift over time for any one course unit.

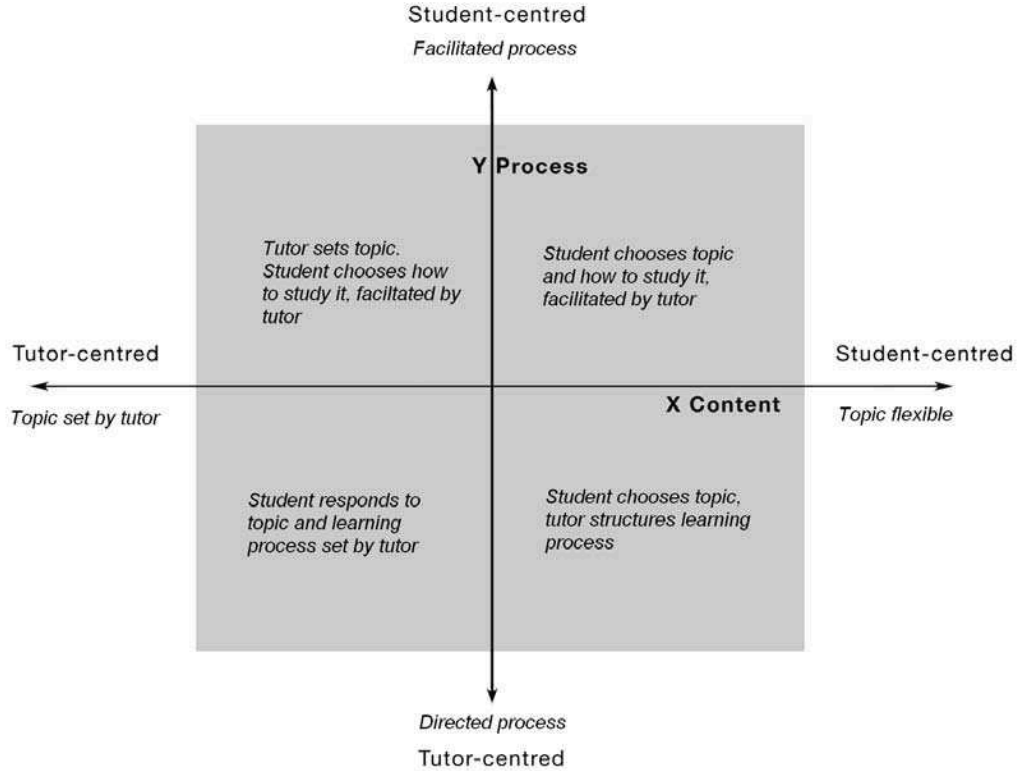

Figure 1. Model 1, two-dimensional model of learning and teaching practice (adapted from McMorrow 2008).

The **content axis** refers to the subject studied, the body of knowledge and the extent to which the students have choice and freedom in the topics studied. External drivers include the curriculum, as influenced by academic subject benchmark statements and professional qualification standards. Internal drivers include the accepted teaching and learning practices in a School, and the adopted teaching styles of tutors.

The **process axis** represents the way in which ownership of the learning process is devolved from tutor to student. It is the extent to which students decide their method and actions employed in the learning assessment process, including the framing of questions to be answered. It is also the freedom they have in deciding the strategies and timetable to achieve the required deliverable, be it a report, presentation, poster or reflective log. At one extreme, the tutor directs or scaffolds the learning process, for instance, by setting milestones, providing worked examples or setting a preliminary formative assessment exercise. At the other, students take responsibility for deciding how to achieve their goals within a less prescriptive structure, and the tutor facilitates the process in a less interventionist way.

Kirschner *et al.* (2006) refer to these two extremes as "guided" and "discovery" learning. We could align EBL with discovery learning in the sense that it is not only the deliverable which is important, but the experiences students gain in the learning process and their awareness of this process. However, it would be misleading to equate all EBL with discovery learning. Enquiry learning is very diverse, varying from Problem-Based Learning (PBL), which is usually scaffolded by carefully chosen scenarios, through to true discovery learning with minimal guidance (Hmelo-Silver *et al.* 2007). The process axis in Model 1 attempts to capture the wide spectrum of learning from one which is highly structured by the tutor to one which is owned by the student.

Kirschner *et al.* (2006) argue that scaffolded (guided) learning is more effective for novice learners, because it reduces cognitive load, making new topics more accessible (Sweller 1988). The implication is that students progress through their degree programme in what Hodge *et al.* (2008) describe as a developmental journey (Table 1), or Perry's (1981) schema of nine positions of cognitive and ethical growth (Moore 1994). In essence, less scaffolding is required as the journey progresses and active learning is more common at higher levels. The appropriate degree of scaffolding does not depend simply on the year of study, but on students' previous experiences of active learning within their disciplines, and will vary among disciplines. We should also consider students' varying learning dispositions (Carr & Caxton 2002) and learning styles (Healey *et al.* 2005); it is important to prepare students and tutors for EBL and group work if they are new to it. Model 1 allows for a progression along the process axis from more structured to discovery learning as the learners' and tutors' experiences develop, regardless of year of study.

