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**Cognitive Learning Styles and Digital Equity: Searching for the Middle Way**

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## COGNITIVE LEARNING STYLES AND DIGITAL EQUITY: SEARCHING FOR THE MIDDLE WAY

Adult education and lifelong learning increasingly goes beyond traditional providers of education to include work based learning provision through to loose collectives supporting informal learning (Bentley, 1998; Marsick & Watkins, 1990; and Dale & Bell, 1999). For lifelong learning to become 'a reality for all' the Lisbon Strategy (European Commission, 2005) states everyone should have equal and open access to high quality learning opportunities throughout their lives (Reding, 2003). The Lisbon Strategy also emphasises that learning opportunities should be provided in a variety of ways to suit individual needs and this in part has shaped our research. 'Searching for the middle way' is driven by a desire to understand the lifelong learner in the context of styles of learning and the emerging implications of technology enhanced learning for digital equity. We begin with the view that learning is a cognitive process that is intrinsic to the learner in both formal and informal settings (Courtney, 1979). A traditional perspective on learning and education is explained by Merriam & Brockett (1997) who state:

*"learning can occur both incidentally and in planned educational activities, while, it is only the planned activities we call education."*

Our research adopts a contemporary lifelong learning perspective of education in both formal and informal settings and our understanding of 'equality for all' is shaped by a critical multicultural perspective (Delpit, 1995; Bennett, 1999; & Gay, 2000) that supports a commitment to learning about peoples' differences. The lifelong learning viewpoint has become an increasingly important perspective through the unprecedented growth of the Web and more recently Web 2.0 and participative social networks. The learning environment, physical and virtual space, is a characterising feature of learning along with the cognitive learning style. The move towards a more holistic use of the term lifelong learning embraces both formal and informal learning and in part is central to the renewed interest in learning styles. Recognizing cognitive learning styles is the first step educators need to take in order to be most effective in working with students of diversity and bridging across formal and informal settings (Tomes, 2008). According to Messick (1976) cognitive style is the inclination people have in processing information in a particular way. This way of processing comes from the individual learners' experiences and develops incrementally over time, and as such it is not easily changed or modified. According to Dunn et. al. (1981) cognitive style cannot be truly assessed or understood outside of the environment to which the learner finds

themselves. As such this highlights the importance of research that takes into account not only the environment learners are in but also the social elements of culturally diverse learners and their respective experiences (Gay, 2000; and Neito, 2000). This is supported by Whetton & Cameron (2005) who see the identification and use of cognitive styles as a way for learners to improve their relationships with others as well as developing critical self-awareness. Cognitive style cannot be viewed in isolation, even though cognitive style can be seen as an individual's preferred or usual way of processing and organising information as the information itself has to be interrogated for bias and objectivity in a social context.

Several studies indicate the discrepancy in research findings between a one-culture teaching populations and increasingly diverse (racial, ethnic, cultural, and social class) learner and work populations (Bennett, 1995; Gomez, 1996). Another body of research highlights the difference in failure rates between individuals from prevailing and minority cultures (Jacob & Jordan, 1987; Yates, 1987). Whilst other research highlights cultural division between educators and ethnically diverse learners as contributing to the differences in success (Au & Mason, 1981; 1987; Ogbu, 1987). These discrepancies and differences identified in research and education practice is central to this study.

There are many learners at high risk of being socially excluded through what many have called digital inequity and related socio-cultural learning contexts of minority groups. We explore the principles of non-discrimination and inclusive education practice through searching for the 'middle way' in recognising cognitive learning styles, cultural context and the implications to digital equity. In seeking inclusive education we are highlighting the potential for inequity that seems to be emerging through limitations in learning styles research in being able to respond to the unprecedented changes in the Web and associated e-learning. Non-discriminatory education frameworks as proposed in this research is the right to education, as enshrined in the Universal Declaration on Human Rights of 1949. Searching for the middle way in learning styles, cultural context and digital equity is endeavoring to be in-tune with the statement that we "have the right to receive the kind of education that does not discriminate on grounds of disability, ethnicity, religion, language, gender, capabilities, and so on" (UNESCO 2003, 5). This research identifies that through learning styles developments and technological innovation educators on the whole are impeding effective responses to minority students and new styles are emerging through which educators could respond more adequately to students' needs. According to Tambini (2001) in the early years

