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Design Models for Interactive Learning Systems: Students' Attitude towards E-Learning Interactions

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Abstract

One of the main objectives of educational research in the area of e-learning is the optimisation of instructional designs to maximise learning opportunities that can be offered through different types of learning interactions for different types of learners. Designing an effective learning system requires looking at several variables and considerations. This paper reviews related literature and looks at theories and models linking technology to learning. The paper concludes with a compiled list of possible factors that may influence students' attitude towards the use of technology for learning as well as related interactivity design guidelines.

1. INTRODUCTION

For a learning system to be effective and interactive for different types of learners, it is vital to consider the user (the learner) who is expected to use such systems for learning, and it is not sufficient just to give students access to different tools and/or learning environments (Bates and Leary, 2001). This requires a student-centred approach that focuses on the learner and gives the student greater autonomy and control over learning choices he/she makes such as learning methods and pace of study (Gibbs, 1992). Consequently, this requires investigation of factors such as learners' different learning preferences, needs, interests, prior knowledge, experiences, background, culture, gender, talents and abilities.

"The significant role played by technology mediation, and the value that rich, engaging content creation, distribution, and management tools contribute to the eLearning experience, enables new levels of engagement and participation among all learning stakeholders" (Wagner, 2008, p.9). However, the use of technological medium and tools for learning and teaching, or e-learning, has mainly focused on technological aspects rather than the

effectiveness or efficiency of its application (Alexander and Boud, 2001). The instructional design should not only be concerned with delivering information to learner, but also with the efficient way information is presented (Mayer, 2001) and the way learning interactions: Learner-Content, Learner-Instructor and Learner-Learner (Moore and Kearsley, 1996) are designed to engage the learner. "Interactions that promote and enable a strong sense of social presence help keep learners engaged and motivated" (Wagner, 2008, p.9). Accommodating individual differences is one of the pedagogical dimensions of e-learning (Reeves, 1997). A learning environment which can be defined as a "space where resources, time, and reasons are available to a group of people to nurture, support, and value their learning of a limited set of information and ideas"(Rieber, 2001, p.3), should be carefully treated due to its limitations both in "what can be learned" and "whose learning will be supported most" and that the complexity of human learning makes it difficult to identify "which learning resources are appropriate for which people" (pp3-4). Some studies looked at different aspects of e-learning in terms of culture and different countries related aspects (for example, Chiu, 2009; Behl et al, 2007; Brewster et al, 2006; Istrate, 2007; Al-Khashab, 2007).Some recommended the importance of institutional readiness, adequately trained staff and access to technology (Istrate, 2007) in addition to looking at possible ways on how technology can accommodate learners' different needs (Sabry and Al-Shawi, 2008), encouraging student engagement in out of class activities (Leese, 2009), and use of mobile technologies for learning (Cavus and Ibrahim, 2009; Wang et al, 2009).

2. LEARNING INTERACTIVITY AND INTERACTION

The terms *interactivity* and *interaction* are often used in education and e-learning, but there appears to be no consensus on what they mean or involve (Street and Goodman, 1998). Interactivity can be considered as a "fundamental mechanism for knowledge acquisition and the development of both cognitive and physical skills" (Barker, 1994, p1). It provides relevant interactions, different choices and variety of interaction patterns (Evans and Sabry, 2003). *Interactivity's* connection to learning makes it difficult to define. Learning itself can be defined in many ways, for example, as a way of interacting with the world (Biggs, 1999), the adaptation of the learner's ability to respond appropriately to a given task (Obitko et al, 2001), and/or as an active process of constructing knowledge (Duffy and Cunningham, 1996). Educational processes which can be viewed as the communication of knowledge to the student (Siemer and Angelides , 1998), according to Wenger (1987), can be defined as the ability to cause and/or support the acquisition of one's knowledge by someone else, via a restricted set of communications. Further, the degree and type of learning interaction vary according to learning theory. For example, behaviourism supports routines of activities, and immediate feedback (Kuhn et al, 1996 cited El-Saddik, 2001), cognitivism supports

exploration, experimentation, and problem solving (Anderson, 1996), and constructivism supports involvement and construction of knowledge through real situations (Koshmann, 1996). However, learning theories should not be treated as solid rules, but as guidelines (Snelbecker, 1999) or as trials that need to be tested (Popper, 1957).

