From sequential to global: Exploring the landscapes of neomillennial learners

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Virtual learning, once the realm of science fiction, is now a reality. The informal learning multi-user virtual gaming environments of neomillennial learners are beginning to shape formal educational landscapes. Such informal environments as *RuneScape* and *Second Life* contain the key pedagogical elements of learner-centred environments: they are visually rich, immersive, nonlinear, allow for individual and collaborative learning, creativity, and allow for learner choice in activities, pathways and assessments. Learning style research in e-learning environments yielded some interesting discrepancies between the learning styles of novice undergraduate e-learners, and between graduate e-learners and educators teaching in, and designing for, e-learning environments. This in turn suggests considered approaches to accommodating both sequential and global learning preferences in e-learning environments. This paper uses the example of *Second Life* to suggest a balanced approach for sequential and global learners.

Keywords: sequential learners, global learners, neomillennial learners, e-learning, MUVEs

Introduction

Virtual learning, once the realm of science fiction, is now a reality. Popular multi-user virtual gaming environments, such as *RuneScape* (http://www.runescape.com) and *Second Life* (http://secondlife.com), are beginning to shape the formal educational landscapes of neomillennial learners. According to Dede (2005a), these multi-user virtual environments (MUVEs) contain the key pedagogical elements of situated learner-centric environments: they are visually rich, immersive, non-linear, allow for individual and collaborative learning, promote creativity, and encourage learner choice in activities, pathways and assessments. Indeed, the motto of *Second Life* is 'Your World. Your Imagination.' In promoting MUVEs as suitable learner-centred environments for formal education in the new millennium, what contributions can research in learning styles make towards their development?

Learning styles is a contentious area of study in higher education and a nebulous concept. So too is the arena of e-learning. Nonetheless, both learning styles and e-learning have been the twin foci of doctoral research examining the impact of learning styles in e-learning (Willems, 2007). This paper examines specific findings of the research in relation to the domain of sequential (linear or serialist) and global (holist) learning preferences in e-learning. The paper goes on to suggest that educators and designers should consider creating balanced learning environments which include both sequential *and* global learning opportunities for neomillennials, and discusses opportunities through *Second Life* as an example.

Dissonant practices in E-Learning

Doctoral research on the impact of learning styles in electronic learning (e-learning) grew out of the experience of dissonant practices in e-learning. Dissonance is defined as the "lack of consistency or compatibility between actions and beliefs" (Encarta Online Dictionary, 2007). Dissonance underlies the discrepancy between espoused theories and the theories-in-use in electronic learning environments. According to Walker, espoused theories are those that can be consciously articulated, whilst theories-in-use are the "implicit in the actions that actors engage in and which can be observed" (2001, p. 336). Philips (2005) has applied the notion of dissonance to e-learning, arguing that there is a dislocation between the espoused theories of technologically-mediated education with what is actually happening (theories-in-use) in many e-learning environments. Dissonance can occur at any level of e-learning, including the subject design (Philips, 2005), the underlying pedagogical philosophy (Philips, 2005), the approach to learning (Philips, 2005), and modes of communication used (Willems, 2008). One additional

area of disparity between espoused theories and theories-in-use within e-learning environments relates to the dissonance between non-linear learning opportunities and the continued reliance on linear learning in relation to choice of media, information structure and layout, and navigation options. These levels of dissonance are outlined in Table 1, below.

Table 1: E-learning's espoused theories versus theories-in-use

Category of dissonance	Espoused theories	Theories-in-use
Pedagogical philosophy (Philips, 2005)	Constructivist	Instructivist
Approach to learning (Philips, 2005)	Student-centred	Teacher-centric
Subject design (Philips, 2005)	Outcomes-based	Content-based
Mode of communication (Willems, 2008)	Multimodal	Monomodal (text); Bimodal (text + audio)
Choice of media, information structure and layout, and navigation options	Non-linear (Dede, 2005a)	Sequential