of e-learning it was identified only a small minority of learners benefited in the context of technology enhanced learning experiences. For individuals to be effective learners in our increasingly knowledge-based society they not only need access to 'online' information but also personalised resources that will help them in building knowledge and understanding in a life-long way. To support the increasing diversity of learners pedagogy has to be fair, culturally responsive, equitable and increasingly relevant to the 'virtual generation' (Prosperpio & Agioia, 2007) . To counter the potential for marginalization, the Education for All (EFA) Framework for Action (UNESCO 2000) affirms that all groups need equity in quality education, and that education systems should take into account the diversity of learning needs among students. This in turn is central to exploring our understanding of the 'middle way' that recognises cognitive learning styles, the related cultural context, and in the implications to digital pedagogy equity .

### **Defining Cognitive Style**

People differ in several ways, not only in outward appearances such as skin colour, height or gender but also in the style in which they think about and process information. The concept of 'style' itself is quite commonplace in our everyday diction. For the purpose of this investigation cognitive style will be considered as a construct (concept, idea) the same way as for example personality and intelligence. According to Riding & Raynor (1998:11)

*"It is a matter of both personal and practical interest to understand why people differ; personal since it helps them to understand themselves better, and practical because with such understanding individuals can be helped to their full potential and more appropriately guided into particular occupations. Among possible contributors to individual difference are intelligence and personality...a further significant contributor being 'cognitive style'."*

The concepts of cognitive style and learning styles find their roots within psychology although for over forty five years researchers from many different disciplines have entered the frame from as diverse fields as education and commerce. This in itself has produced a plethora of research that arguably could be described as disjointed with theories surfacing from many different disciplines with differing underpinning perspectives for their research. The definitions of learning style are numerous and are made more difficult when they are interchanged with the concept of cognitive style or used in conjunction with learning strategy. According to Riding (1997) cognitive style is the usual way in which a particular person assesses, perceives and remembers, whilst learning style is used to highlight the effect of cognition within a learning context. Riding and Cheema (1991)

assess cognitive style using their own wholist-analytic spectrum that illustrates how they see cognitive style as a major element of learning style. In this case cognitive style refers to the manner or way of organising and processing information or as Lycan (1999:51) describes as:

*"The concept of cognition is closely related to such abstract concepts as, mind, reasoning, perception, intelligence, learning, and many others which describe numerous capabilities of human mind and expected properties of artificial or synthetic intelligence. Cognition is an abstract property of advanced living organisms; therefore it is studied as a direct property of a brain or of an abstract mind on sub symbolic and symbolic levels."*

The move between behaviourist to cognitive psychology over the last fifty years or so has seen changes in our perception of how behaviour and cognition are linked. It is suggested, the way we function as people is dictated by three elements or factors: socio-cultural, psychological, and physiological (Greene, 1995). A cultural outlook on cognition requires understanding of how culture influences and shapes cognition and the world around us (Greene (1995). Riding & Cheema's (1991) review of different cognitive styles (Cognitive Styles Analysis – C.S.A.) suggested that there are two distinctive groups. The Wholist-Analytical element of cognitive style describes how people process information. For instance Analytics process information in what is termed component parts, and are very organised, whilst Wholists include the bigger picture and are more intuitive (Witkin et al., 1977). The Verbaliser-Imager dimension of cognitive style is explained by Riding (1994) with the example of Verbalisers seeing their data, facts and figures in "words" whilst Imagers being more likely to see or represent information in "pictorial" form. Hartley (1998) simplifies the questions around cognitive and learning styles stating:

*"Cognitive styles are the ways in which individuals characteristically approach different cognitive tasks; learning styles are the ways in which individuals characteristically approach different learning tasks."*