Learning does not only involve interaction with information or knowledge in a direct manner, but also it utilises interaction with others (Boud et al, 1993), it is therefore involves total engagement (Alexander and Boud, 2001). Interactivity of learning can take different shapes through using different types of learning interaction, which can be categorised into three main types: student-content where learner interacts with information (S-I), student-teacher (S-T) where the learner interact with experts, and student-student (S-S) where the learner interacts with other learners (Moore, 1989; Hillman et al, 1994; Moore and Kearsley, 1996). Further, most learning happens *independently* and people consider they learn best at their own pace, at times and places of their own choosing, often with other people around (especially fellow learners), and when they feel in control of their learning (Race, 1994). Harasim (1989) highlighted the positive effects of active engagement in learning, sharing information and perspectives through interaction with other learners. To recap, the terms *interactivity* and *learning* incorporate overlapping elements such as interactions with information, peers and teachers. They also incorporate factors such as active engagement rather than passive one and that the degree and type of learning interaction may vary according to learning theory. Sabry (2005) defined interactivity of learning systems as, the engagement of learners in the learning process through the *interaction* between the four main components of learning systems (figure 1) including: Learner, Information, Pedagogy and Technology, with a carefully balanced design of the 3-elearning interactions (3-ELI) taking into consideration the learning preferences of the target population (Learner component).

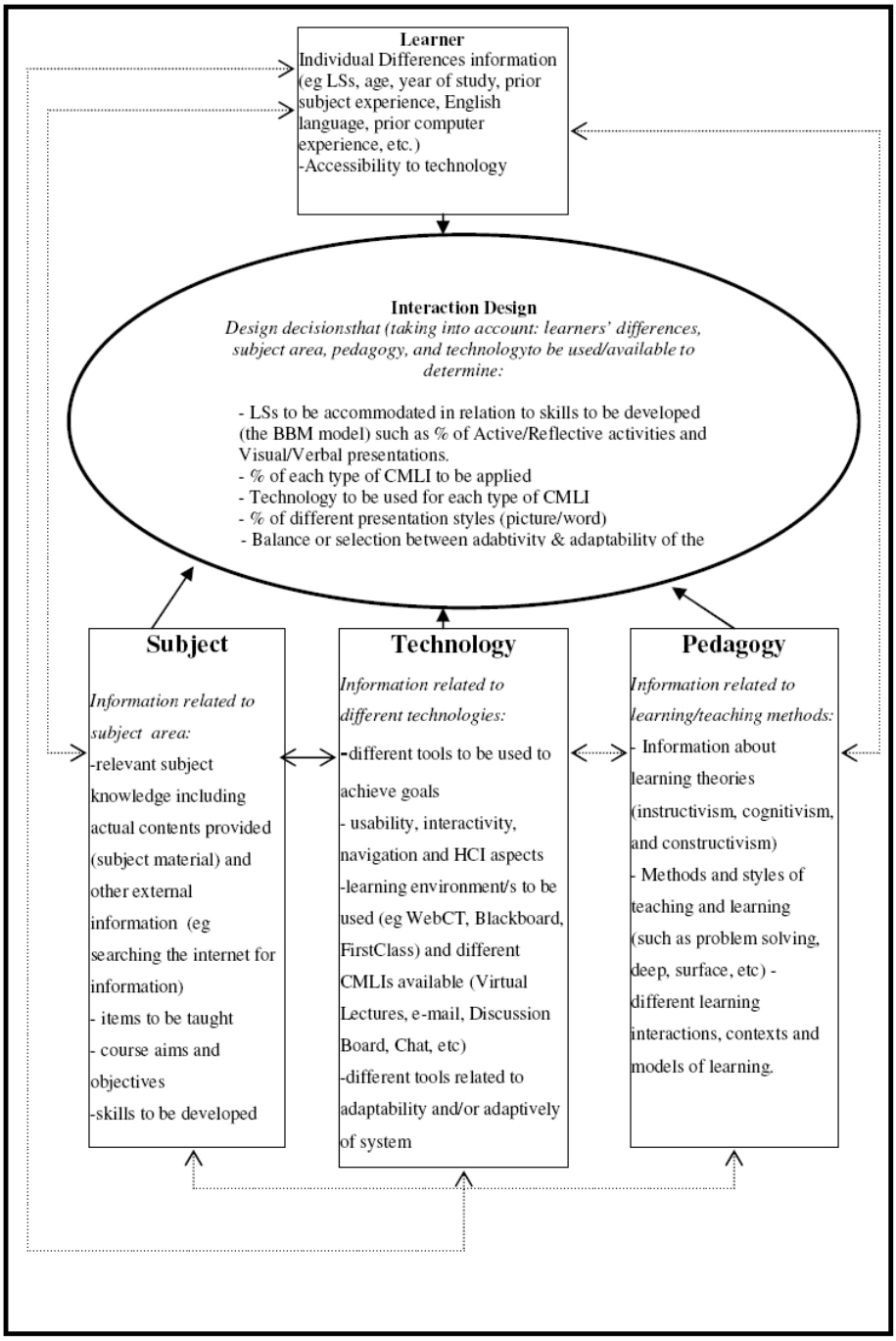

Figure 1- Components of an Interactive Learning System –ILS (source: Sabry, 2005)