Developmental level	**Student traits**
Reliance on external references [Foundations]	Knowledge viewed as certain. Reliance on authorities (e.g. professors, parents) as a source of knowledge. Externally defined value system and identity. Act in relationships to acquire approval.
At the crossroads [Intermediate learning]	Evolving awareness of multiple perspectives and uncertainty. Evolving awareness of own values and identity and of limitations of dependent relationships.
Self-authorship [Capstone]	Awareness of knowledge as contextual. Development of internal belief system and sense of self-capacity to engage in authentic, interdependent relationships.

Table 1. The developmental journey of the student. Source: Healey & Jenkins (2009), based on Hodge *et al.* (2008).

Applying Model 1 to Teaching Practices

Figure 2 shows how traditional lectures, dissertations and selected projects supported by CEEBL map onto the two-dimensional functional model. In a traditional lecture, both the content and learning process are determined by the tutor. This is not to say that lectures have no role to play in teaching and learning, nor that all lectures are simply a one-way transmission of information. Pyramid activities, question and answer sessions and interactive 'just-in-time' teaching techniques, using classroom clickers to give instant feedback on topics requiring clarification (Birch and Walet 2008), all move the 'lecture' along the content axis towards a more student-centred approach.

Final year dissertations or projects and Ph.D. theses are common examples of EBL, although may not be recognised explicitly as such. In many Humanities disciplines, the capstone dissertation would be at the student-centred end of the content and process axes, with students generating their own topics and taking responsibility for the learning process. In some disciplines, however, students choose from a list of approved topics. Most final year dissertations and projects are relatively less scaffolded, and so lie in the upper right, sector quadrant of Model 1.

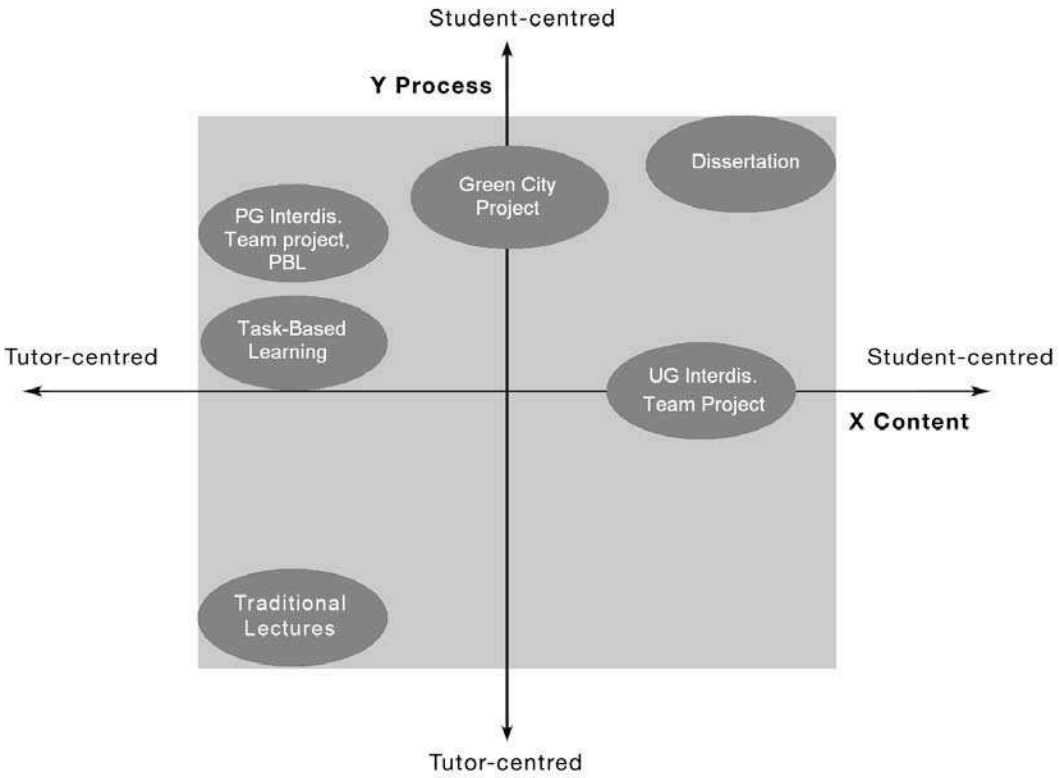

Figure 2. Model 1, showing how selected CEEBL-supported projects and traditional lectures map onto the two axes (based on McMorrow 2008).

