Personalised learning environments: Core development issues for construction

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Summary

The growth of e-Learning has been continual and sustained. This has been fuelled by developments in Information and Communication Technologies (ICT) the nuances of which are starting to reap considerable benefits in the educational and business environments. Specific benefits have included e-interoperability, scalability, adaptability and the mass-customisation of learning packages to the distributed learner community. Notwithstanding the technology related issues, from a pedagogic perspective, learning styles and instructional strategies are now being intensively studied in the 'traditional' classroom setting to leverage advantage. However, there has been little research undertaken on the application of learning styles within the educational arena, perhaps because of limited authoring applications or explicit choice vis-à-vis the creation of instructional strategies for specific learning styles. In this context, some of the evidence identifies that the more thoroughly instructors understand the differences in learning styles, the better chance they have of meeting the diverse learning needs of learners. Therefore, the paradigm of 'one size fits all', by default, can only address the generic learner issues (and not the specific 'personalised' learner requirements). This paper introduces the concepts and issues

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surrounding the development (and barriers) of personalised learning environments, which incorporates learning styles.

Keywords

Personalised learning environment; learning objects; learning styles; pedagogy.

1. Introduction

The development of technology-enhanced learning is continually evolving (Bouzeghoub *et al.,*2006) and with the advent of digital age the learning industry has experienced a major paradigm shift over the last decade in e-Learning (Sampson *et al.*, 2002; Venkatachary, 2002). This rapid development has placed educational environments in a state of flux (Andrews & Crock, 1996) as institutions strive to embrace these opportunities in order to innovate and dispel the conventional 'intractable' conditions for learning (Benesova *et al.,* 2002). Such conditions include the concept of synchronous communication; inflexible learning geared to a specific timeframe; high learner to instructor ratios; expensive materials, etc.

e-Learning involves different aspects of using e-documents for learning related activities. It tends to embrace such issues as managing curriculum courses on the Web (advertising, registration, scheduling, exams, etc.), through to online publishing, tutorials, assessment, etc. Specific efforts have been made to create high-quality and relevant online learning material, as well as the support infrastructure (to support and facilitate the learning process).

Learners often have different levels of motivation, different attitudes about teaching and learning, and different responses to specific classroom environments and instructional practices. In this context, the more thoroughly instructors understand these differences, the better chance they have of meeting the diverse needs of their learners (Felder and Brent, 2005). Furthermore, Karagiannidis and Sampson (2004) noted that there was a general shortage of evidence to back up the belief that e-learning provided real advantages - the assumption of which was that 'traditional' mode of instruction (one –to-many lecturing/one-to-one tutoring) cannot fully accommodate the different learning styles, strategies and preferences of diverse learners. Following this train of thought, research is now being undertaken on adaptive learning environments that can personalise the learning experience (Vercoustre *et al.*, 2005, Sampson and Karagiannidis, 2002).

2. Research Methodology

The research methodology approach adopted for this paper embraces the distillation of core research material gathered from a detailed literature review. The literature review encompassed concepts and issues surrounding the development (and barriers) of personalised learning environments, specifically within the context of the management and social sciences fields. A qualitative approach was used in

this research, as this was considered more suitable for studying social and cultural phenomena (Berger and Luckman, 1966). This paper explores the relationship between pedagogy and technology in the context of the design and implementation of a Personalised Learning Environment (PLE). The technology issue was addressed in terms of learning objects and standards, together with their roles and functions in providing interoperability between delivery platforms, reusability and manageability of e-learning materials, and accessibility. The implementation framework for the PLE adopted the principles of the "Collaborative System Design" approach as identified by the Advanced Distributed Learning (ADL) Initiative Guidelines (ADL, 2006).

3. e-Learning

The term 'e-Learning' is relatively new (Bose, 2003), and several definitions have been cited. For example, Horton (2001) cites e-Learning as "the use of Internet and digital technologies to create experiences that educate fellow human beings", whereas Fry (2000) defines e-Learning as "delivery of training and education via networked interactivity and a range of other knowledge collection and distribution technologies". Moreover, Roffe (2002) defines the term e-Learning, e-Education or online learning as "…the way people communicate and learn electronically which has recently emerged as a key source of competitive advantage in the information society". Welsh *et al* (2003) define e-Learning as "the use of computer network technology, primarily over or through the Internet, to deliver information and instruction to individuals".