3. LEARNING PREFERENCES

Learners are different, in personality, culture, age, gender, learning styles, perception, abilities and intelligence (Riding and Rayner, 1998). They vary on a wide variety of psychological dimensions and such differences (Individual Differences) can have effects on many types of mental operations (Parkin, 2000). Knowledge of learning preferences can help in the understanding and decision making in relation to strategies that work best for different types of learners. The investigation of such differences is essential because,

humans are different and perceive the world in different ways; understand and learn in different ways and under different conditions (Claxton and Murrell, 1987; Felder, 1988; Pask, 1988; Birkey and Rodman, 1995). The notion of *perception*, as one of such differences, has been investigated by many authors (Biggs, 1999; Marton and Booth, 1997; Prosser and Trigwell, 1999). It is the conscious experience or awareness of surroundings and sensations (Goldstein, 2005). *Perception* of something as something is not just a response to a stimulus, it is the upshot of a cognitive process (Harre, 2002),. It equips the person with a useful view of the world, one that helps to interact effectively and safely with the environment, and stresses the important and diminishes the irrelevant (Sekuler and Blake, 2002). Students' perceptions of learning tasks may affect both how they are approached and degree of success achieved (Hounsell, 1997).

Learners also use different learning strategies (Riding and Rayner, 1998), perceive and process information in different ways (Felder, 1993) and consequently develop different patterns of behaviour that they are most comfortable with, which are more commonly referred to as their learning styles (LS). According to Keefe (1979), LS are considered to be "characteristic cognitive, affective, and psychological behaviours that serve as *relatively stable* indicators of how learners perceive, interact with, and respond to the learning environment" (1979, p.4). The complexity of human beings makes it difficult to find one style that perfectly represents every individual (Lockitt, 1997). Classifying learners as *Active* or *Reflective*, *Visual* or *Verbal*, or else is the subject of much debate and research (Keefe, 1979; Kolb, 1976; Kolb, 1984; Curry, 1983; Witkin et al, 1977; Honey and Mumford, 1992; Sadler-Smith, 1996; Canfield, 1992; Ladd and Ruby, 1999; Felder and Silverman, 1988; Felder and Soloman, 1999; Gardner, 1993; Moore, 1999). Some learning styles categories include preferences for learning visually, auditorily, or kinesthetically (touching, feeling, or hands-on) or preferences for working in groups or individually. Others may include bodies of research on different learning theories, learning contexts, brain functions, and the dynamic nature of learning, learning habits, different learning situations, and reactions to changes in environment. Any learning preference assessment (or LS), is a snapshot of student's view or perceived preferences. As every human being is a unique, complex and sophisticated individual that represents a product of a comprised collection of attributes including: experiences, cultures, environments, attitudes and many more variables. Thus any assessment or evaluation will not be comprehensive or complete, but is merely an initial step to better understand student's learning preferences and needs.

4. LEARNING MODELS

Learning models help to highlight constructs or areas of concern, relationships and influential factors that may have some affect on learning. One of the models that consider learners' differences is Biggs' 3-P Model of Learning (Biggs, 1989). According to Biggs (1989), the teaching process associated with deep learning approach, should include high degree of learner activity and interaction with both peers and teachers. The model (figure 2) includes elements of both individual differences and instructional design. It represents an integrated system design that incorporates three influential and interacting components, *presage* (personal and situational factors) that exist before starting a particular course of learning, *Process* (approach the student adopt to learning tasks, whether deep or surface) and *Product* (learning outcomes). Whilst the model considers learner' differences and learning outcome, it does not focus on different types of learning interactions.