In the Undergraduate Interdisciplinary Team Project (Woods *et al.* 2004, 2006), teams were free to select any topic for their six-week project with very few restrictions (to be of environmental or societal relevance and relate to each discipline in the team). Arguably, devolving content to students in this way was easier because the primary learning objectives were to acquire transferable skills and develop an appreciation of interdisciplinary working. However, the challenging task of choosing a topic and breaking it down into research questions placed the students in the role of researcher, similar to Healey's (2005) research-based mode (Figure 6). It is placed mid-way on the process axis, because the learning process was scaffolded by a worked example with weekly milestones, reflecting the fact that the majority were new to EBL. However, for the second half of the unit, the learning process was more student-centred, being less structured and involving a reflective element.

The Postgraduate Interdisciplinary Team Project (Woods *et al*. 2005) was similarly focussed on transferrable skills, but it was more tutor-centred in content than the Undergraduate Interdisciplinary Team Project. Because of the shorter duration (four weeks), two PBL scenarios on water quality in contrasting cultural settings were given to the students, to free up time otherwise required in negotiating a topic and include the cross-cultural component (developed and developing world scenarios). The learning process was less scaffolded than the undergraduate one, as most of the participants had experience with EBL. It is therefore placed farther towards the student-centred end of the process axis.

Franc *et al.* (2006) describe their first year French project as 'task-based learning' (TBL) because tasks were carefully chosen scenarios in phonetics and grammar which had 'crisp', uniquely correct answers, as opposed to fuzzy problems with many possible solutions which are more typical of PBL. We therefore suggest that the project is placed close to the tutor-centred end of the content axis, and mid-way on the process axis to reflect the degree of scaffolding provided.

Content in the Green City Project (Smyntek *et al.* 2010) was moderately devolved to students, in that broad topics were proposed by the client, Manchester City Council. Dissertation students or student teams selected a specific topic, and then negotiated the lines of enquiry within the external partner's remit. The position on the process axis varied from very student-centred in an individual dissertation to more scaffolded in team projects. However, we welcome comment on placing of all the examples in Figure 2.

The Three-Axis Functional Model: Model 2

Model 1 could be extended to include a further dimension - a **context axis**, as in Figure 3. This axis is more subjective and contentious because it refers to how relevant the learning is perceived to be by students; so it will vary with the individual. At one extreme, it may be regarded as highly relevant by the tutor, but seen as abstract and of limited relevance to the learner. It often, but not exclusively, involves using quasi- or genuine real world examples and contexts to improve student motivation. This is certainly not to imply that tutor-devised scenarios or more abstract material are not relevant to student learning. Indeed, scenarios devised by tutors can be highly authentic because they draw on greater knowledge and understanding of the domain. Instead, the context axis highlights the importance of making relevance explicit to students. An example is the task-based project in French, cited earlier (Franc *et al.* 2006). Here, tutors devised scenarios for peer-to-peer learning in which phonetic rules were learnt by contextualising hypothetical but realistic problems: for instance, improving work colleagues' pronunciation of a typically challenging set of words.