In addition, Hirumi (2002) defines e-Learning as a "learning that is stimulated primarily through the use of telecommunication technologies, such as electronic mail, bulletin board systems, electronic whiteboards, inter-relay chat, desktop video conferencing and the worldwide-web. Urdan and Weggen (2000) define e-Learning as "…a set of applications and processes, including computer based learning, web based learning, virtual classrooms, and digital collaboration". Tavangarian et al. (2004) define e-Learning as "…..all forms of electronic supported learning and teaching, which are procedural in character and aim to effect the construction of knowledge with reference to individual experience, practice and knowledge of the learner. Information and communication systems, whether networked or not, serve as specific media (specific in the sense elaborated previously) to implement the learning process".

3.1 Pedagogical Developments in e-Learning

From a pedagogical perspective, Bixler and Spotts (2000) reported that since e-Learning is a relatively recent phenomenon, the underlying pedagogical principles have not really been fully considered, and in this context it can be noted that the majority of pedagogical principles that apply to the 'traditional' classroom delivery method also apply to e-Learning. A number of pedagogies and approaches are often quoted in the e-Learning literature (constructivism, communities of practice, collaboration). However, it is suggested that much of what is described could more easily be explained in terms of didactic and behaviourist approaches to learning (Canole *et al.*, 2004). Thus, e-learning can not continue to exist without pedagogical techniques, nor without incorporation and consideration of

domain-specific knowledge (Govindasamy, 2002). This situation poses a serious challenge to any organisation embarking on (or implementing) e-Learning in their environment. Furthermore, in the context of learning management systems (LMS), (Govindasamy, 2002) also noted that many features and tools of LMS are often left unused. This could be construed as a waste of resources, since these tools often account for a considerable amount of the resource expenditure. Furthermore, in the worst case scenario, these tools may end up being a barrier to pedagogical principles (thus affecting its effectiveness) let alone return on investment. From this standpoint, it is argued that pedagogical principles are backbone theories that govern good practice, and which form the primary rubrics from which teaching and learning coalesce. In relation to e-Learning, good practice of teaching or instruction is well represented in a diverse linking science known as Instructional Technology (Govindasamy, 2002).

From a learning context, several models for learning have been proposed, such as Kolb's experiential learning cycle (Kolb, 1984), Jarvis' model of reflection and learning (Jarvis, 1987), and Barnet's framework for higher education (Barnett, 1990). Each model has particular focus and emphasis, and is aligned with a particular set of theoretical perspectives (Canole *et al.*, 2004) to encourage specific aspects of learning. Although e-Learning appears to offer benefits for adult learners, including 24/7 delivery, e-Learning courses have however been criticised for their lack of pedagogic underpinning. When designing instructional material, it is therefore important to accommodate elements that reflect these nuances, e.g. learning styles (Bajraktarevic *et al.,* 2003). Furthermore, technological developments have now made it much more important to concentrate on learning styles and preferences (Weber and Brusilovsky, 2001), including the correlation between individual learning styles and the learning environment (Beacham *et al.,* 2002). Hence, these issues are currently being 'mapped' against technological developments, the process of which is creating very powerful knowledge-based learning environments that can be tailored to suit individual learner needs (blending learning content and learner styles), as a close relationship between pedagogy and technology evolution is an important aspect in designing and managing educational systems – vis-à-vis the role of technology evolution as an enabler of new pedagogical concepts(Pahl, 2003).

3.2 Instructional Design (ID) Theory

Instructional Design (ID) theory is "a theory that offers explicit guidance on how to help people learn and develop" (Reigeluth, 1999). This sets out procedural steps to systematically design and develop instructional materials (Dick and Carey, 1990; Gagne *et al.,* 1988; Merrill *et al.*, 1996)*.* There are many different theories that are used for Instructional Design (Dick and Carey, 1990; Gagne *et al.* 1988; Merril *et al.* (1996). One of the important characteristic of ID theory is that these are design-oriented (or goal-oriented). ID theories require at least two components: (i) methods for facilitating human learning and development and, (ii) indications as to when and when not to use those methods (Reigeluth, 1999). According to Alshawi *et al.* (2005)*,* ID theories focus on the learning process through the implementation of cognitive approaches, e.g. the sequential steps for effective learning (refer Alshawi *et al.,* 2005 for key instructional ID theories). Merrill *et al* (1996) described a set of perceptions for determining the appropriate instructional strategies needed to enable learners to

acquire instructional goals. This approach appears to also prescribe a variety of instructional methods depending on the type and nature of the subject matter, individual learning styles, assessment procedures and others.