Neomillennial learners

The term 'neomillennial' requires definition. Some consider 'neomillennials' to be one of the many pseudonyms for Generation Y learners (Ygeners). However for others, Generation Y is distinguished from, or overlap, other generations of learners. For example, Neuborne and Kerwin (1999) define Generation Y as those specifically being born between 1979 and 1994, whilst for Dede (2005a, p. 7) Millennial learners are those who were born after 1982 with Neomillennials being born after 1994. Differentiating between the two latter terms, millennial learners are those who learn using the world-to-the-desktop interface, whilst neomillennials are involved in immersive e-learning environments (Dede, 2005b, pp. 15.1-15.2). Sankey defines neomillennial in terms of learning modalities, with 'neo' meaning 'new', 'millennial' referring to the learning modality required for the new millennium (2006, p. 82). Laurillard (2002) describes how these learning modalities are associated with the media utilised for learning in a given context. Along similar lines, Dede argues that "the technology and media used by children during their formative years do have an influence on how they learn, as do the media used by adults" (2005b, p. 15.1). Virtual gaming environments such as *RuneScape* are where my son, a neomillennial by Dede's definition, virtually meets his friends after school. Thus neomillennials in the context of this paper will be used to define learners who are involved in using mediated immersive virtual learning spaces for education.

MUVEs as neomillennial learning environments

The union of *hypertexts* with *multimedia* (integrating text, audio and/or sound with graphics, animation, haptics and/or video), has resulted in *hypermedia* (Davies, 1997). Hypermedia learning environments potentially provide learners with a high amount of learner control, including the ability to access information in both linear and non-linear ways: "Ideally, this navigational and representational freedom leads to active, constructive,...self-regulated [and] adaptive learning" (Opfermann & Gerjets, 2006, p. 615). However, despite the espoused theory of non-linear learning, these environments can also be linear (sequential in structure). Davies (1997) argues that there are three main ways that the connections between the nodes of information are organised in hypermedia, and that these range in complexity from linear formats which underutilise the potentials of hypermedia, through to star and tree formats which are more complex and less linear. Dede argues that branching formats are the definers of millennial learning, whilst non-linear associational webs are the definers of neomillennial learning (2005b, p. 15.15). Multi-user virtual environments (MUVEs) are examples of hypermedia learning environments. MUVEs are defined as those environments which:

> enable multiple simultaneous participants to access virtual contexts, to interact with digital artifacts, to represent themselves through "avatars", to communicate with other participants and with computer-based agents, and to enact collaborative [and individual] learning activities of various types. (Nelson et al., 2005, p. 21)

The distinguishing feature of MUVEs such as *Second Life* is that they are immersive three-dimensional virtual environments. Further, in both *RuneScape* and *Second Life*, novice players (newbies) commence in

a secluded area where they learn basic skills with their avatar (if they choose) before heading out into virtual world. MUVEs have grown out of the synthesis of existing game technologies, videos, MOOs (interactive fiction), MUDs (multi-user dimensions), and MMOs (massively multiplayer online role-playing games, also known as MMOGs or MMPORGs). MUVEs are accessed via the Internet via either a computer or other Internet-connected devices. Dede et al. (2004) argue that "MUVEs are a promising medium for creating and studying situated learning because they can support immersive, extended experiences, incorporating modelling and mentoring, about problems and contexts similar to the real world" (2004, p. 160). In formal educational uses of MUVEs, Blaisdell (2006) argues that the teacher's role is as a guide in exploration, and not the deliverer of information that it is in traditional teacher-centred approaches to learning. Thus MUVEs can be used to create replications of the real world, thereby overcoming barriers such as physical challenges, safety or cost, to promote learning (Blaisdell, 2006). However, Peters (2007) reminds us that they can also be used to create alternative or divergent realities.

On global and sequential learning styles

Learning style theory is a contentious arena of study, made complex by the number of assessment instruments, the various philosophies upon which these are based, and the claims made by some of their practitioners. For example, a research team of Coffield and his associates (2004) identified over 71 different models of learning styles that they arranged into five 'families' of learning styles, spanning at one end of the spectrum from those who believe that learning styles are fixed or innate behaviours, to a view learning styles as part of a broader consideration to learning at the other. The *Index of Learning Styles* (*ILS*) (Felder and Soloman, 1991, 1994) lies in the fourth 'family' of this learning styles spectrum, viewing learning styles as 'flexibly stable'. It is based on a premise that a balanced approach to teaching and educational design will yield better educational experiences and outcomes for the diversity of learners which will make up any given cohort. The results of the *ILS* point to ways that learning can be optimised within educational environments to assist both learners and educators better understand themselves (how they approach learning), each other, and the learning environments in which they are immersed (Felder & Soloman, 2003).

