RETHINKING E-LEARNING DESIGN ON GENERATIVE LEARNING PRINCIPLES

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Abstract

As the latest in a long history of educational innovations implemented in the wake of technological advances, e-learning appears to have adopted a widely accepted and largely technocentric instructional design paradigm, that generally lacks an educationally sound, theoretical basis for design. We report on an investigation of the fruitfulness of a new, generative theory and model of learning for making sense of e-learning design, and briefly discuss some similarities and differences between this generatively principled e-learning design framework and other design and technology selection frameworks in the field. We suggest charting a course for digital education by formulating an e-learning design process that is generative in nature, and set out a research agenda on this basis. This might provide the necessary direction, amidst winds of change, in particular though not exclusively for corporate e-learning.

Keywords

educational design, generative learning theory, learning objects

Introduction

As the latest in a long history of educational innovations implemented in the wake of technological advances, e-learning appears to have adopted a widely accepted and largely technocentric instructional design paradigm (Papert, 1990). Despite the existing body of educational research, educational design occurs in response to here-and-now needs analysis, and then a product (in this case an e-learning environment or system) is developed, implemented and evaluated. Generally these phases occur in that order, although sometimes they can be less distinct or visited iteratively or in cycles. However, it is already apparent that the reality of e-learning has fallen a long way short of the hype, as the task of building e-learning environments to cater for identified needs (both learners' and organisations') proves more challenging than initially anticipated. Significantly, the current trend towards the use of learning objects alongside current development methodologies (for example, Wiley (2000) risks exacerbating this problem. Even if repositories of pre-specified tasks become easily accessible to instructional designers, this availability will not compensate for the lack of accompanying hard research data; about their educational credibility, or about the circumstances in which their worth for learning can be demonstrated.

In this paper, we suggest a way forward, one that has emerged from our collaborative work as student- and teacher-researchers in a Master of e-Learning program. First, we lay out our diagnosis of the problem: in essence, a simplistic (and perhaps even flawed) view of the design process, one that risks compromising the educational integrity of e-learning systems. Then, we propose an alternative view of e-learning design, based on what we call generative principles, and we begin the task of elaborating and testing it. We conduct a detailed examination of the design of three boutique e-learning environments, created on generative principles. Using the corpus of research data surrounding these environments, together with our own experiences of them, we identify design-specific factors that might account for their success. We sketch the research and development agenda that arises from this preliminary work, and some implications if this new, generative view of e-learning design becomes more secure. We conclude by commenting on the nature and significance of the context in which our ideas have developed.

Towards diagnosis: Realising the necessity for and power of principled design

The work we report here was undertaken collaboratively as an independent study by two of us (JC and JS), as students, for one subject's credit in the second year of a Master's degree in e-Learning. The work was mentored by the third author (LS), a teaching academic in the program and a key member of the development teams of two of the e-learning environments studied. JC and JS entered the course with strong personal and professional agendas, formed over their years of educational, and now corporate, experience. In particular, through their postgraduate study in this program, they wished to resolve the following issues, which they identified as currently problematic for e-learning and not adequately addressed by traditional design practices:

- Establishing and maintaining strong connections between knowledge and skills treated in e-learning environments and those learners encounter in their current and future contexts;
- A need for any time and place learning that is embedded in an organisation's culture, the acceptance of such learning by management as being valid and available when required rather than simply just in case;
- The need for staff development to be appropriate to learners' immediate needs; and
- The need for improved course design, flexible and accessible technology, and increased learner preparation and involvement.