3.3 Technical Developments in e-Learning

The rise in prominence of e-Learning evolved out of the dot-com boom (Bose, 2003). Since then, e-Learning has become a relatively significant component of training and development within the corporate environment (Waight and Steward, 2005). Knowledge of e-Learning has largely been developed from the experiences of learners and teachers in education using Interactive internet technologies to create online learning environments that support learning communities (Downes, 1998; Fisher *et al.*, 2000; Hill and Hall, 2001). In addition, considerable resources have been leveraged to create high quality and relevant online learning material, as well as to the design and implementation of systems that support users in their learning process (Vercoustre and McLean, 2005). However, Vercoustre and McLean (2005) pointed that the process of creating learning materials are labour intensive and time consuming, even with the existence of a detailed course descriptions and lesson plans. In this context, Casey and McAlpine (2003) describe that preparing learning materials typically involve:

- Finding good document sources relevant to the topics and to the audience.
- Selecting more specific parts of documents that could be reused, in particular graphics, tables, images, which have a high illustrative power, and creating new material that can be adapted for personalisation and future reuse.
- Defining the sequence in which documents and fragments about some concepts should be accessed or presented.
- Defining the curriculum planning that would fit with the pedagogic approaches, and that will hopefully adapt to the actual learner.

Boyle (2003) reinforced this mandate, noting that developing cost effective e-Learning material is now considered as one of the most important factors, especially concerning the return on investment equation. This fundamental cost can often be influenced by the level of interactivity used, as the higher the level of interactivity then the greater the demand on resources (and vice versa). Hence, the cost of developing high levels of learner interactivity can be quite considerable, with figures of around 300 hours for every 1 hour of e-Learning content developed being quoted (Collaborativelearningsystems, 2005). In addition, there are other costs to consider, e.g. the operational costs, content delivery costs, maintenance costs, etc. This is however, highly dependant upon a number of factors, not least users' learning styles, current knowledge base, adaptability, shareability, etc. (Watson and Ahmed, 2004). In this capacity, programme authoring should try to define reusable learning material that can be retrieved, adapted and assembled in a coherent way (Vercoustre and McLean, 2005; Rosenberg, 2001). Thus, it is apparent that one particular solution to these issues could be the potential use (and reuse) of learning objects (Alshawi *et al.,* 2005).

4. Learning Objects

A learning object is considered as any resource or content object that is supplied to a learner by a provider with the intention of meeting the learner's learning objective(s), and is used by the learner to meet that learning objective(s) (Vercoustre and McLean, 2005). According to Dahl and Nygaard (1966), the key notions behind learning objects are that they can be used and reused in different (and multiple) learning contexts. Duncan (2003) considers learning object as something tangible that is produced by bringing together subject knowledge and pedagogical expertise.

The current focus in the e-Learning domain has predominantly been centred upon the development of technical infrastructures that support reusability, interoperability, durability and accessibility of learning content (Bannan-Ritland *et al.,* 2002 and Hummel *et al.,* 2004), and the use and reuse of these learning materials has been an issue for more than two decades (Collis and Strijker, 2003). However, the 'reusability' of an electronic learning resource often depends on its 'fit' with the language, culture, curriculum, computer-use-practices, and the pedagogical approaches of the potential learners and their instructors. In this context, the reuse of learning objects has managed to gain a lot of attention in the business world (Collis and Strijker, 2003), as reusability is an important principle that serves as the foundation for describing a learning object (Polsani, 2003). According to Collis and Strijker (2003), this issue often occurs in the context of the introduction of 'e-Learning' as an alternative to 'classroom courses. A lot of work has been focused on the development of standards for learning objects and significant effort has been made to develop standard descriptions for aggregations of learning objects, e.g. in the form of a course module (Lukasiak *et al.,* 2005).

4.1 Characteristics of Learning Objects

The following entails the core characteristics that relate to learning objects (Longmire, 2000; Knolmayer, 2003):
- A unit of learning material that should ideally not need to be redesigned or modified.
- have the ability to be subjected to any type of Instructional Strategy and not lose its meaning or be altered.
- The reuse of such material in the construction of further new or different new material.
- There is no need to alter, or know exactly what is inside a specific object.
- To be taken from its knowledge structure and reused by placing it seamlessly into a new knowledge structure to form a new course as desired.
- Refers to a set of steps whereby learners can search for a specific object, and if they require this object for their new course, to simply choose it and insert it into their specific requirements.
- Able to be searched.
- The ability for the Learning Objects to be used on multiple hardware.
- Enable the learner to integrate the disparate strands of instruction of the learning object into a concrete holistic result.