There are four domains on the *ILS.* Felder and Soloman (1993) caution that these dimensions are not to be perceived as "either/or" dichotomies, but rather "continua". The results in the continua range from weak, to medium, through to a strong preference at the other end of the domain. The first continuum considers individual preferences for the processing of information (active to reflective learning). The second relates to how an individual prefers to perceive information: sensors (sensory, facts) or intuitors (theories). The third concerns itself with the mode of information reception (visual to verbal communication). The fourth domain, which is the specific focus of this paper, examines how an individual develops an understanding through the structure and organisation of information in the learning environment (sequential and global learning preferences). A brief comparative overview of the two sides to the spectrum of understanding information, based on Felder and Soloman (1993), is provided in Table 1 and will be expanded upon in the following sections.

Table 1: Sequential and global learning (based on Felder & Soloman, 1993)

Fourth domain of the *ILS*: Understanding information		
Understanding Information	Sequential Learners	Sequential learners understand best when information is presented in linear steps that progress logically from one another. Similarly, when problem-solving, sequential learners tend to follow linear pathways to find the solution to the problem.
	Global Learners	Global learners however, absorb material without connections and then suddenly understand the whole. Whilst they might be able to solve problems quickly and in novel ways, they may have difficulty explaining how they got to the solution.

The categories of 'sequential' and 'global' are referred to under different labels by others in the broader field of learning styles research. For example, Pask (1976) refers to 'serialists' and 'holists', whilst Tharp (1989) uses the terms 'linear' and 'wholists', and Riding and Cheema (1991) refer to 'analytics' and 'wholists'. In this paper, the terms 'sequential' and 'global' will be adopted.

Sequential learning and educational design

Sequential learning styles are concerned with a systematic approach to learning. Catheral defines sequential learning as "breaking a defined objective into multiple smaller segments with the desired aim

of imparting a routine-based task on the learner" (2008, p. 101). Learning design for sequential learning preferences is the basis of traditional approaches to education:

> Most formal education involves the presentation of material in a logically ordered progression, with the pace of learning dictated by the clock and the calendar. When a body of material has been covered the students are tested on their mastery and then move on to the next stage (Felder & Silverman, 1988, p. 679)

Further, these authors argue, "Everything required to meet the needs of sequential learners is already being done from the first grade through to graduate school: curricula are sequential, course syllabi are sequential, textbooks are sequential, and most teachers teach sequentially" (ibid). Text and speech, the key examples of verbal communication, are linear events, with the primary media of sequential learning being text. As Mayer notes, text "consists of discrete units presented in a linear sequence" (2001, p. 67). Laurillard writes:

> The traditional educational methods and media, such as lectures, books, films, and television programmes, are all narrative in form...The structure provides a linear dynamic that links the components to each other via relationships (2002, p. 91)

Sequentially structured e-learning environments utilise a linear forwards/backwards approach in the delivery of information and learning opportunities, and this also applies to hypermedia environments. An example of the structure of these sequential learning environments involves the graphic by Bajraktarevic, Hall and Fullick, (2003) in Figure 1, below.

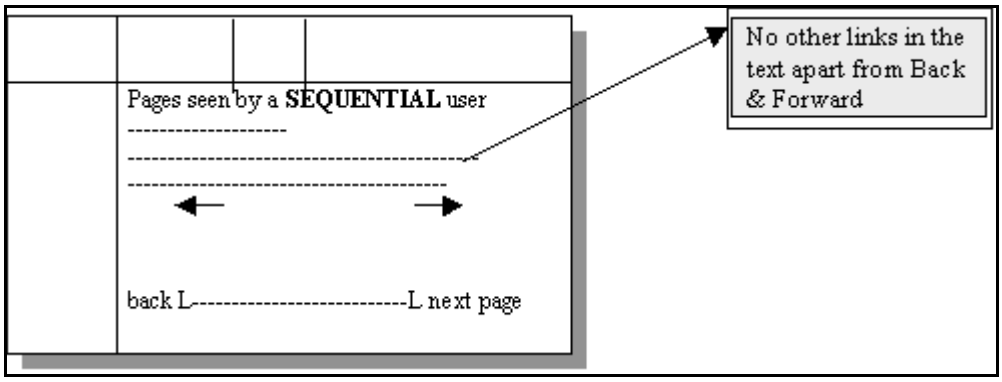

Figure 1: Hypermedia design for sequential learners (Bajraktarevic, Hall and Fullick, 2003, n.p.)