At the beginning of the first year of this Master's program, students were required to immerse themselves, as learners, in e-learning environments. At the same time, they were supported in developing their knowledge of a range of learning theories. Together, these tasks were intended to help students refine their ability to critique e-learning environments by attuning them to implicit views of learning. In order to make diverse theoretical foundations even more obvious, students were asked to conduct a detailed comparison-and-contrast study, selecting two e-learning environments for such treatment. JC and JS (as members of a group of five students) chose to examine a corporate market leader and the Generative Virtual Classroom (GVC) (Schaverien, 2000). The group's experience of GVC contrasted markedly with their experience of the commercial product, which had been developed using instructional design methods commonplace within corporate e-learning. As confirmed by a growing body of research, this conventional methodology produced a formal and often abstract, instruction based product that ignored the validity of individual group members' learning strategies and was far removed from the reality of their real world practice (Winn, 1997). The group judged the commercial product, common with many e-learning environments, to be poorly designed, uninspiring and unengaging (Norman, 2002 & Phillips, 2002). The group also noted the lack of comprehensive research into the use of corporate e-learning systems. (Moyer, 2002).

It was through their study of the GVC that JC and JS were introduced to a biologically based generative theory of learning (Schaverien & Cosgrove, 1999, 2000). In fact, by the end of that study, the group reported that they could perceive generative principles within the design of their Master's program itself and recognised the power of their own learning in an environment underpinned by generative learning theory. Furthermore, by testing this theory against their own experiences in education and corporate training, JC and JS recognised that it may have much to offer corporate practice. By the end of their first year in this Master's program, having developed e-learning design and technology selection models to fit their own professional contexts, JC and JS had formed the view that all aspects of the design of an e-learning environment, could be seen as learning events in themselves. They hypothesised that the design and development of an e-learning environment, including technology selection, might need to be consistent with the learning theory that underpins that environment in operation.

In effect, their studies had led JC and JS to recommend the need for and the power of principled design as a possible way forward for e-learning. A two-part research and development agenda for testing the worth of this recommendation emerged:

1. To analyse a number of already-designed environments underpinned by a generative theory of learning, in order to understand more clearly the nature and significance of the relationship between that theory and the e-learning design process, including technology selection; and
2. Based on these research insights, to design and test a new generative e-learning environment for a specific organisational context.

The present paper reports the outcomes of the first part of this agenda, beginning with a description of the biologically based generative theory of learning at its core. Preparations for the second part are also well underway, but will not be reported here. This two-part agenda aims to contribute, first, to the exploration (as recommended by Bohm and Peat, 1987) and, in due course, to the critique of conceiving of e-learning design on generative principles.

Identifying principles for design: A biologically based generative learning theory and its derivative learning model

Recent insights from the neurosciences and evolutionary epistemology have led a growing community of scholars to recognise learning as a generative act (after Wittrock, 1974, then Minsky, 1985, & Corballis, 1991). On this view, learners test ideas, which they may either have created or inherited (Edelman, 1993) for their value, retaining those that have survived their tests (Minsky, 1985, Plotkin, 1994). Such a view of learning fits well with empirical evidence from a recent set of studies of technology-and-science learning and teaching (Cosgrove, 1995; Cosgrove & Schaverien, 1996; Schaverien & Cosgrove, 1995). These studies depicted a subtle dynamic between learners' active experiences and their developing knowledge, suggesting that knowledge had not been transmitted, but rather created anew, in the contexts in which these learners learned. Learners appeared to select, recognise and strengthen a repertoire of ideas and behaviours through iterative cycles of testing against their own evolved and evolving values through a lifetime of experience (Schaverien & Cosgrove, 1999, 2000).

This view of learning predicts that adult learners, with their strong repertoires honed over a lifetime of experience, may well find learning more difficult, more in conflict with their well-established values, than might younger learners (Schaverien & Cosgrove, 1999). Therefore, the design of learning environments which acknowledge this process and attempt to build on existing values, experience, knowledge and skills may go some way to overcoming this potential barrier to the creation of new knowledge and skills. Schaverien & Cosgrove (2000) present a learning model derived from this generative view, that includes five contiguous acts of natural learning, and the model has since incorporated a sixth act. Learning can ‘begin” with any of the six acts and follow idiosyncratic pathways. Table 1 summarises the nature of each of the six acts of the generative learning model, drawing on Schaverien & Cosgrove’s (2000) descriptions. This generative theory of learning, together with the learning model derived from it, provided JC and JS with a set of principles that could potentially support e-learning design processes, including technology selection. They set out to try to understand the nature and significance of the relationship between these principles and features of three generative e-learning environments.