4.2   Benefits of Learning Objects

Invariably with any type of paradigm shift and incorporation of new technology, there will always be advantages and disadvantages associated with the dynamic change involved (James, 2003). The benefit of learning objects comes from their reusability. As discrete units, they can be incorporated into a wide range of courses or learning scenarios. Their standards-based structure makes them available for use in many different learning management systems and other applications. They also appear to be pedagogically effective.

According to Alsubaie (2006), learning objects are a cost-effective, efficient alternative to traditional course construction and materials. Moreover, they are more cognitive aligning than traditional material, thereby improving the learning process. Furthermore, they can be deployed within courses within a distributed Learning Environment that can offer performance, location, cost and learning advantages over traditional Learning Environments. They are reusable, self-contained, meta-tagged and should contain learning outcome entities that can offer considerable cost, production and delivery performances over traditional material, as well as leverage the elements required to successfully improve the learning processes that are vital if a learner is to partake in the learning experience – especially personalised learning (Alsubaie, 2006).

CLOEstories (2001) listed the following reasons why using learning objects can provide a positive value for the instructor, the classroom and the learners:

1   *Providing Different Ways and Modalities for Learning:* Bringing a learning object into the classroom can mean presenting content to the learner in new and novel ways. It could bring some interest to a disinclined learner, even spark a euphoric moment for others. Presenting content in a different and/or new way to how the information is traditionally taught in the classroom can present a variety of fresh and even different perspectives.

2   *Engaging the Learner in a New Way:* Stemming from the point above, providing the learner with learning objects in the classroom, something that is different from the traditional ways of teaching, could create a greater engagement factor for the learner. Meeting the learners' expectations, needs, etc can present added learning benefits.

3   *Size, Flexibility, and Adaptability:* Learning objects can be created in a variety of manageable sizes. Putting a number of Learning Objects together can create a larger object, or even a larger learning unit.

Listed below are among the benefits gained by organisations in using learning objects (Mortimer, 2002):

- Able to develop and deploy learning content quickly and efficiently.
- Able to port content easily between multiple learning management systems and learning

- Content management systems.
- Able to reduce content development and delivery costs.
- Able to reduce maintenance time and costs.

Likewise, learners benefit because they can access individualised learning paths, and competency-based rather than course-based learning events. A distributed learning environment that may consist of a PLE amongst other learning environments can potentially teach effective learning object-based, personalised training programmes to a plethora of learners. According to Alsubaie (2006), this has distinct advantages over utilising traditional material since it can allow potentially hundreds of learners to access courses simultaneously. Furthermore, it enables the learner to learn in their own time and at their own pace.

5. e-Learning Standards

Standards play an important role in the innovation, development, evolution and adoption of any product (Alshawi *et al.,* 2006). According to Alshawi *et al*. *(2005)*, the e-Learning industry and organisations need to protect their learning content and increase return on investment. Standards help to protect the six 'abilities' which protect and even nurture e-Learning investments. The following e-Learning standards have been identified by the e-Learning Consortium (2003):

Interoperability:
- Able to mix and match content from multiple sources (and within multiple systems).
- To enable multiple systems to communicate, exchange and interact transparently.

Re-usability
- To enable content and code to be reassembled, disassembled, and re-used quickly and easily.
- To enable content objects to be assembled/ used in a context other than that originally designed.

Manageability
- To enable the systems track the appropriate information about the learner and the content.
- Management of the complex selection and assembly of personalised content.

Accessibility
- To enable learner to access the appropriate content at the appropriate time on the appropriate device.

Durability
- To ensure buyers are not trapped by a particular vendor's proprietary learning technology.
- To ensure that no additional investment is required for re-usability and interoperability.

Scalability

- To enable learning technologies to be configured in order to have expanded functionality to serve broader populations and organisational purposes.
- To enable an organisation's return on investment in e-Learning products to be increased if they can be leveraged beyond the original scope.

Affordability

- To ensure that the learning technology investments are wise and diverse to risk.

According to Alshawi *et al.* (2006), there have not been official standards in e-Learning that content providers must adhere to - only a collection of different specifications by different organisations. However, many leading organisations have now started to share these concerns and beginning to develop an official standard with interchange capability.