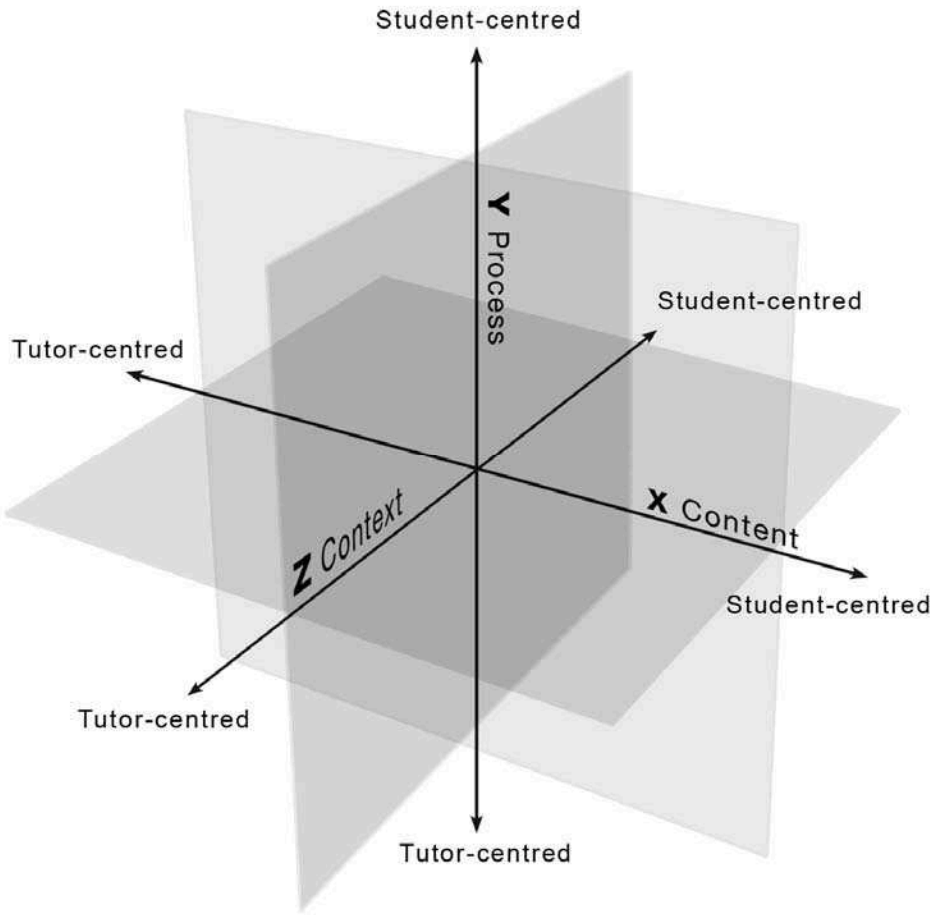

Figure 3. Model 2, three dimensional functional model of learning and teaching practice.

The context axis represents the continuum between practice perceived by students as lacking context and relevance, to one which is perceived as highly relevant, often involving a real-world context. In practice, abstract and real-world are not mutually-exclusive, since real-world contexts need to be theorised and abstracted to make sense of a complex real-world scenario. For example, students in the Green City Project (Smyntek *et al.,* this volume) were encouraged to relate their client-based problem to theoretical frameworks of sustainable development. The Green City project is placed provisionally at the student-centred end of the context axis, since the students saw it as highly relevant (Figure 4).

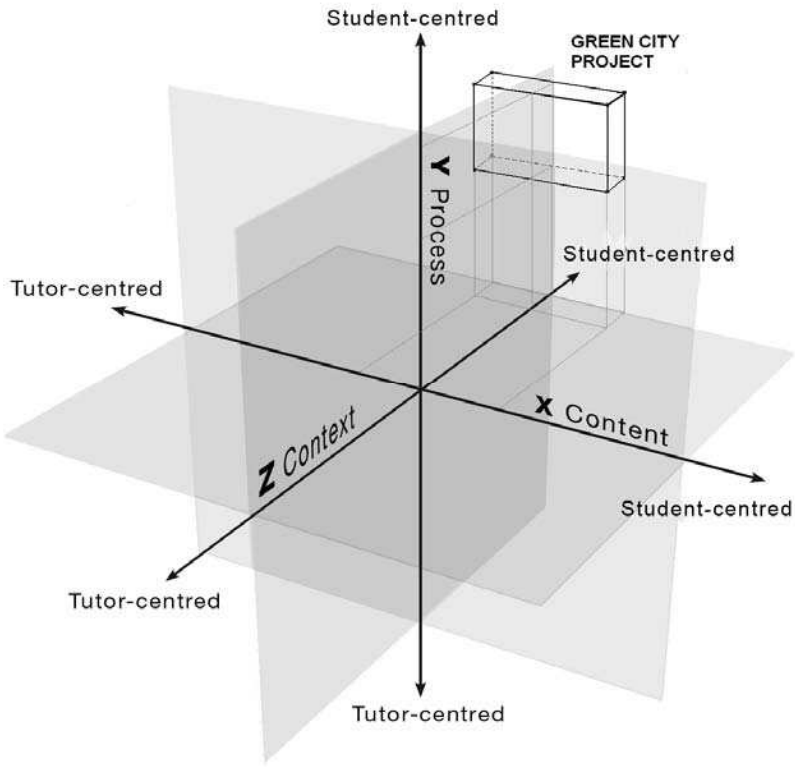

Figure 4. Model 2, three dimensional functional model of learning and teaching practice, with the Green City Project placed into the model.

Three-Dimensional Values-Based Model of Learning: Model 3

One reason it is so difficult to change practice is that it also involves a change of ideology, and the introduction of a new paradigm and discourse which underpins practice. Aubrey is developing a third model (Model 3, Figure 5), which proposes a framework from which to

understand the underlying pedagogy, and theory of teaching and learning practices. This values-based model explores the ideological implications of teaching in practice. Part of the inspiration for this values-based educational model came from Makiguchi (1930) a Japanese Buddhist educator, who believed the purpose of education is to enable students to create value in their communities and achieve happiness. This educational philosophy has much in common with the principles of EBL. Makiguchi (1930, p.196) stated that,

> *the aim of education is not to transfer knowledge; it is to guide the learning process, to equip the learner with the methods of research. It is not the piecemeal merchandizing of information; it is to enable the acquisition of the methods for learning on one's own; it is the provision of keys to unlock the vault of knowledge.*

The values-based EBL model is also a way of articulating the dimensions of an holistic educational model, which proposes essential aspects of curriculum design.