Exploring	Immersion in a learning context. Here, learners can: • select inquiries and formulate ideas that are personally salient, • identify personal learning goals and outcomes, and • test them against a background of evolving values and past experiences. So, exploring acknowledges learners’ existing capabilities and enables them to generate and test ideas through experiences.
Designing	Starting the process of testing ideas. Here, learners can: • evaluate tests currently available, select and develop a set of criteria for tests that are appropriate in their contexts. This process of selection is driven by values and goals, which have been generated, selected and affirmed possibly in an exploring act or immediately preceding this phase as well as in past history. So, designing enables learners to extract “methodologies” from culture (including literature) and design a framework within which to test their evolving ideas.
Making and Operating	Doing the actual testing. Here, learners can: ▪ create and use the criteria and framework selected in the design phase. This

	process requires learners to categorise or partition their environment (after Edelman, 1993) on the basis of their test, their values and their goals. It could include a tangible construction, including a theory or thought experiment or the posing of a seminal question. So making and operating enable learners to create and use something that are of value to them, based on their selected ideas from the designing phase.
Explaining	Conscious expression, to themselves and others, of the value of their newly evolving ideas. Here, learners can: • invent stories to make sense of what their tests revealed, and • regenerate ideas as a result of tests that were designed, made and operated in preceding phases. Prior ideas, ideas which learners develop through the testing itself, and ideas which emerge from learners' consideration of their results, all serve as sources from which learners can develop explanatory theories and contribute to the next iteration of tests of those theories. So explaining communicates the value of newly generated ideas selected by means of tests. Evidence includes changes in behaviour as well as models and theories.
Understanding	Bringing curiosity to rest, if only momentarily, before further ideas and tests are generated. Understanding requires that knowledge gained by learners fits with or can be adapted to their own environment. It can evoke a strongly felt recognition of the value of a regenerated idea or behaviour. When learners understand something about their world, they incorporate a part of it into themselves. So understanding acknowledges that the new found theoretical knowledge/skill has been incorporated into the learner's context and practice.

Table 1: A summary of the six acts of learning, according to a learning model derived from the biologically based generative theory of learning (Schaverien & Cosgrove, 2000).

Three generative e-learning environments

The following three generative e-learning environments, researched and developed by academics in the UTS Faculty of Education and Institute for Interactive Media and Learning, to address acknowledged conceptual problems in science education, were selected for study:

1. The Generative Virtual Classroom (GVC) (Schaverien, 2000),
2. Views of Electricity (VOE) (Cosgrove & Alexander, 1993), and
3. Where does the Cold come from? (Cold) (Cosgrove, Schaverien, Forret & Trowsdale, 2001).

GVC is a hybrid e-learning system designed to help learners (in this case, teacher education students, teachers and other interested members of school communities) to develop sophisticated and educationally powerful understandings of learning (Schaverien, 2000). It consists of a pair of nested virtual classrooms: a virtual primary classroom inside a virtual university classroom. It provides opportunities for learners to observe and discuss authentic examples of children's successful learning, thereby deepening their own insights into learning and teaching science for their own practice.

VOE is a computer mediated tutoring system that aims to help learners (K-12 and tertiary students of science, as well as prospective engineers, teachers and scientists) to recognise and plan to resolve the mismatch between their capacities to reason successfully about simple electrical circuits and those of scientists. Learners can identify and test their ideas about the conservation principles behind the theory of electrical charge with a view to aligning their personal theory with scientific theory (Alexander & Cosgrove, 1995; Cosgrove & Alexander 1993; Cosgrove & Schaverien, 1997).

Cold is a hybrid e-learning system designed to help learners (in this case, prospective science teachers) to recognise and resolve the mismatch between their ideas and those of scientists, with respect to thermodynamics. It provides opportunities for learners to test and refine their own theories about heating and cooling phenomena, within a particular, innovative teaching approach that uses technology (in this case, the refrigerator) as a way of understanding fundamental scientific ideas.