6. Personalised Learning Environment: Definitions and Attributes

Alsubaie (2006) defines a Personalised Learning Environment (PLE) as "an electronic learning environment consisting of a learner and the Instructional System". According to Alsubaie (2006), most of the learning environments available claim to offer personalised learning. However, the effectiveness of such programmes for individual learners is limited for a variety of reasons and as such these elements have not fully attained their potential to create effective and efficient personalised learning. These include: (i) information rather than instruction being delivered (e.g. the course material is thus pedagogically ineffective); (ii) the lack of exchangeability and reusability between learning materials; (iii) ineffective implementation strategies; and (iv) the mechanistic utilisation of technology, rather than technology being utilised as an informatics driver.

Nevertheless, over the past few years PLE has increasingly become more popular. Personalised support for learners becomes more important when e-Learning takes place in an open and dynamic learning and information networks (Dolog and Sintek, 2004). The PLE should ideally be a robust and flexible Instructional System-based learning environment which can provide cost-effective learning based on the personal needs and background of the learner. It should be capable of delivering individual, bespoke and personalised training matched to the individual needs and learning style. The usability of a PLE is typically designed towards a specific end delivery system or a specific set of standards (Sampson *et al.,* 2005).

The emergence of the Knowledge Society and the Knowledge-based Economy signify a new era for education and training (Sampson and Karagiannidis, 2002). According to Rosenberg (2001), the typical demands made on the way education and training is planned, organised and delivered are as follows:

- Personalised training schemes tailored to the learner's objectives, background, styles and needs.
- Flexible access to lifelong learning as a continual process rather than a distinct event.

- Just-in-time training delivery.
- New learning models for efficient integration of training on workplaces.
- Cost effective methods for meeting training needs of globally distributed workforce.

The rapid evolution of ICT provides e-Learning as a new paradigm in education and training. Sampson (2001) reported that e-Learning capitalises on advances information processing and internet technologies to provide, among others:

- *Personalisation*: where training programmes are customised to individual learners, based on an analysis of the learners' objectives, current status of skills/knowledge, learning style preferences, as well as constant monitoring of progress. On-line learning material can then compiled to meet personal needs, capitalising on re-usable Learning Objects.
- *Interactivity*: where learners can experience active and situated learning through simulations of real-world events and on-line collaboration with other learners and instructors.
- *Media-rich content:* where educational material can present in different forms and presentation styles, and learning material can indexed and organised in such a way that it can be searched, identified and retrieved remotely from several different learners providing the right material to the right person at the right time.
- *Just-in-time delivery:* where technologies such as electronic performance support systems can facilitate training delivery at the exact time and place that it is needed to complete a certain task, and wearable computers can provide real-time assistance in actual work environments.
- *User-centric environments*: where the learner takes responsibility for his/her own learning, and the instructor acts as the 'guide on the side' rather than a 'sage on the stage.

The constitution and delivery aspects of a PLE should address the parameters of (and relationships between) learners' needs and requirements, learners' learning process and the learning/ knowledge repository (refer Alshawi *et al.,* 2005; Alsubaie, 2006 for further detail). According to Alshawi et al. (2005), learners are continually searching for ways to fulfil their individual needs, and in this context, are influenced by their individual histories and preferences. Learning behaviours often differ by preferred learning styles and environment as well as motivational and transformational factors. Attaining a match between learners' needs and the 'supply side' will require replacing traditional educational approaches with alternatives that emphasise the primacy of the learning materials architecture in order to deliver effective personalised learning environments.

The efficiency of the delivery process depends on a variety of factors to be achieved in terms of creating, searching, reproducing, assembling and delivering the body of knowledge in support of the learning experience; which are considered important, as substantial investments are made in the creation of learning materials in a usable and acceptable format (Alshawi *et al.,* 2005). This is where the assembly of learning objects as the reusable digital resource comes in to naturally embrace the relationships of object technology with pedagogy and learning.

6.1 Barriers Pertaining To the Development of PLE

Personalised learning is still a new concept, and there is as yet little evidence of where e-Learning fits within it. While e-Learning has been said to present a cost-effective solution to these issues, ICT awareness among teaching staff is patchy, and teacher competence in ICT also uneven. Awareness of the benefits of online learning is high, but there is still a strong perception that it would leave staff feeling isolated (Gunasekaran *et al.,* 2002). Some of the barriers pertaining to the development of PLE have been identified below:

- *Over-Reliance on Technology:* The genuineness of technology as a key driver for personalised learning depends on how much it is fit for purpose and designed to meet the needs of users. Technology should not be seen as the sole route towards a more personalised approach. Personalised learning, interpreted through e-Learning, needs to avoid becoming isolated individual learning, with the student entirely self-directed and interacting only with the computer. The ability of technology to provide instant and regular feedback is a definite advantage - but only when coupled with teacher support.