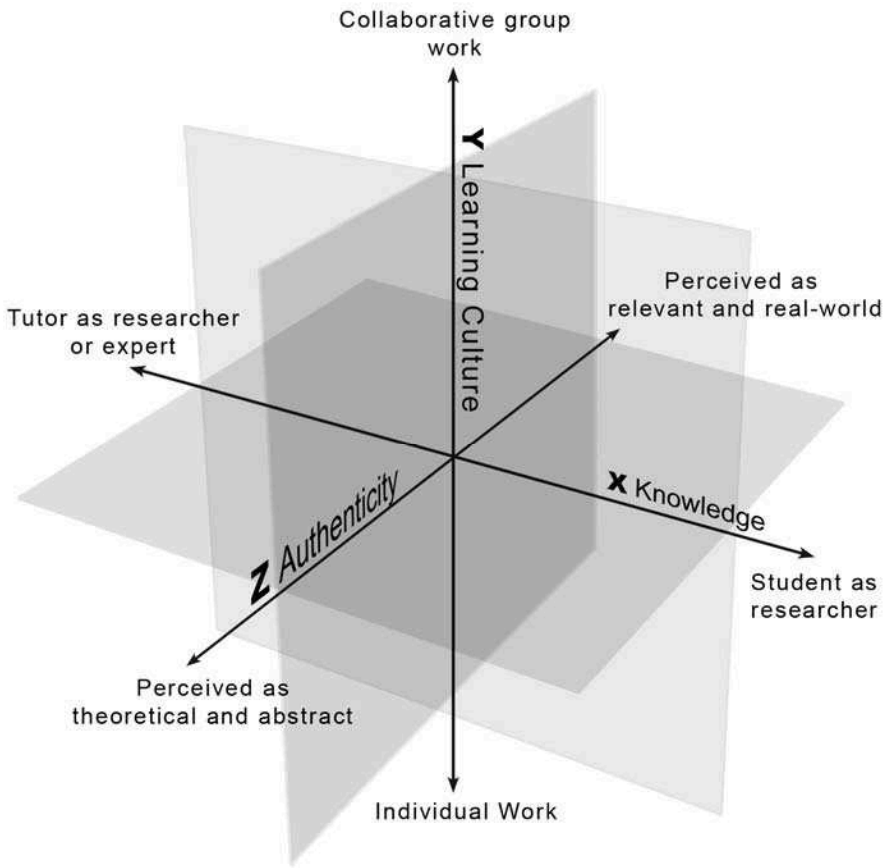

Figure 5. Model 3, three-dimensional values-based model of learning and teaching practice.

- The x-axis represents the extent to which the student is the researcher, whether the curriculum KNOWLEDGE creation is student-led or tutor-led.
- The y-axis represents the extent to which the ethos or LEARNING CULTURE is individualistic and competitive, or collaborative group work.

- The z-axis represents AUTHENTICITY, that is, the extent to which it is perceived to include: theoretical and abstract, and relevant and real-world dimensions.

The **knowledge** axis represents the extent to which students have the scope to create or re-create knowledge (to author knowledge), as opposed to having to acquire *critically* the knowledge of others. There are parallels with Healey's (2005) and Levy's (2009, 2010) models discussed later.

The y-axis in Model 3 attempts to represent the underlying ethos and **learning culture**, the degree of cooperative learning, from students working predominantly as individuals to a predominant team ethos. Individualistic processes would include individual examinations, individualised course work and individual reflection. However, it is important to acknowledge that collaborative group work still includes individual accountability and reflection, and that teams can compete. It is not dualistic, and teaching practices can incorporate aspects across the entire axis. Johnson *et al.* (2007) drew on extensive research to support their position that cooperative learning (for example, in enquiry-based group work), as compared to competitive and individualistic efforts, tends to result in higher achievement, longer term retention of what is learned, higher-level cognitive and critical thinking, better creative problem solving and intrinsic motivation.

Model 3's y-axis also represents a tension between a societally conscious life (Makiguchi 1930) and social constructivism where students expand their knowledge within a social context (Vygotsky 1978), with social interactions and peer learning; and a self-conscious individualistic view of education where students compete for grades and, ultimately, for jobs. The ethos embodied in the educational experience of students does have an impact on our communities and the culture of wider society. Learning collaboratively may help our communities to become more collaborative.