In MUVEs such as *Second Life* sequential learning opportunities take place through information being delivered through the communicate (chat) function, connoted by the 'air-typing' hand movements of particular avatars. Sequential learning can also be catered for by constructing linear tasks wherein the avatar cannot proceed to the next level or stage of a task without firstly completing successfully the preceding level. The advantage of sequential learning environments is that particular knowledge or skills must be acquired before moving to the next level in the learning environment. They attend to the details before them, but other than forwards/forwards movements do not have other navigational control. The disadvantage is that for some learners, and for some tasks and subject areas, a global approach within the learning environment is more appropriate. A further disadvantage to sequential learning designs relates to group learning environments. Individuals learn in different ways and at different rates. Progression to the next level of a task in group hypermedia learning environments may lead to frustration, boredom or inattention by some participants.

An example of sequential learning applications is reflected in the *Second Life* screen capture in Figure 2 (above) in which tertiary educators in real life gather for a virtual symposium in *Second Life.* The learning moment involves a guided tour of a particular learning space on Monash Island. Between the explorations of the learning space, the avatars are listening to information about the environment that the tour leader is relaying through the 'communicate' function of the MUVE.

Global learning and educational design

Whilst sequential learning starts with the basics and builds up to the whole, global learning involves the looking at the big picture in order for the understanding of its constituent parts to take place. Himes

Figure 2: An educator's symposium in *Second Life*)

(2004), in a keynote address, notes a discord between the expected inductive structure in writing a thesis, for example, in which the student sequentially builds up an argument and other ways of communicating in the new millennium, as for example, in hypermedia environments. Different media encourage different ways of communicating information (Laurillard, 2002). As noted, printed text, writing essays, and reading books, encourage a sequential style of learning. This in turn has at times been transposed into the new media learning environments, despite the espoused potentials. These environments enable different communicational possibilities; possibilities that are ideal for global learning style preferences. McKee writes:

> The new media…are "massaging", in Marshall McLuhan's term, our individual minds and collective culture away from text-induced linear, sequential thinking toward non-linear thinking characterized by multiple simultaneous modalities. Spatial display and analysis offer a visual, intuitive, effective means for solving a wide range of complex problems. (n.d., p.5)

Himes (2004) has spoken about the preference of global learning by 'digital natives' (students) as involving media focused with pictures, sound and videos, who think deductively and communicate in hypertext, in contrast to their educators as 'digital immigrants' who predominantly focus on the media of text and foster inductive, logical thinking and writing. Buckingham notes that "Many of these new media are...non-linear: they can be accessed at any point, and the user can navigate their own pathway through the material" (2007, pp. 77-78). Pictures and visual representations are ideal for global learners. Mayer argues that "pictures allow holistic, non-linear representations of information" (2001, p. 68). This statement supports assertions by Tharp, that designing for global learners includes "emphasizing whole-story discussions and overarching themes and by using visual diagrams and metaphors" (1989, p. 353). Indeed, Tharp points to the association of the importance of visual communication in perception and representational structures for global learners (ibid).

It has previously been argued that the formal education system has catered well for learners with sequential learning preferences through the choice of learning design (Felder & Soloman, 1993), media and persistent practices in the delivery of information (Sheely, 2006). However, global learning opportunities have been less well catered for within academia (Tharp, 1989). Dede argues that one of the benefits of emerging technologies to deliver instruction increasingly offer a match to the neomillennial learning styles of those who use them is the possibility of communication through "nonlinear, associational webs of representations rather than linear "stories" (for example, authoring a simulation and a Web page to express understanding, rather than a paper)." (2005b, p. 10) An example of the structure of these global learning environments involves the research by Bajraktarevic, Hall and Fullick, (2003), and is shown in Figure 3, above. Note the global site structure view on the left hand side of the hypermedia view, and the multiple content tabs allowing access to different aspects without the requirements of linear progression, through for example, the response of a 'correct' answer.