Examining the relationship between generative principles and e-learning design

The approach JC and JS took to this enquiry was to position themselves as learners experiencing the environments, in order to try to unravel how each e-learning environment operated to support generative learning. This method afforded them the opportunity to consider activities and media from a learner's perspective. However, they were not trying to make an evaluation of the environments in terms of these environments' original design objectives. This would have required them to place themselves directly in the target learner's context and would require a huge and unrealistic leap of imagination. Research into the use of these environments with actual learners has been described elsewhere in Alexander & Cosgrove, 1995; Cosgrove & Alexander, 1993; Cosgrove & Schaverien, 1997; Schaverien, 2000 and Schaverien, 2001.

By contrast, JC's and JS's aim was to use these generative learning environments, to generate and test ideas about how a hypothetical learner might be operating within such environments. In effect, they tried to reverse engineer the design process that brought these environments about, in order to identify design features that might be key to particular acts of generative learning. They wished to take a critical look at how technologies were used to support such learning, thereby assessing their potential and actual value for generative learning. In essence, they wished to understand more clearly how generative learning theory might underpin the design of new e-learning environments and systems.

To do so, JC and JS immersed themselves in each e-learning environment in turn. They recorded their initial thoughts about these environments and used the discussion boards in the UTS Learning Management System (Blackboard v5, known on campus as UTSOnline) to present and explore their findings, testing and regenerating ideas together. They also conducted a detailed examination of the literature from previously conducted empirically based research that surrounds these environments. From this analysis, they were able to infer the occurrence, in particular parts of these environments, of specific acts of learning, as described in the generative learning model and to identify similarities and differences between the educational contexts designed into these environments. We turn now to a synthesis of JC's and JS's findings, first in terms of design features supporting specific acts of learning and then, in terms of general, contextual characteristics of these environments.

Provoking learners to explore

All three environments use particular techniques by which to provoke learners' exploration. The following examples are noteworthy:

- **Initial tasks encourage learners to articulate current personal ideas or theories.** Such tasks allow learners to make explicit connections to their current knowledge, their worldview or past experiences. In so doing enable learners to formulate a baseline against which their new knowledge might be calibrated. For example, in Cold, learners are explicitly asked to write down their personal ideas about how a fridge works. In GVC, learners are encouraged, though not compelled, to write their initial reactions to each video. In VOE, learners are explicitly asked to select a theory of electricity that is the closest match to their personal theory. In all three cases, video and/or animation is used to assist learners to generate ideas, and on-screen notepads or option buttons help them record their ideas.
- **Artefacts or images from learners' contexts and real life experiences are used to begin conversations about the concepts at hand and learners' understandings of these concepts.** For example, in Cold an everyday artefact (a fridge) is used; in GVC, classic examples of students' learning and in VOE, everyday artefacts in the form of an electrical kit. Such conversations quickly surface learners' levels of knowledge (and ignorance), for learners themselves (Kerwin, 1993).
- **Artefacts, images or concepts are isolated for dedicated study, removed from much of the complexity of learners' contexts or everyday lives.** For example, in Cold, video is used to allow learners to explore selected aspects of the workings of a fridge, in itself. In GVC, video excerpts present snapshots of particular students' learning in the classroom so learners can observe different aspects of learning, in themselves. In VOE, the accompanying kit allows learners to explore the workings of batteries and bulbs, in themselves. Isolation of artefacts, images or concepts in these ways appears successful in prompting learners to explore.