- *Learner Resistance:* e-Learning can in some circumstances adversely affect student retention, with students citing the problem of having insufficient time, which seems to have replaced the historical problem of distance to access and complete their e-Learning programmes. Lack of familiarity with ICT can also present a serious barrier, according to an action research project. Providers need to avoid self-satisfaction in assuming that prospective learners will be IT-conversant.

- *Staff Development:* There seem to be a long way to go before personalised learning through e-Learning can be fully realised. Confidence in adopting new technologies appears to be a key issue. There needs to be a commitment to training at a senior level. Skills in selecting, organising and adapting learning materials will become crucial in developing personalised learning approaches, as will technical skills in the use of multimedia resources.

7. Learning Styles: Defined and Described

The critical learning concept of learning style should be addressed within all learning environments, whether technology based or not. There is no single way to describe learning styles, as a number of definitions appear in the literature (Sampson and Karagiannidis, 2002). For example, Conner (2005) defines learning styles as "….the ways you prefer to approach new information". Dunn (1990) described learning styles as "….the way each learner begins to concentrate, process and retain new and difficult information". Moreover, Keefe (1979) defines learning styles as a ". . . diagnosis [that] opens the door to placing individualised instruction on a more rational basis. It gives the most powerful leverage yet available to educators to analyze, motivate, and assist students in school . . . it is the foundation of a truly modern approach to education". In addition, Honey and Mumford (1992) define

learning styles as "…..a description of the attitudes and behaviour which determine an individual's preferred way of learning".

The acquisition of different types of knowledge and skill appears to require different conditions for learning (Gagné, 1985). According to Merrill *et al.* (1996), if an instructional experience or environment does not include the instructional strategies required for the acquisition of the desired knowledge or skill, then effective, efficient, and appealing learning of the desired outcome will not occur. Sampson and Karagiannidis (2002) have classified learning styles into 11 models, namely: Kolb's Learning Styles Inventory; Dunn and Dunn; Felder and Silverman Index of Learning Styles; Riding-Cognitive Style Analysis; Honey and Mumford-Learning Style Questionnaires; Gregoric-Mind Styles and Gregoric Styles Delineator; McCarthy-4 Mat System; Gardner-Multiple Intelligence Inventory; Grasha-Riechmann - Student Learning Style Scale; Hermann-Brain Dominance Model and Mayers-Briggs – Type Indicator (Sampson and Karagiannidis, 2002).

7.1   Importance of Incorporating Learning Style into a PLE

Learning seems to be seen as an integral part of everyday life at work. The skill of knowing how to learn is considered a must for every worker. It opens doors to all other learning and facilitates the acquisition of other skills (Blackmoore, 1996). Student learning is a complex multivariate phenomenon. Some individuals are heavily dominated by one learning styles, or are just particularly weak in one style, so some learning activities are dominated by explicit or implicit assumptions about learning styles (Honey and Mumford, 1992). The activity may be geared to a particular style of learning as to cause a mismatch with any other learners whose own major styles are different. Also of course, there are learners whose learning styles are wide spread, so there are learning activities which contain opportunities to learn in different styles (Sims, 1990). According to Kim and Chris (2001) and Kolb (1984), educational research and practices have demonstrated that learning can be enhanced when the instructional process accommodates the various learning style of students. Learners come from different backgrounds and have a great variety of differing profiles, learning styles, preferences and knowledge hooks. Learning should be as personalised as possible (Vincent and Ross, 2001) as a 'one size fits all' approach has been seen to be ineffective (Watson and Hardaker, 2005). Incorporation of learning styles is said to bring an advantage during the development and implementation of a learning environment (Sims, 1990).

The need for both teachers and trainers to take learning styles into account appears to be greater today than before, due to the increasing use of technology-aided instruction. Technology offers a lot of new 'delivery mode' options as compared to the traditional 'face-to- face' classroom format, including a variety of computer and television-based delivery mode formats (Buch and Bartley, 2002). The development process based on individual learning styles and preferences through adaptive technologies has been a successful approach towards training that enables real-time performance evaluation through behavioural and attitude measures (Watson and Hardaker, 2005). O'Conner (1998) pointed out that technology offers new capabilities to reconstruct learning environments around specific learning styles. An assumption was made that individuals with specific learning styles would