The advantages then of non-linear, global learning is that they can provide the 'big picture' for learners. In *Second Life*, for example, global learners are catered for by not only the visual representations, but also the navigational options and map features of the environment (Figure 4). Avatars can fly above to explore

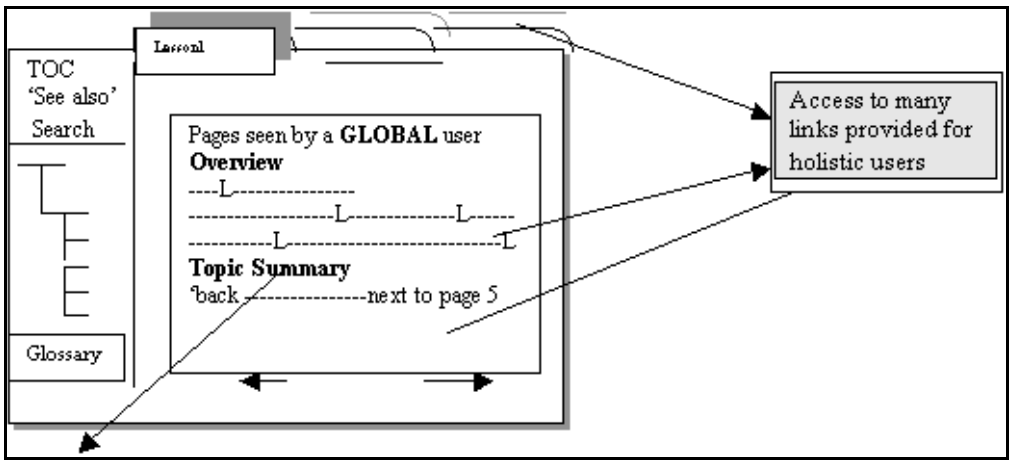

Figure 3: Hypermedia design for global learners (Bajraktarevic, Hall and Fullick, 2003, n.p.)

and see the 'big picture', dart back and forth completing other required tasks in the same island, and return to the group and catch up on the string of chat, as is recorded in the minimisable 'Local chat' window on the lower left of the screen, in order to piece together the requirements of the learning scenario. They can also teleport from one virtual location to another. The construction of formal learning environments for global learners in *Second Life* involves non-sequenced activities. For example, students are free to explore all aspects of the particular learning environment, completing tasks in any order, to build up an overall understanding.