Cultural aspects influenced by your social environment clearly impact upon the relationship between learning and cognition (Hill, Puurula, Sitko-Lutek, and Rakowska, 2000). Koper states that interoperable networked learning is able to support collaborative learning through learning communities. This technological perspective moves the focus towards behaviour and the process of learning that learners undertake to achieve understanding (Koper, 2004). Sadler-Smith (2001) made this point in identifying that a principle objection to notions of learning styles tools is their

limited consideration to the social context within which learning takes place. Reynolds (1991) identified the importance of learning context through the study of an educational programme for 5-15 year old Navajos Indians but such research in the early 1990's even though significant had limited impact on influencing the behaviourist roots of learning styles research. Searching for the middle way recognises the increasing need, through technological changes, for research into cognitive learning styles, the related cultural context, and in the implications to digital pedagogy equity .

### **Characterising Cognitive Learning Styles & Associated Preferences**

Characterising learning styles as the cognitive and psychological behaviours exhibited by people provides a moderately good indication of how they actually perceive information (Keefe, 1979). In addition we need to acknowledge how culture affects and influences the way we see the world and provides us with some indication that this very same culture will have a significant bearing upon how and what we learn (Neito, 2000). Grasha (1990) and Terpstra & David (1985) see culture as affecting the preferences of learners especially within the context of student interaction, knowledge acquisition and cognition. The culture in which a person is immersed may not be the same culture that they experience within the educational system and for many this results in an inconsistency in the acquisition of knowledge. Kolb and Fry (1974) argued that culture and cultural ideals were part of the socialisation that everyone was a party to and as a consequence they suggested that education and more precisely learning styles were influenced by culture. This arguably is why some cultures fair better than others within education. The notion of a connection between learning styles and culture is central to this research in viewing culture as instrumental in shaping the learning environment.

When reflecting upon cognitive styles, learning styles, and culture in characterising cognitive learning styles two particular frameworks of note are Dunn & Dunn's (1974) Learning Styles Inventory and Gardener's Multiple Intelligences Theory (1983). These frameworks and associated methods for characterising learning styles we have used as illustrative frameworks that reflect our viewpoint on the relationship between learning styles and the cultural context referred to as the learning environment. The connection between learning styles and cultural context provides the nexus for exploring what we have termed the 'middle way'. Gardner's theory can potentially offer eight different ways for an individual to learn with each being as valid as the other. Gardner illustrates this by recommending educators to place equal importance on what he views as

different types of intelligence's and for educational institutions to move away from promoting or focusing their attention on words and numbers suggesting instead that teachers employ a variety of ways to conduct their classes be it team learning, role play, inner reflection, field trips or computer aided learning. Gardner identified several types of intelligence in people that includes: verbal Linguistics learners, logical-mathematical learners, musical learners, spatial learners, bodily kinesthetic, interpersonal learners, intrapersonal learners, and naturalist learners (Gardner, 1999). In contrast the Learning Styles Inventory (Dunn & Dunn, 1974) focused on there being a wide array of learning styles within any group of learners and that the style is influenced by behavioural, environmental and cultural factors. Dunn & Dunn sought to identify stimuli that could influence a person's learning and thus seeking to change the learning environment to suit the learner. For example when faced with a demanding new task some learners find it easier to work alone whilst others prefer the feedback they get from group work. Individual's responses to these stimuli based on behaviour, environment and culture provides a learning styles profile which in turn supports personalised learning that endeavors to enhance learning behaviour. The stimuli identified included: emotional stimulus, environmental stimulus, psychological stimulus, physiological stimulus, and sociological stimulus.

Gardner's and Dunn & Dunn's classification frameworks are intended to be illustrative of the role learning styles can undertake in shaping educational programmes that support cognitive behaviour, learning environments and associated cultural diversity. Such frameworks that characterise cognitive learning styles continue to emerge and shape the learning experience for many. Current pedagogical styles in learning are changing to those which encourage the active participation of students and learning styles research needs to reflect this through a greater focus on the social and cultural context (Salmon, 2003). Students engaged, not just with each other, but also with the content that they are creating, storing and retrieving from shared community resources. For example, more recent research by Armstrong's (2004) makes steps in this direction by researching the learner-teacher relationship and the implications to effective learning.