Aubrey reinterprets the context z-axis from Model 2 as an **authenticity** axis, moving it from perceived academic relevance into deeper questions of academic values. The authenticity axis would then form a continuum between real-world, authentic, personalised education and more theoretical, abstract but complementary education. However, readers assuming that there is an implication that theory is abstract and inauthentic has proven the most contentious area of our debate. This is in fact not the case, McMorrow sees the teaching and learning of theory as central to disciplines, and therefore not inauthentic, and not abstract in a good EBL setting. And Aubrey seeks to raise authenticity as a neutral concept, so that teachers themselves may reflect on and make their own judgement as to what value that the educational experience they facilitate can contribute to society, the environment and the happiness of the student.

Parallels with Education for Sustainable Development

There are parallels between Model 3 and principles underlying education for sustainable development (Henderson and Ikeda 2004), in that both highlight underlying values. Ikeda's (2002, online) vision of education for sustainable development is to build a value-creating educational system where students are empowered to create value in their communities through,

> *a contributive way of life [which] is based on an awareness of the interdependent nature of our lives--of the relationships that link us to others and our environment.*

This pedagogy clearly articulates an ethos of learning as a philosophical tradition.

There are also parallels between education for sustainable development and EBL more generally. We suggest that good sustainability education would employ EBL. Sterling (2001) from the Centre for Sustainable Futures CETL at the University of Plymouth argues that in order to achieve sustainability (the reconciliation of environmental, social and economic demands), a move away from a transmissive mechanistic paradigm to an ecological paradigm is required. In an ecological paradigm, each of the dimensions of the axes in Model 3 would be integrated, enabling a transformative educational system which can contribute to society achieving sustainability. He argues that in the dominant educational paradigm there is a disintegration between eidos (knowledge creation), ethos (learning culture) and praxis (authenticity of the action), which he envisages as essential to achieve whole systems thinking in education.

One CEEBL funded project already referred to, the Green City Project, and its successor, the Manchester Sustainable City Project, embody many of these EBL dimensions. However, EBL has much wider application beyond education for sustainable development; it is a good flexible model for any education in any discipline. The diverse case studies that CEEBL have supported are testament to that. There are many other ways to incorporate EBL dimensions into teaching practice. The creative case studies in this and the previous CEEBL publications provide an array of interpretations from academics who value the students' learning experiences and have invested time in striving for excellence.

Towards a Combined Model

The axes in all three models are best viewed as a continuum between non-dualistic interconnected opposites. Academics' teaching practice may tend to one extreme of an axis, or incorporate aspects of both extremes, depending on the course unit in question and many other factors. It is not essential for EBL to have all the student-centred components, but for it to be excellent it is more likely to include aspects in the top right quadrant of Model 1 or the equivalent octants of Models 2 and 3, that is, towards the student-centred end.

The functional and values-based perspectives together yield three models. Taken together**,** four dimensions (which are notoriously difficult to convey in a clear graphical form) of the student learning experience at university emerge. In our on-going debate, we have attempted to rationalise these as follows:

- **Knowledge** creation, or eidos approximately equivalent to **content**;
- Learning **process**;
- Learning **culture**, or ethos; and
- Perceived **authenticity** of the practice or action, or praxis, approximately equating to **context**.

Relationship to Other Models and CETLS

The Learning Through Enquiry Alliance (LTEA) is a network of CETLs who share an interest in EBL. The LTEA is committed to research-informed pedagogic development, and to pooling and co-developing knowledge about how to become better agents for change. Pedagogic models have emerged from these CETLs including: Healey (2005), and Healey and Jenkins (2009) from the Centre for Active Learning based at the University of Gloucestershire; and Levy (2009, 2010) from the Centre for Inquiry-based Learning at the Arts and Social Sciences based at the University of Sheffield.