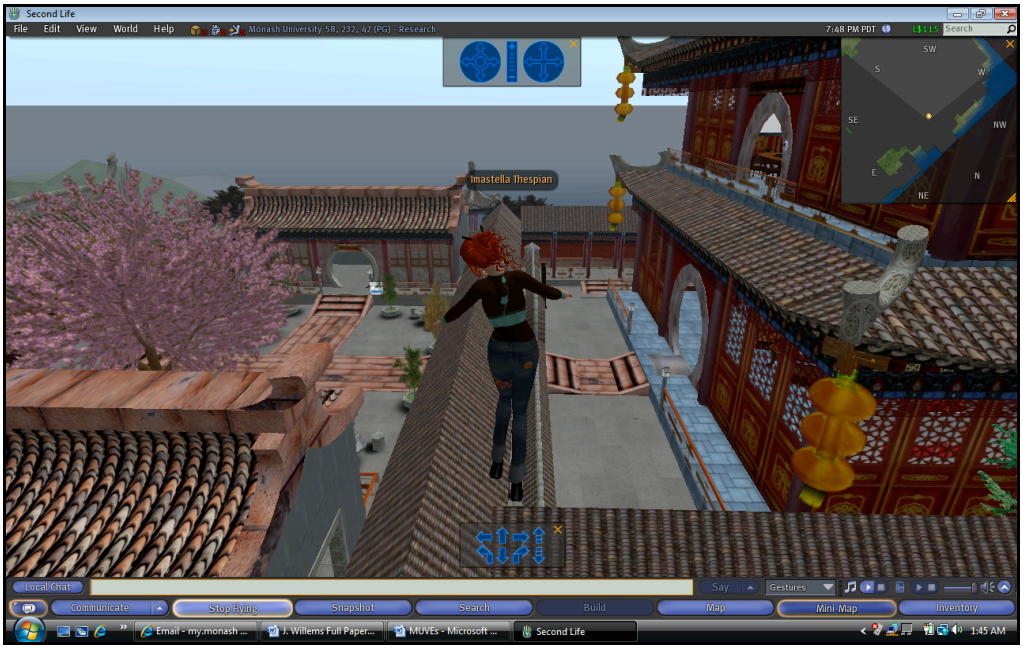

Figure 4: Global view of a learning environment in *Second Life*

Whilst one disadvantage of non-linear learning environments is potential confusion or disorientation brought about by cognitive overload (Opfermann & Gerjets, 2006), the map and mini-map (see right-hand corner, Figure 4) features of many MUVE environments such as *RuneScape* and *Second Life*, can help counter this effect. They enable a two-dimensional visual tracking in the virtual landscape. Additionally, the mini-map feature for example, identifies other avatars present in the region (small green 'dots' in *Second Life*) enabling meeting and collaboration, or avoidance, as the case may be. Further, the avatar's range of vision is identified in the mini-map by the semi-translucent sector in the mini-map. This is not a full 180 degree view, but approximates a 100 degree field of vision. The avatar can be manipulated by the learner in order to see different viewpoints, unlike other learning media such as film, wherein only one view of the environment (the cameras) is possible.

To match or mismatch learning styles in educational environments

One of the major arguments in learning styles research is whether to match (align the learning environment with the learner's learning style in order to enhance learning) or mismatch (immerse the learner in a learning environment which is counter to their learning style learning in order to help them develop ways of operating in those learning environments). The argument of matching the instructional design to a student's learning style relates not only to learner cognition and motivation, but also to positive learning outcomes (McLoughlin, 1999). For those who argue for matched environments, their case is supported by the research results of Bajraktarevic at al. (2003), who found that "learning outcomes can be improved if designers of hypermedia courseware provide a different sequence and presentation of materials to accommodate individual learning style differences."

Those who argue for mismatched environments Rowbotham (1999, n.p.) articulates the philosophy behind this practice: "by consciously striving for a mismatch between the two elements, the learner may be forced to develop a less dominant learning style, achieving greater learning versatility". However, mismatches between the learning environment and an individual's learning style can lead to students becoming bored and inattentive, doing poorly in assessment tasks, and becoming discouraged about the course, the curriculum, and the student's own capabilities (Felder & Silverman, 1988, p. 674).

Others, such as Felder (2007), suggest that it is ideal to create balanced learning environments, and to do so, both matching and mismatching is required. This provides opportunities for a learner to explore a learning environment using their preferred methods of learning as a safety net, with opportunities to learn in a different manner. Supporting this approach, Palloff and Pratt summarise arguments by Claxton and Murrell (1988) that

> matching activities with learning styles is particularly appropriate when working with students who are new to the college experience or who are poorly prepared to learn, because the lowest course attrition and most effective learning occur when learning is matched. However, some mismatching is also appropriate so that students can learn to learn in new ways and bring into play ways of thinking and aspects of self not previously developed. (2003, p. 33)

In other words, given opportunity, learners can build confidence and develop skills in a matched/mismatched (that is balanced) learning environment. Virtual gaming environments of MUVEs offer the perfect arena for balanced learning design. This is because "game design often incorporates progressively more difficult challenges to keep players balanced on the edge of frustration with the level of difficulty and satisfaction from achieving a goal" (Laughlin et al., 2007, p. 6). That is, the situated learning offers simultaneously comfort and extension, and the story-like setting helps to overcome the concerns of disorientation brought about by cognitive overload in non-linear approaches to learning design.

Research methodology

Doctoral research was conducted on the impact of learning styles in e-learning. Three cohorts were identified for comparison. These were novice undergraduate e-learners, graduate e-learners, and educators teaching in, or designing for, e-learning environments. Of these groups, 45 novice undergraduate e-learners, 9 graduate e-learners, and 28 educators took part in the study. Each cohort was given two research instruments to complete. The first was Felder and Soloman's *Index of Learning Styles* (1991, 1994). This yielded quantitative data across the three cohorts cross four domains (or continuums) of learning style preferences. These are active-reflective, sensing-intuitive, visual-verbal, and sequential-global. The second instrument was a survey questionnaire which gathered both quantitative data in terms of demographics, and qualitative data, in terms of the participant's open-ended responses to their personal experiences in the e-learning environment.

Results

Of specific interest in this paper are the results gathered on the fourth domain of the *ILS.* This final domain is the sequential-global continuum which ranges from strong preferences towards sequential learning at one end of the spectrum, through to strong preferences for global learning solutions at the other. Comparisons of quantitative data in the domain of sequential and global learning style preferences between the three cohorts on result obtained from the completed *ILS* are reflected in Table 2, below.