The 'learning preferences' is also central to the understanding of learning styles and is viewed as an individual's preference to select or favour one technique or combination of techniques over another in their acquisition of knowledge (Sadler-Smith, Allinson & Hayes, 2000). Reichmann & Grasha (1974) identified three learning preferences. Firstly, dependent learners who prefer a highly structured environment whereby they are set tasks and are assessed by teachers. Secondly,



collaborative learners' who are most comfortable when in a group environment. They lean towards discussion led solutions and collaborative projects. Thirdly, independent learners' who like to have some bearing or influence over the content and structure of the information that is disseminated to them. Such an approach considers the teacher in this equation to be a resource. The interpretation of learning preference (dependent learner, collaborative learner, independent learner) identified by Reichmann & Grasha (1974) is supported by more recent research by Sadler-Smith (2000).

Autonomous methods (independent learners) may include types of learning that are not contingent upon an educator being present and often includes technology enhanced learning such as 'Serious Gaming' and simulation software. This is in contrast to dependent methods which rely upon the educator as being instrumental in facilitating the learning process and this could include classroom lectures through to video conferencing and Podcasting. Whilst collaborative methods used by the learners may include discussion groups, role-play and increasingly online collaborative gaming such as SecondLife and Wiki's. With the emergence of Web 2.0, and associated social networking, the blend of physical and virtual for the formal and informal learner is becoming more seamless. This broad understanding of the characterising of learning preferences is extended by Scandinavian learners who were tasked by Marton and Sajilo (1976) to read academic articles and from the analysis they identified two different approaches to study. Firstly, the deep approach which was concerned with actually using past knowledge and experience along with questioning the writer's opinion to come to a conclusion about the respective article. Secondly, other learners employed a technique that would allow them to remember the salient facts of the respective article and this Marton and Sajilo titled the surface approach. This research was developed further by Biggs (1987) with the identification of another approach called the strategic achieving approach where the organisation of materials and acquisition of knowledge are geared towards achieving high marks in tests and examinations.

These preferences and approaches to learning cannot be considered outside the context to which they take place or outside the elements involved in this learning process such as teachers or technology or as Fry, Ketteridge & Marshall (1999) state:

*“one of the greatest misconceptions on the part of many students is their belief that a subject consists of large amounts of factual knowledge and to become an expert all one need do is add this knowledge to one’s existing store. It is the responsibility of the teacher to challenge and change such conceptions and to ensure that their teaching, the curricula they design, and the assessments they set, do not seem to echo this perspective”.*

This view is supported by Biggs & Telfor (1987) who suggest that the teaching and learning context in which learners and teachers work within, along with their approaches to study, can be learnt and modified for optimum benefit for all parties involved. Typically teachers should have a greater awareness of learning styles as this aids in developing a blend of teaching strategies to accommodate the diversity of their learners (Perry, 1989). This argument is echoed by Riding & Rayner (1998) who believe that learning performance can be improved if the mode of presentation used is conducive to the individual’s particular cognitive style and learning preference.

Over many years learning styles research demonstrates the influence of behaviour, learning environment and associated culture on the learning performance. The complexity and importance of a learners environment and culture is being compounded by the rapid growth of e-learning and the emergence of online learning communities of practice as a broad based phenomena being facilitated by Web 2.0 technologies. It is clear that the ‘virtual generation’ (Proserpio and Agioia, 2007) have moved the Internet into software application development that is led by the demand for online social networking. For example Flickr, YouTube, Delicious, MySpace are viewed as software from the ‘street’ and the developments are closely associated with open source communities who have influenced e-learning providers to also move from content orientated systems into the rapid development of personalised and collaborative tools. The implications, in the context of this research, is the potential for greater support for cognitive learning styles and associated learning preferences but this would also require a shift from the current focus routed in behaviourist pedagogy. From an educationalist perspective there is an increased acceptance of cognitive learning styles and the need for improved insightful understanding of cultural diversity and this is viewed as a potential driver for change in software development. Both technological and educational developments provides insights into the move to support an holistic approach to the lifelong learner that is routed in the adoption of a multi-disciplinary perspective.