have a preference for specific training delivery formats (Buch and Bartley, 2002). Since e-Learning has predominantly had a 'one size-fits all' approach, the idea of incorporating learning styles into the learning environment will enable learners to learn more effectively and also be motivated to learn by building a 'road-map' based on their individual psychological types and learning preferences (Gunasekaran *et al.*, 2002; Sims, 1990).
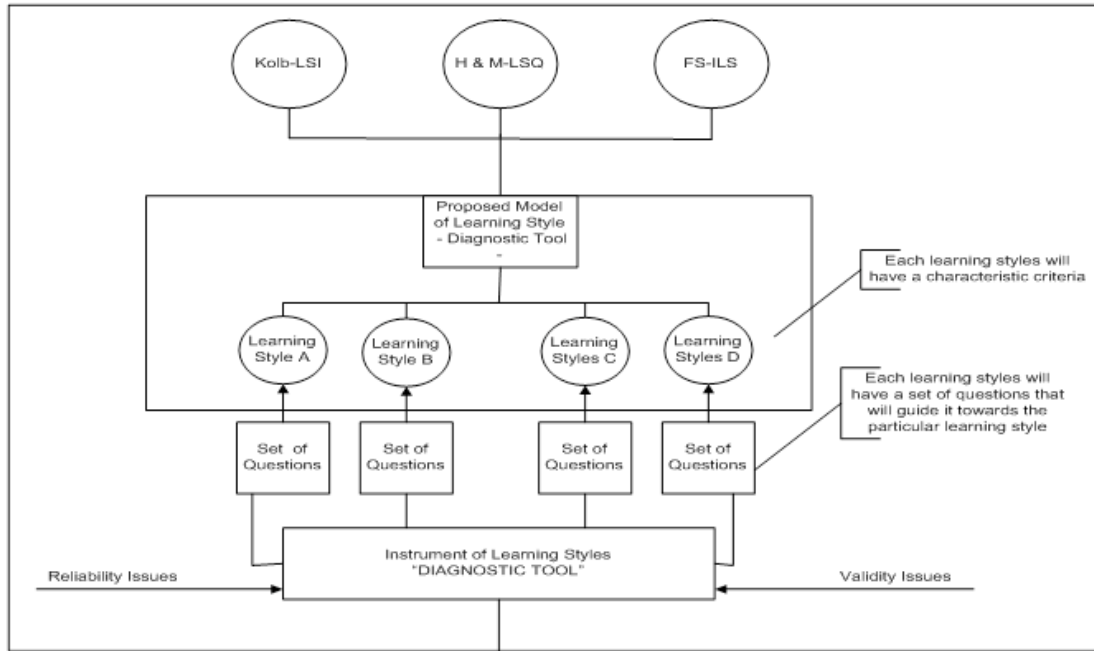
Teachers or instructors should: (i) know the material well before beginning to teach; (ii) write objectives and keep them in focus from planning to evaluation; (iii) letting the students know what the objectives are; and (iv) determine the learning style of students before teaching and educating students according to their own learning style and showing them how to cope (Vincent and Ross, 2001). According to Vincent and Ross (2001), learners need to know what their own learning style is in order to manage their learning more effectively and efficiently. At the same time, trainers should also be aware of the learning styles of their students so that they can establish alternate ways of teaching identical information to students. The Dunn and Dunn model of learning styles prescribes that all individuals have a specific learning style; this differs from person to person, and each person has learning style strengths or preferences. The model suggests that it is easier to learn through one's strengths or learning style preference. The central aim of the model is that the "closer the congruence between students' learning style and their teachers' teaching styles", the higher the level of achievement (Pheiffer *et al.,* 2005). Alsubaie (2006) suggests that learning styles should be incorporated in a learning environment to achieve a holistic environment that appeals to a whole raft of learners.