Encouraging learners' designing, making and operating

All three environments attempt to encourage and support learners to design, make and operate tests of their ideas. For example:

- **All environments present a view of learners as builders.** In Cold, learners are encouraged to develop a series of questions about a fridge and how it works and to set up ways of testing their thoughts, in order to refine a coherent and plausible story. Focusing activities allow them to conduct experiments and access two "experts'' views of what happened assist them in this process. In GVC, as learners articulate and retain views that they value, they begin to build their own personal theory of learning. By recording their own notes alongside video excerpts of learning events, learners are in fact developing criteria to test the validity of what they see against their own values and practice. Through the GVC's community view and discussion boards, learners are offered opportunities to test their developing theories. In VOE, as learners progress through bulb experiments, they are designing their own analogy of electricity and developing tests for their personal theories. By building circuits using the accompanying kit, learners can actively carry out these tests, developing relationships with materials, taking ownership and creating physical connections between the environment and their own real life contexts (Papert, 1980). This is explicitly demonstrated when learners who believe that charge is consumed rather than conserved test that theory by using two ammeters. As learners move through these e-learning environments, interacting with artefacts, their ideas evolve, as they design, make and operate testing cycles.
- **All environments make clear to learners the particular, key role of analogical thinking in learning, encouraging them to generate and test their own analogies.** For example, Cold presents two analogies for heat transfer within its slide shows and learners can develop their own analogies as they refine their theory of how a fridge works. In GVC, children in the video demonstrate the use of their own analogies to try and explain difficult concepts and test these analogies for their explanatory power. In VOE, animation is used to present two analogies for electricity: a water flow model and a differentiated fuel-and-carrier model; and learners are encouraged to develop their own analogies based on their developing theory of electricity. Creating their own analogies provides a way for learners to test their developing ideas against their own beliefs, experiences and cultures. To some extent to understand how something works in itself, learners have to make something new with it, build with it, play with it and make it their own (Papert, 1980).
- **All environments treat learners' views with respect, as legitimate starting points, whilst providing access to other views for further development.** In Cold, videos of experiments allow learners to predict outcomes and develop explanations, and then test these ideas against what actually happens and how experts make sense of it. In GVC, excerpts of children's learning allow learners to develop their own theories, and access to others' views (including a pre-recorded, generative interpretation) supports development of learners' ideas about learning over time. In VOE, experiments on-screen and with the accompanying kit, together with the provision of a potentially more powerful way of thinking analogically about electricity, allow learners to explore and test their own developing theories. In these ways, all three environments make subtle but salient use of experts' views of significant concepts at hand. As well, they allow learners to test their ideas against domain knowledge without being directly challenged, without explicitly categorising their current personal views as being false. Rather, these views are treated as consequences of prior experiences and means are provided for learners themselves to continue to develop them. Such avoidance of direct confrontation on its own is deliberate, and contrasts starkly with earlier views in science education research that it was cognitive dissonance, of itself, that wrought changes in learners' ideas (Cosgrove & Osborne, 1985). In fact, some studies have shown that experiences of cognitive dissonance have led learners' to fortify their views rather than to discard them, jeopardising learners' chances of developing them at a later date. Diverse media, including video, audio and animation are used in all three environments to support such activity.

Towards explaining and understanding

As previously stated, all three environments aim to support learners to develop ideas fundamental to particular discipline domains. In each case, such development requires learners to achieve alignment with particular key ideas at the core of the design of the particular e-learning environment. However, the ways in which this is achieved vary with individual learners and within populations of learners, and learners develop unanticipated but related ideas and theories in the process, as they take control of the progression of their ideas (Schaverien, 2001; Cosgrove & Schaverien, 1997). It has been comparatively straightforward to describe how these three e-learning environments provide for exploring, designing, making and operating; and all of these features anticipate that learners' explanations and understandings will follow. However, it is now incumbent on us, even though it is less easy and so a little more speculative, to describe design-related features that might hedge the chances that explanation and understanding will occur. To do so, we refer to research studies of learning in these e-learning environments and to the interpretative sense made of these findings. We believe the following general contextual features of these environments qualify, though those familiar with these environments might discern some others:

- **All three environments, to varying degrees, support diverse, learner-driven pathways and open-ended outcomes.** Such design contrasts with the particular version of outcomes-based approaches currently predominant in Western educational cultures, in which specific, often narrowly focused goals are set and pathways circumscribed a priori by teachers. Of course, designs that support more fluid educational agendas are considered legitimate elsewhere (Winn, 1997). These environments do not preclude achieving anticipated outcomes, instead by legitimating other outcomes as well (particularly those that relate to learners' own agendas), such designs can hedge the possibility of significant theorising (Schaverien, 2001).
- **Each environment makes substantial use of conversations for learning.** In Cold, conversations are generated by video images of a fridge, by provoking learners to record their ideas, and by encouraging learners to consider others' views (including those of previous students and experts), to test their ideas. In GVC, videos provoke conversations, as learners record their own views, access others' by means of the community database and by listening to pre-recorded generative interpretations, and participate in threaded email discussion, to generate and test their ideas. In VOE, the bulb experiments, the personal views, analogies and other students' views provide opportunities for learners to create a dialogue in which they can both generate and test ideas. However, the objective of such conversations is not to align the message sent with the message received, as is the case in transmissive teaching approaches (Cosgrove & Alexander, 1993). Nor can these conversations be described as Socratic teacher-student dialogues (Laurillard, 1993, 2002). Instead, such conversations are designed to provoke sense making by learners, to support them in generating, testing and regenerating their theories in a culture in which others are doing the same. Such conversations can therefore occur between students and teachers, amongst students, in the wider community, or privately as learners converse with their inner selves (Cosgrove & Alexander 1993; Cosgrove & Schaverien, 1996). Creating meaning from these multiple voices, be they internal or external, real or fictional, is the very process of making sense and understanding for oneself (Ackermann & Strohecker, 1999).
- **Each environment both connects with and draws substantially upon the resources of the community and the context within which it is situated.** A learning community is present within each environment, in that learners can access views of other learners and experts, and, of course, the wider community via the WWW. In GVC, learners can also participate in a dynamic learning community by means of a growing community archive and by email discussion. Rather than being designed to stand alone, all three environments can operate within learners' contexts, as mentoring systems that learners can use, as they require, anytime and any-place, within their real-world practice. As truly multimedia environments, they make use of mixed media (and not necessarily only high-end technologies) to support learners' regeneration of ideas, drawing on CD-ROMs, the WWW, accompanying electric kits, real-world classrooms, laboratories and lives. Locating these e-learning environments in the real world in this way, within a dynamic of complex, changing circumstances appears to hedge the chances that learners will value and pursue explanation and understanding. This appears particularly to be the case when learners are encouraged to make explicit their ideas at regular and frequent stages of the learning process, designed in these e-learning environments.
- **As technological contexts for learning, each of these e-learning environments is designed to provide learners with objects-to-think-with (after Papert, 1980).** These include the kinds of analogies already described, analogies that mediate and frequently transform the ways in which learners think about fundamental ideas in disciplines. However, they also include the kinds of reflexivity reported in many studies of the GVC in use, where learners begin to consider that their observations about children's learning in the GVC might well apply to their own learning (Allard, 1998; Schaverien, 2001 & Sen, 1999). Though we can appreciate such outcomes when they occur, we are at an early stage in identifying those factors that are most influential in assisting learners to explain and understand so profoundly and consciously. It may be that e-learning environments support learners' regeneration of ideas in distinctive ways.

Discussion and Implications

It appears from this analysis that, at least for the three e-learning environments studied here, a generative learning model exposes potentially important learning-related design concerns that risk being neglected by other e-learning design frameworks. Romiszowski's (1981) framework, for example, adopts a systems approach to design in which learning objectives and activities are defined and fixed a priori. This is a teacher/designer centred approach, instructionist in character, and risks making scant allowance for learners' own objectives and pathways. Whilst we agree with Romiszowski that anticipated teaching methods and learning tasks will influence media selection, we stress the importance of conceiving of an iterative process of e-learning research and development. In such a process, both design and media selection are revisited in the light of those new learning opportunities afforded by developments in technology and by our developing knowledge of how students learn. All three learning environments considered here were designed on the basis of a conversation between what was educationally desirable and technically possible. They also incorporate a wide, deep and particular knowledge of the evolution of students' discipline ideas, gained during a sustained research program. Each environment has been or is currently being modified iteratively, as a result of continuing formative and/or summative research investigations of student learning.