## The Emergence of Digital Pedagogy Equity

For the purpose of this research 'digital pedagogy equity' indicates methods of instruction, or a style of instruction using digital technologies. Having an awareness and understanding of styles-based pedagogy is viewed as the basis for equity in pedagogy. Digital pedagogy equity can also be referred to as the correct use of teaching strategies through digital media. This idea of equality, understanding and cultural pluralism is shaped by critical multicultural scholars such as Delpit (1995); Bennett (1999); & Gay (2000) who all believe that there has to be an investment or commitment to learning about peoples' differences irrespective of what they may be. This focuses upon the need to use culturally responsive teaching styles (Gay, 2000) to meet the diverse needs of learners and this provides an insight into the underpinning paradigm that shapes this research. Most educators teach students with limited formal knowledge of how students learn in either formal or informal settings. Typically teachers have significant self awareness of how they learn best but in contrast limited self reflection on how their students learn. This has the potential for inequity in the teaching process if the way they learning is projected into there teaching methods and techniques (Fry, Ketteridge & Marshall, 1999). This is intended to illustrate the need for embracing the uniqueness of teaching styles and supporting the uniqueness of cognitive learning styles. Riding & Rayner (1998) argue:

*“A pedagogy which incorporates style-led differentiation will achieve authentic accommodation of individual differences.”*

Pedagogy equity seeks to provide a leveling opportunity for diverse learners by providing a diversity of teaching techniques and styles. In addition to critical multicultural paradigms on pedagogy equity such 'seeds' have been nurtured by prominent behaviourist and styles orientated scholars, including B.F. Skinner since the 1940's, B. Bloom in the 1950's and R. Shank in the 1990's. They all start with the premise that a needs analysis of each learner has to be performed prior to selecting a teaching strategy that is conducive to that individual's way of learning.

The importance of the cultural context in supporting equity is integral to the holistic approach to adult education and lifelong learning that considers the learners' background, experiences and understanding (Freire, 1970). According to Gay (2000), to achieve true equity we need to embody culturally responsive pedagogy which would mean equal access irrespective of ethnicity, socio-economic factors, gender, age, religion and other related aspects of the learners background.

Many studies on cross cultural behaviour and cognition find significant differences in the way people process information and interact with one another. This again is supported by research, especially in the field of cultural psychology. As we have touched upon, cultural psychology or an individual's 'make-up' is a product of their respective culture (Nisbett et al, 2001). Nisbett & Norenzayan, (2002) viewed cultural psychology as an analysis of cultural environments and norms that affect the way people interact and think. This notion of culture that affects cognition and learning is supported in both anthropological and psychological studies ranging from Wood, Ford, Miller, Sobczyk, & Duffin (1996); Riding & Rayner (1998) through to Nisbett, Peng, Choi, & Norenzayan (2001); Chen & Macredie (2002) and Nisbett, & Norenzayan (2002).

Supporting pedagogy equity through understanding cultural psychology and culturally responsive practices (Gay, 2000) is integral to our research and is viewed as an enabler for the development of technology enhanced learning environments. Of course there are the inherent differences in research perspectives to be considered in any analysis of how or why people do what they do. The fundamental differences between cognitive and behavioural psychology is illustrated in the paradox: how can we be sure that cognitive psychology research is actually evidence of internal cognitive processes rather than just observed behavioural responses to some kind of interaction? In addition there is the relationship between cognition and behaviour to be considered. As we know with routine activities there is some element of cognition. According to Steinberg, (2003) behaviour and cognition are intrinsically linked. If there is to be any insight into behaviour in exploring why people do what they do then we need to know how people think, This is in contrast to the behaviourist perspective which primarily focuses on observable behaviour. This perspective is rejected by Greene (1995) who argues that behaviours cannot always be predicted. For example thought processes are not always rational and people make mistakes and have lapses in memory. In the case of interaction with technology Picard (1997) supports this view, suggesting that emotions have a role in learning, cognition and as a consequence behaviour. Technology enhanced learning and related e-learning applications have primarily embraced the behaviourist perspectives. This in part is a reflection of the limitations and potential inequities in technological developments that support 'adaptive learning management systems' and emerging learner information profiling tools but it is also the influence of technologists over educationalists in the learning design process.