These results demonstrate a weak to medium skewing towards global learning preferences for both educators and graduate e-learners, on the one hand, and a weak skewing towards sequential learning preferences by undergraduate e-learners on the other side.

Table 2: Three-cohort comparison of frequencies on the sequential / global domain

Cohorts	Sequential Learning			Global Learning		
	Strong	Medium	Weak	Weak	Medium	Strong
Undergraduates (n=45)	8.7%	2.1%	41.3%	34.8%	10.8%	2.1%
Graduates (n =9)	0.0%	0.0%	22.2%	44.4%	11.1%	22.2%
Educators (n =28)	6.9%	3.4%	13.8%	31.0%	27.6%	17.2%

The sequential or global learning style results from each cohort on the *ILS* were then amalgamated (Table 3) *to* provide an overall view and an opportunity to compare results from other research using the *ILS.* The results reflected a mild skewing towards sequential learning in the undergraduate e-learners, with a moderate skewing towards global learning in the graduate e-learners and educators ($p = 0.007$). The results were then compared to some other studies using the *ILS* as a research instrument. A couple generated similar results in the sequential/global domain. For example, Zywno (2003) reported similar results in her comparative study with 58% undergraduate electrical engineering students (n=132) recording a preference for sequential learning, and 65% faculty members (n = 48) recording a preference for global learning.

Table 3: Combined results (rounded)

Research cohort comparison	Sequential %	Global %
Undergraduate E-learners	52	48
Graduate E-learners	22	78
E-Educators	24	76

Discussion: Towards balanced learning designs in e-learning

The findings of this research support a disparity between mild sequential learning design for novice e-learners and moderate global (holistic) learning designs for experienced e-learners. However it should be noted that other learning style preferences exist within the cohorts. Whilst Dede (2005a, p. 15.8) has suggested the need for a move away from the "sequential assimilation of linear information" and "summative assessment and towards the creation of "nonlinear, associational webs of representations" within neomillennial learning environments and assessments, the results of this current research suggest instead the need for a balanced approach to e-learning design, one in which both sequential and global learners are catered for. In other words, in formal educational learning environments, the needs of sequential or global learners should not be forgotten in any adoption cycle.

There is a concern that if learners always have the choice to learn only in their preferred manner, then they will not develop the knowledge, skills or confidence to learn in divergent ways. In factoring in both sequential and global learning options in learning design, this is not to suggest the creation of what Coffield et al. (2004, p.3) call a "pedagogical sheepdip". This analogy suggests that all learners will be inoculated with everything within a learning environment. Rather, the suggestion here is the learning design is constructed to allow the learner active choice in the way in which they interact with the communicated information in any educational environment yet provide opportunities within the same environment to develop less preferred ways of learning through set tasks. Thus in matched/mismatched learning environments, sequential learners have the opportunity to approach their learning sequentially and also develop skills in learning in a global manner, with provision for the same opportunities for global learners.

Conclusion

MUVEs are a realm of learning for neomillennial learners. The hypermedia features of e-learning bring together the possibilities to design not only in a traditional sequential manner, but also to foster learning designs for global learners who have traditionally not been well-catered for in formal education circles (Felder & Soloman, 1993). For example, the visual and navigational features of MUVEs, such as *RuneScape* and *Second Life*, allow for non-linear educational opportunities for the emersion for global

learners. However sequential learners may find such hypermedia environments confusing, and may need the security of an alternative structure which is a linear progression.

NASA, in its 2007 report *eEducation Roadmap* (Laughlin et al., 2007, p. 6), has identified that a research focus in neomillennial learning should be on how online, persistent, computer-based and console games, such as *Second Life*, accommodate different learning styles. It is hoped that this research contributes somewhat towards this. The research has provided a timely reminder that in the new millennium, learning environments need to be design with balance in mind. Balanced e-learning environments are those which use both "holistic understanding" and "logical steps" in the process of learning (Spencer, 2000, p. 18). This notion of balance is neither a 'one-size-fits-all' approach, nor a "pedagogical sheepdip" (Coffield et al., 2004). It is instead a considered alternative; one in which the learner is given some realm of choice in their learning, plus the opportunity to develop their ability to learn in other ways.

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