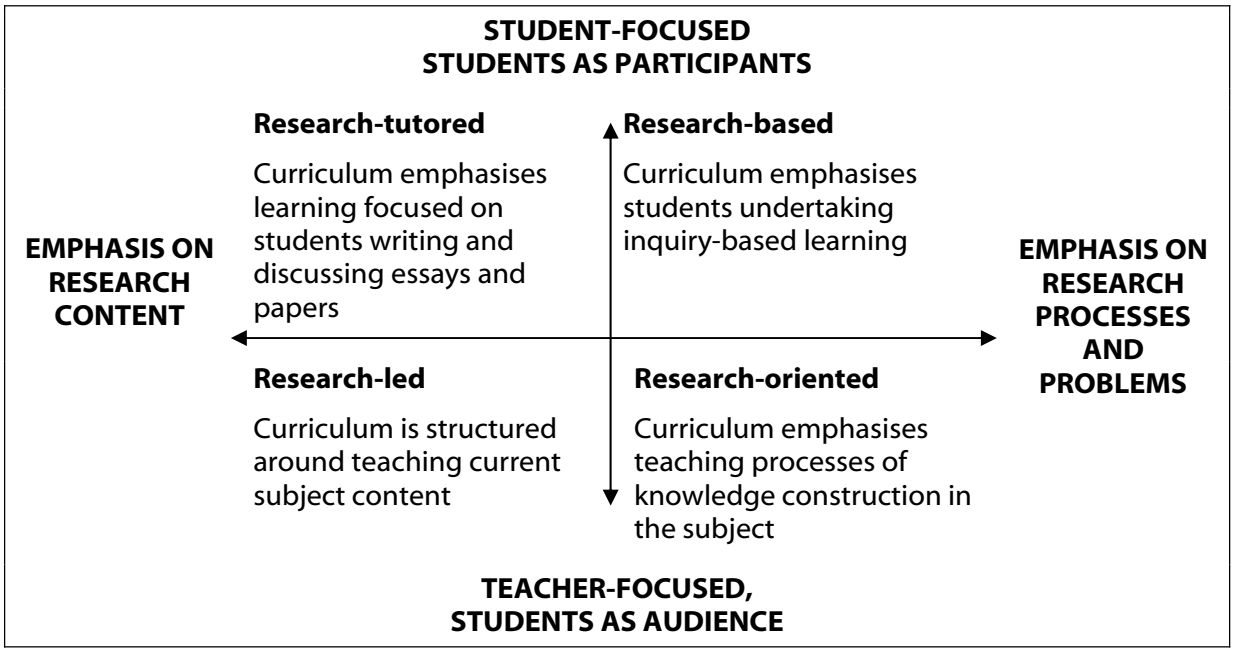

Figure 6. Curriculum design and the research-teaching nexus (after Healey (2005, p.70)).

Healey (2005) explores the research-teaching nexus and the role of EBL (Figure 6). He describes a research-led curriculum where what students are taught (content) is dominated by staff research findings and interests, and information transmission is the main teaching mode. This grades into a research-based curriculum, where students learn as researchers, with an emphasis on the learning process, and the curriculum is designed around EBL activities. In his representation, the vertical axis stretches from active to passive student participation, and content and process are seen as two separate end points of a horizontal continuum.

Levy (2009) goes beyond the teaching-research relationship to provide a model specifically for inquiry-based learning (Figure 7). Her model could be seen as more finely dividing Healey's upper-right, 'research-based' quadrant. Model 1 (Figure 1) at first appears similar to Levy's, in that the horizontal axis of both move from staff to student-led content, but Levy adds authorship of new knowledge as the vertical axis. The other major difference is that Model 1 includes as a criterion the degree of devolution of the learning process (expressed as amount of directed support or scaffolding). Levy's most recent version (2010) picks up on this, subdividing each quadrant into more and less supported.