Over the past fifteen years and more we have seen an unprecedented increase in the amount of research focussed on cross cultural communication via technology enhanced learning and related multimedia applications (Nielsen, 1990; Norman, 1988; Danet & Herring, 2007; Burnett & Buerkle, 2004; and Faiola & Matei, 2005). The difference in possession and use of information and communication technologies by people from differing backgrounds or groupings is often referred to as the digital divide. The demand for technological competency has increased over the years as society and the workplace has seen a marked upturn in the use of e-learning, and related Web 2.0 supporting software, in both formal and informal educational environments. It is also clear that educationalists need to be taking a more instrumental role in ensuring pedagogical equity in the design and use of technology enhanced learning (Bolt & Crawford, 2000). In broad terms this should support the closing of the gap between learners in relation to access and use of technology in moving towards digital equity for all. Digital equity within this context is an attempt to ensure that learners, irrespective of their socio-cultural backgrounds, have fair and equal access to technologies that embeds pedagogy equity into the design process. According to Solomon et. al. (2003) digital equity is more than just creating an environment that is conducive to digital access it is about ensuring that learners are provided with the opportunities to be fully immersed in what for many is becoming ubiquitous technologies. This ensures they are not just users of technology but also influencing the application through individual and group participative learning practices. Digital equity research to date mainly consists of research into levels of 'access' related to issues of age, gender, location, race, religion, and socio-economic factors. Digital equity research also deals with the various levels of 'access' that need to be addressed for there to be some semblance of digital equity (Wiburg & Butler, 2003).

- Access to current technologies and networking including fixed and mobile devices
- Access to meaningful, high quality, culturally responsive content that provides participatory functionality
- Access to facilitators and educators who are skilled in the use and application of various digital technologies
- Access to technological infrastructure that are maintained and managed by educational institutions

In striving for digital equity, through technology enhanced learning and content design, it is important to embed the cognitive learning styles into the process that is primarily influenced from

the behaviourist and secondly cognitive theory perspective. Despite the behaviourist theory being useful in terms of emphasising the importance of reinforcement in learning (Roffe, 2002), it is limited when reflecting on current educational thinking in the adoption of a narrow view of the way people learn. This for example is illustrated through Skinner's Operant Conditioning Theory (1969) that emphasises the importance of reinforcement in learning. He suggests that when a positive reinforcement is given it increases the likelihood that behaviour will be repeated because a reward is given. In comparison current educational thinking views learning resources, underpinned by a behaviourist approach, as being limited in scope in the context of learning. According to Clark (2003): "Practice tends to lag hopelessly behind progress in theory". Clark (2003) suggests that the design of most technology enhanced learning solutions, that are rooted in a behaviourist approach, provides limited recognition for the learner as an active, and constructivist learner. As we have discussed psychology of learning explores a wide range of factors that has implications in the sense of being active, motivated, cognitively complicated, constructivist learner. In enabling digital equity we need to ensure learning is reinforced and a constructivist approach that recognises behaviour, cognitive learning styles and cultural context is adopted when designing and developing technology enhanced learning solutions.