Our suggested approach has something in common with Laurillard's (1993, 2002), in that the design of these environments is anchored in a particular view of learning. However, even though Laurillard's more recent conversational learning model extends her Socratic framework to take account of the collaborative role of peers, it still privileges teachers' ideas (both about the terrain of disciplines and fruitful directions for ideas development) over those of students. In addition she herself limits its usefulness to academic learning, stating that it is "not normally applicable to learning through experience, nor to everyday learning nor to those training programmes that focus on skills alone" Laurillard (1993; p102). For all these reasons, we believe the generatively principled design approach outlined in this paper may well provide a more authentic basis for addressing contemporary demands for a creative corporate workforce.

As we have already noted, a generatively principled approach regards e-learning design as a learning event in its own right. Such a view fits comfortably with and extends frameworks, such as Bates' (1995), developed with learners in mind; and it contributes a potentially fertile design avenue to a debate which has become mired, of late, in behaviourist-constructivist dichotomies (Boyle, 2002). Our methodology, in addition to the connections we acknowledged within our professional contexts, strongly suggests that e-learning design strategies might fruitfully be founded on research-based understanding of existing organisational learning and teaching, as well as on continuing, imaginative investigation of the worth for learners of these e-learning approaches themselves.

The basis for e-learning design described in this paper supplies the following possible solutions to key issues raised at the start of this paper:

- Legitimating learners' own ideas, contexts and real-life experiences, whilst removing some of the complexity surrounding the presentation of difficult ideas, ought to hedge the chances that learners will be able to apply e-learning delivered skills and knowledge within their diverse organisational workplaces.
- Providing a mentoring system, by way of an e-learning environment, available any time and any place over sustained periods of time, ought to help to address requirements for learning to be embedded in an organisation's culture, whilst also addressing learners' immediate needs.
- According dignity to learners' own contributions, and helping them to unravel their underlying value positions through the support of a learning community, ought to enhance communities of practice within organizations, thereby building on existing knowledge bases to support evolutionary institutional change from the grassroots.

In these respects, this framework also provides a way of moving forward that may well take e-learning research and development past those instructional design models that are currently dominating this field. In particular, it proposes a new view of the modular components of e-learning environments, based not on pre-specified, fixed and archived content as most learning objects are, but on evolving components that enhance knowledge creation by learners in their own context. As a consequence, altogether new kinds of educational entities might be developed, quite different from existing conceptions of pre-specified instructional tasks or events. Conceivably, such entities could exist at higher levels of granularity than is envisaged for many current learning objects. They would incorporate much more specific research-based detail of the educational challenges that exist and the learning that can and does occur in particular disciplines and/or fields of practice. One advantage of such a learning-centred approach would be the ability to track, and therefore understand, aspects of the lineage of successive attempts to enhance learning with advanced technologies. So, we might reasonably expect to be able to deliver improved e-learning environments in shorter time frames. Of course, such an outcome would enhance the status of education as a viable and effective knowledge-generating discipline in our era.

This paper's analysis only refers in passing to the long years of research from which these here-and-now e-learning designs evolved. This process has been more fully reported in research studies referenced in this paper. Together with these accounts, the present analysis suggests the worth of a research enterprise based on generative principles, one we surmise to be of equal value to corporate, academic and community learning. Such an enterprise would

- generate seminal ideas for disciplines, organisations and cultures;
- identify, describe and analyse successful learning and teaching approaches to such ideas (including but not exclusively computer-mediated ones);
- conduct authentic tests of the worth of e-learning environments designed on such insights; and
- re-generate (and where possible, scale up) e-learning environments on the basis of the findings of these tests.

We are strongly of the view that such an enterprise is not only feasible but also worthwhile; and we use the development of this collaborative paper as evidence for that argument. Within a Master of e-Learning, through commitment, energy and the willingness to suspend judgement for a time, three of us (students and teacher) have been able to distil this collaborative work, in tune with our diverse personal and professional interests and at the philosophical edge of this emergent discipline. We believe it is testimony to the worth, in many contexts, of a (generatively) principled approach to educational design.

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