8   Personalised Learning Environment (Incorporation of Learning Styles): Conceptual Framework
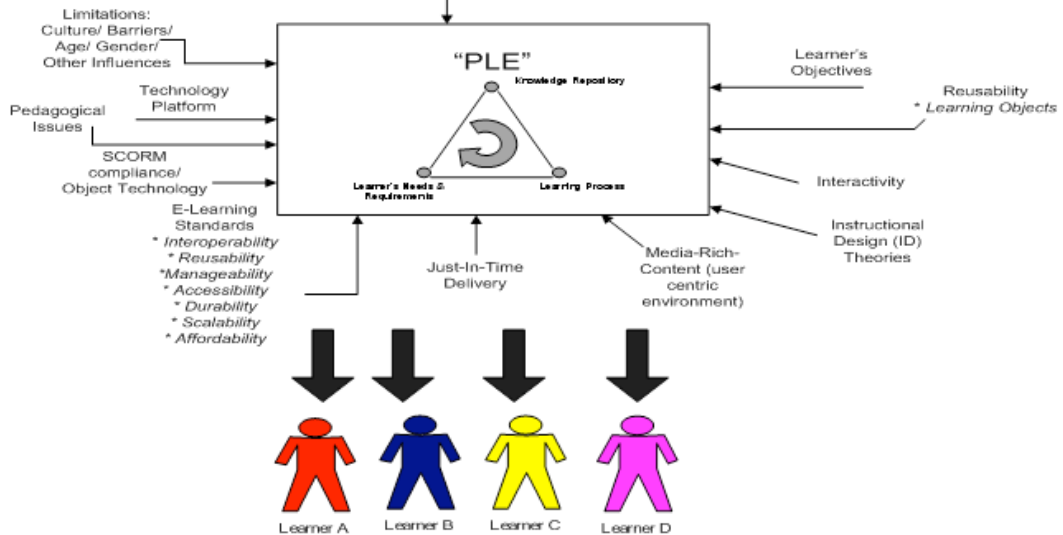
Figure 1 explains the process involved in developing a PLE prototype which is divided into two phases; (i) the development of the Diagnostic tool, which is the tool to identify the learners' styles (Phase1) and (ii) the development of the prototype itself (Phase 2).

Figure 1
Personalised Learning Environment Prototype Incorporating Learning Styles : Conceptual Framework

8.1   Phase 1 – Development of 'Diagnostic Tool'

During this phase, literature review is conducted in recognising the models of learning styles available. The models of learning styles are then narrowed into three most cited and considered reliable models of learning styles. Each of the three models of learning styles has their own instrument of learning styles. By critically analysing and amalgamating the similarities of each learning styles in each model, a proposed model of learning style is constructed. Within this model, there will be a set of learning styles. This instrument will be known as a 'Diagnostic Tool' to measure a learner's learning style and will be developed based on critically studying the three core instruments chosen and amalgamating the questions (merging the questions from all three core instruments and discarding the repeated ones to avoid duplicates). This 'Diagnostic Tool' will have to look into the issues of reliability and validity. This tool will then be validated by getting expert opinions in the field of learning styles. Once validated, the tool will be tested within 50 learners from the University of Salford. The respondents of the questionnaire will be targeted to address the following issues; (i) age, (ii) gender. (iii) educational Background, (iv) ethic group, etc. to ensure that no biasness have occurred during the conduct of the testing.

8.2   Phase 2 – Development of the Prototype

The development of the PLE prototype is the second phase of this research. ID theories will be used to 'map' pedagogy with technology. Learning objects will be used together with e-Learning standards and interoperability between delivery platforms, reusability of e-learning materials, etc. The final stage of this research will then incorporate a case study research approach in order to ascertain the construct validity, relevance, and 'market-fit.

9.   Conclusion

The advances in technology have increased the demand for new and innovative teaching approaches, prompting the design and development of cost-effective and high quality e-Learning environments which can efficiently respond to learners' needs and requirements. Over the past decade, research has attempted to address key areas in this field, such as the automation of the learning process, improving the portability of e-learning materials, pedagogy, learning objects and e-Learning standards. The relationship between pedagogy and technology also appears to be an important aspect in designing educational systems.

It appears that the developments and strategic alliances in e-Learning could produce a revolution in the way education and training is delivered in the knowledge-based economy, particularly increasing the delivery of knowledge globally through the Web. It is widely accepted that learning through the Web (e.g. e-Learning) can take place anywhere, at any time, through any computer and without necessarily the presence of a human tutor. However, research findings have found that the majority of

e-Learning applications are rather static and represent a generic approach to tutoring that does not take into account the individual needs (e.g. learning styles) of each student that is using the educational application.

Hence, this paper has provided a literature on the issues (and barriers) of incorporating learning styles into a PLE. The quality of technological delivery and developing effective pedagogies are crucial issues in shaping the said e-Learning future. This paper briefly introduced the conceptual framework for the development of a PLE (incorporating learning styles) from an educational, pedagogical, and technological as well as standardisation perspective by adopting the principles of the "Collaborative System Design" approach, as identified by the Advanced Distributed Learning (ADL) Initiative Guidelines (Alshawi et. al, 2005). This conceptual model has not been tested and the author invites rooms for discussions and comments for improvement. This conceptual framework will lead towards a development of a personalised learning environment prototype which incorporates learning styles for the UK construction industry leading towards a PhD study.

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