Digital equity research therefore needs to move beyond the currently accepted boundaries of digital divide and deal with the psychological, cultural and technological complexities that moves with the challenges of realising digital pedagogy equity. Digital pedagogy equity is rooted in a desire that technology enhanced learning is used constructively to enable culturally responsive teaching that meets individual styles of learning. For lifelong learning in the context of formal and informal settings the need for closing the gap in terms of access is clearly being realised but mere access to these technologies within a learning environment may not be adequate and, as discussed, may lead to digital inequity. These barriers to the equity of learning are numerous and arguably not caused by our new found reliance on technology but our level of access to it. Swain & Person (2001) argue that there are considerable differences in levels of access and experience of computing in the context of a person's behavioural, psychological and cultural context. We need to ask ourselves what are the fundamental factors hindering achievement in this area and why different sets of researchers have differing views upon how digital and pedagogy equity can be achieved. We then have to assess how these differing views will affect our collective ability to bring about change with pedagogy equity being instrumental to technology enhanced learning. There is a need for the identification of the barriers that are more susceptible to change (Fulton & Sibley 2003) in enabling

digital pedagogy equity through supporting cognitive learning styles in facilitating lifelong learning. Table 1 below illustrates some of the key areas of research of the past thirty years into learning styles and culture, and more recently into digital equity. Table 1 below provides a 'window' into the limited research conducted to date that explores culturally responsive teaching in the context of the relationship between cognitive learning styles and digital equity.

TABLE 1 - A 'Window' into Cognitive learning styles and Digital Pedagogy Equity Research

### **Searching for the 'Middle Way': Styles, Culture & Equity**

Learning theories and associated models have changed over time and as such their application to emerging technologies has been piecemeal. This is illustrated by the earliest behaviourist learning models which were grounded in the notion that all learners and their actions should consider behaviours that can be observed and described scientifically without the need for observation of inner physiological occurrences. This continues with an objectivist approach where knowledge exists outside of the learner and outside of the learning context. This moves us to our present constructivist models supporting technology enhanced learning that states the act of understanding brings about the construction of knowledge. The awareness of how we process information and think (meta-cognition) is essential to the improvement of our learning and this is also rooted in an acceptance of style (Wenglinsky, 1998).

We believe that 'style' based pedagogy will lead to a more equitable learning environment (Riding & Rayner, 1998), which in turn 'opens the door' to achieving digital pedagogy equity. This is supported by Brown, Fry & Marshall (2003) who feels the identification and use of style(s) can aid teachers in understanding their student's problems which in turn will lead to them adopting appropriate teaching strategies to accommodate the diversity of cognitive learning styles exhibited by their students. At the same time there is a general view that there is currently a cultural bias within the use of learning technologies which comes from the teacher and respective students' experiences and backgrounds (Pea, 1994). Evidence suggests that student learning is greatly improved if technology enhanced learning incorporates or relates to student experiences (Wlodkowski & Ginsberg, 1995 and Sianjina, 2000). Arguably this insight and reflection of digital pedagogy equity is partly being realised through cognitive styles analysis. This is supported by the view that cognitive style relative to other factors has a major influence on learning and related performance at the specific level of dialogue and content design through to the level of overall

attainment (Riding & Rayner, 1998). There is a clear need in increasingly diverse formal and informal settings for teachers to consider cognitive styles and cultural differences, especially in how learners learn and see their environment when selecting and using technologies.

Resistance to change has been found to be one of the greatest barriers to adopting new teaching techniques and practices (King, 2002; Barak, 2005) and this is illustrated in the unprecedented adoption of e-learning that embodies technological innovation but is limited in pedagogical innovation. Despite the potential benefits and drawbacks, the use of technology enhanced learning is a trend that will continue growing (Carr & Farley, 2003) . The likelihood of its increasing prevalence and the fact that such technologies present new challenges to educators mean that it is crucial, for the benefit of learners, that the most effective techniques for using such technologies are exploited (Carr & Farley, 2003). e-Learning for distance delivery is only just beginning to offer any realistic alternative to face-to-face teaching through the recent widespread access to broadband on 'desktop' and mobile devices. To date technology enhanced learning is far from intuitive for the learner, and the actual benefits to the learner is viewed as limited in scope (Spangler, 2004). Historically, the emphasis during the creation of electronic learning materials has been on simply transferring the content of existing print information to a multimedia format. It is now evident that further research and development is needed into the learning design process that considers different styles of learning in supporting equitable computer interaction and learning (Huang, 2004; Evans et al, 2004; Riffell & Sibley, 2005).