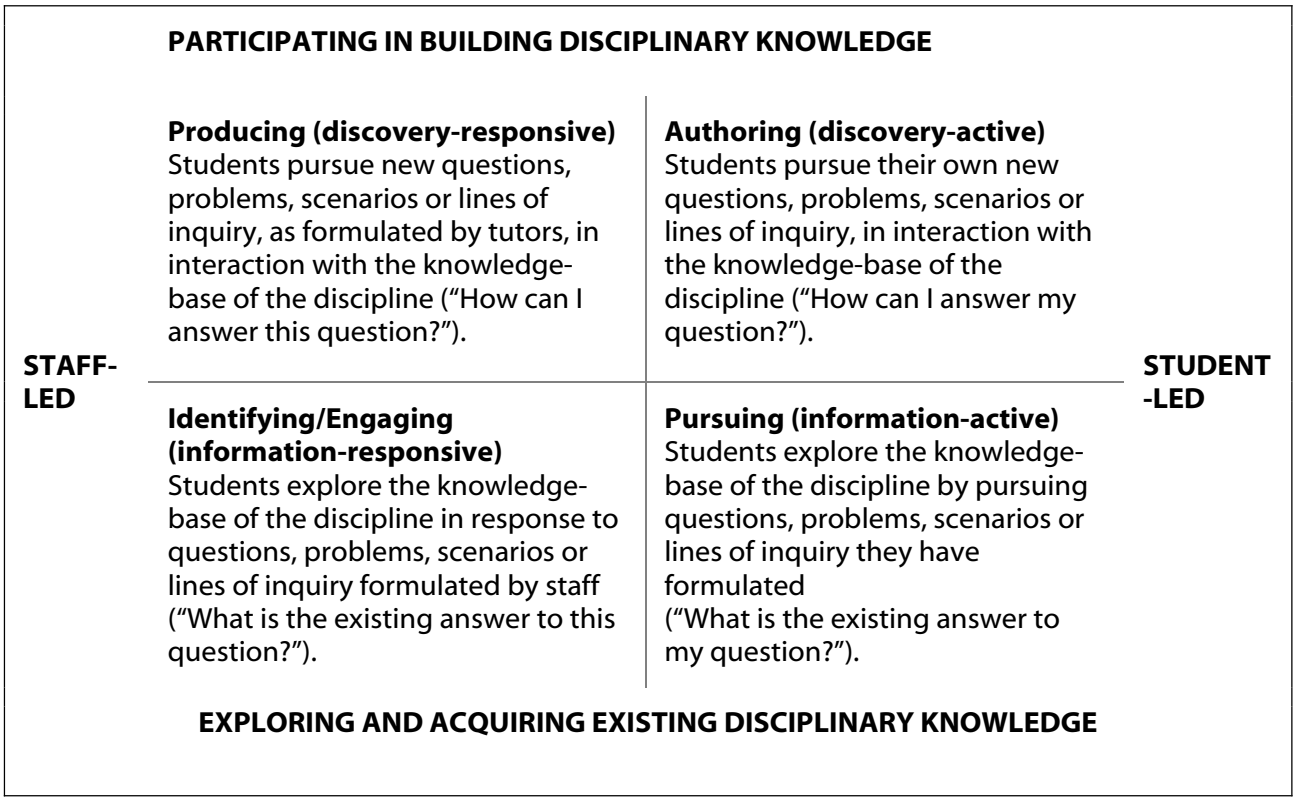

Figure 7. Levy's (2009) model of inquiry-based learning presented in Healey and Jenkins (2009)), and updated from Levy (2010).

Models in Action: Surveying the Student Learning Experience

Mapping course units onto the axes of any model, as in Figures 2 and 4, requires reflective practice by tutors. The student perspective is also very valuable, and arguably essential for the context axis of Model 2 and the authenticity axis of Model 3. Such feedback was available for the Green City project, but is not routinely collected and centrally analysed across the whole University at Manchester. Our current University-wide feedback forms ask how students rate the *teaching* they receive; the dominant paradigm is therefore students as passive recipients. Should we not also acknowledge students as active learners, and ask also how they rate their experience of *learning* at Manchester?

A student survey initiated by the Centre for Excellence in Applied Undergraduate Research Skills, another member of the LTEA, at the University of Reading has used models similar to those presented in this paper as the basis for forming a more student-centred survey of the student learning experience (Creighton *et al*. 2008). The Reading survey was based on the North

American equivalent of the National Student Survey, and elicited students' learning experiences across the University using questions chosen to map onto on a combination of Healey's (2005) research-teaching nexus model and Levy's (2009) model of inquiry-based learning . Key questions included the degree to which students rated teaching as student or staff-centred, and the proportion of time they spent in activities such as memorising versus analysing and synthesising material (Healey and Jenkins 2009). The Reading survey produced mappings similar to Figure 2 for each Faculty, School and discipline. Manchester would benefit from a similar survey, perhaps based upon refinements of the models presented in this paper.

Conclusion

Three models have been presented for debate and their relationship to two other published models has been outlined. Model 1 is a functional model of EBL from a teaching practitioner's perspective (McMorrow). Model 2 is an attempt to combine both authors' ideas. The third goes farther, expressing Aubrey's ideas for recognising values in the curriculum. The model will continue to evolve with feedback from staff and students.

The process of writing this paper has involved much debate between ourselves, as well as with colleagues at CEEBL. We hope that the models proposed will facilitate similar discussion amongst academic teaching staff of what enquiry-based learning is and where it fits within a broader educational model. We seek to encourage academic reflection on how we as an academic community teach, and perhaps elicit a reform in teaching practice. Creating excellence within teaching institutions ultimately requires a change in practice and an increased recognition of the values inherent in higher education. Indeed, change was central to the CETL initiative.

A starting point is to ask where you would place your teaching practice on the axes in the simple two-dimensional functional model (Model 1), as in figure 2, and then to try and place your ideal practice on the two three-dimensional models. Do the models presented in this paper work, or are other axes required? Does Aubrey's value-based model (Model 3) represent the type of educational experience that you truly value? Would a move towards the top right-hand sector of Figure 5 enhance the student experience and provide learning opportunities which encourage students to fulfil their potential to create value within our communities? This echoes Ramsden (2008), who calls for universities and colleges to explore new models of curricula, which extend students to their limits, develop skills of inquiry and research, are imbued with international perspectives and possess a sense of obligation to the wider community.

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