The principles which underpin lifelong learning and guide its effective implementation clearly emphasise the centrality of the learner, the importance of supporting diversity through equal opportunities, and the quality and relevance of learning opportunities (Reding, 2003). As we move towards a more 'participative' learning approach of both face-to-face and on-line learning we need to emphasise the centrality of the learner in enabling pedagogy equity and secondly educators in relation to their knowledge of the groups they are working with and the technologies they are using (Knapp & Glenn 1996). A key characteristic is the centrality of the learner within formal and informal learning experiences. Equality of opportunity, that makes learning available for all, without discrimination, is a crucial concern, not least because of the way in which knowledge and competences impact on citizens' life opportunities. This change needs to address the systematic and pervasive inequities that have manifested themselves within all areas of education and that



reflect the inequalities in the wider society that include factors such as gender, age, ethnicity, disability, religion, and language discrimination.

On a macro level increased consideration is needed into how technology enhanced learning developments can support the cognitive learning styles of the learner in improving the learning experience. For this to be feasible a styles inventory or related classification tool needs to support the teaching process for individual learners. Amongst the new potentialities is the 'semantic Web' and the possibility of personalised learning experiences (Matthew's, 2005). Newer technologies employing cognitive pedagogies, may well be able to support serial learning styles through the use of cognitive scaffolding supported by these tools. This would, however, not accommodate views of learning styles that includes the learners cultural context or other more holistic styles. Both collaborative learning and the accommodation of learning styles are currently under represented in mainstream e-learning applications. However, it remains to be seen how the fundamental differences between collaborative social learning and individualised learning will evolve. On a micro level we need greater understanding of the fundamental nature of cognitive leaning style and how interaction with other behaviour would help in understanding the construct more. What is the range of influencing factors to style? What is the interaction between prior experiences and style? Are there cultural differences in style? These central considerations and questions would then move us towards a middle way in understanding cognitive learning styles and cultural contexts and how this may support us in achieving digital pedagogy equity for all.

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TABLE 1

<b>Characterising factors</b>	<b>Cognitive style</b>	<b>Cognitive Learning Style</b>	<b>Digital Equity</b>
	Personality Perception Processing information Problem-solving	Learning behaviour Learning styles Learning preferences Learning strategies	Pedagogy equity Culturally responsive Information Access Personalised learning
Allison & Haynes(1996) Intuition vs. Analysis	▲	▲	
Biggs (1987) Study Process Questionnaire	▲		
Curry (1987) Psychometric standards	▲	▲	
Dunn, Dunn & Price (1989) Learning Styles & Culture	▲	▲	
Entwistle & Tait (1995) Surface vs. Deep		▲	
Faiola & Matei (2005) Cultural Cognitive Style		▲	▲
Greene (1995) Cognition & Culture	▲		
Honey & Mumford (1992) Learning Styles Questionnaire	▲		
Hill (1976) Cognitive style interest inventory	▲		
Kagan (1965) Impulsivity vs. Reflexivity	▲		
Kauffmann(1979) Assimilator vs. Explorer	▲		
Kirton (1994) Adaption vs. Innovation		▲	
Kolb (1984) Experiential Learning & Style	▲	▲	
Pask (1972) Holist vs. Serialist	▲	▲	
Pavio (1971) Verbaliser vs. Visualiser		▲	
Riding & Rayner (1997) Defining Cognitive Style	▲		
Reichman & Grasha Learning Preferences Collaborative & Independent		▲	
Soloman Allen & Resta (2003) Digital Equity	▲	▲	▲
Riding & Cheema (1991) Cognitive Styles Analysis	▲	▲	
Witkin (1962) Field-dependence/Independence	▲	▲	

Table 1 - A ‘Window’ into Cognitive learning styles and Digital Pedagogy Equity Research