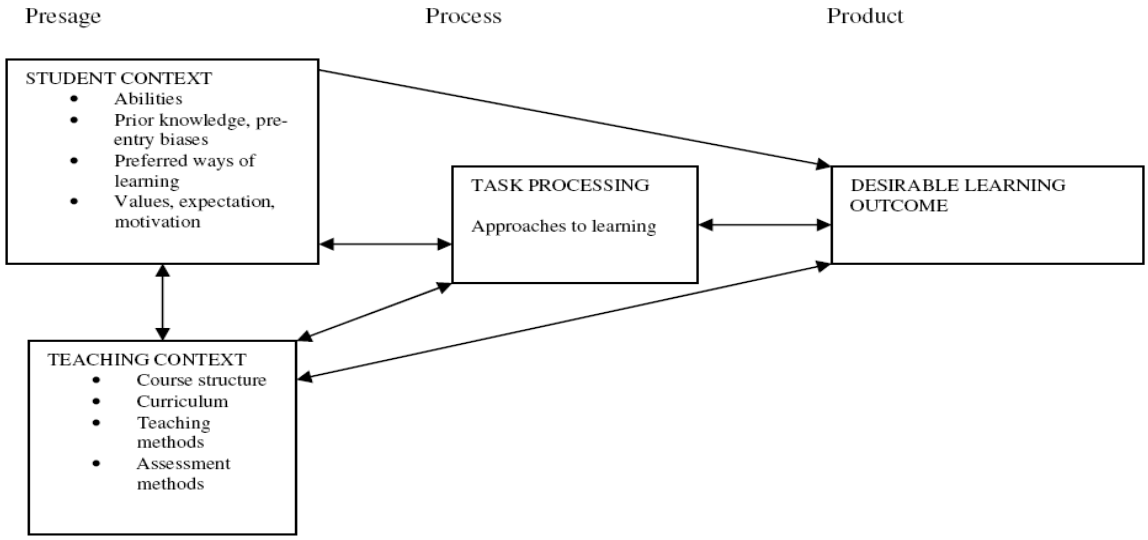

Figure 2 The 3-P model (based on Biggs, 1989)

Some research has shown positive results on student's learning outcome when the learner is able to use their preferred learning method (Campbell and Campbell, 1999). Performance is a result of many factors some of which are tangible and direct and some are intangible or indirect. Whilst learning interactions may not necessarily have direct effect on student's performance, it seems to have positive effect on student attitude towards their learning (Kearsley, 1995). According to Rieber (2001), the design should not only be concerned with students' learning performance, but also with their attitude and feelings towards learning interactions. However, this study realises that designers, understandably, are essentially concerned that learning occurs as well as improving the student's learning experience, and that the actual proof of students' short term success is in achieving what is commonly known as students' *performance* or their *tangible* behaviour

Laurillard's Conversational Model (1993) incorporates interactivity elements that are represented in several characteristics that engage the student in the learning process, such as being *Discursive*, *Adaptive*, *Interactive* and *Reflective*. The main focus is on student-teacher (S-T) interaction and does not specifically highlight other interactions such as Student-Student and Student-Information interactions, different learning styles or students' differences. On the other hand, the TAM model (Technology Acceptance Model) by Davis (1989) and Davis et al (1989), focuses on students' attitude towards technology. It constitutes factors that may help predicting computer use, including *perceived usefulness* and *perceived ease of use* (figure 3). Where the perceive usefulness of IS can be defined according to Davis (1989) as "the degree to which a person believes that using a particular system would enhance his/her job performance' and the perceived ease of use as 'the degree to which a person believes that using a particular system would be free of physical and mental efforts" (p320). However the model does not specifically look at *learning* aspects or students' differences in terms of learning styles, different types of learning interactions.

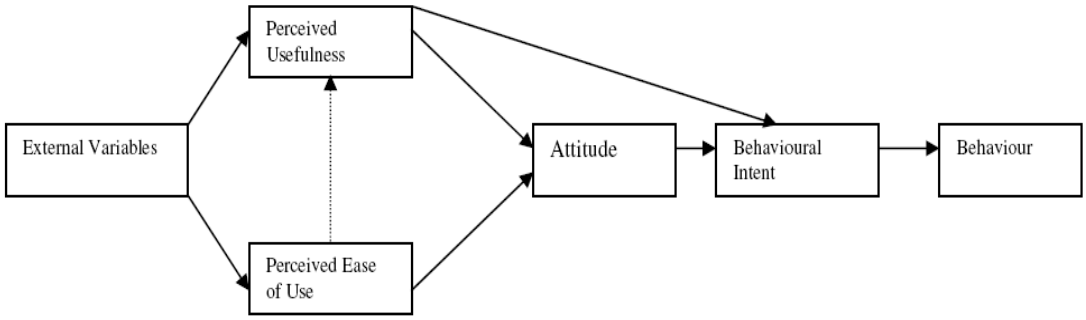

Figure 3- Technology Acceptance Model (Davis, 1989)

Similarly, Collis's 4-E model (Collis et al, 2000), argues that an individual's likelihood of using WBL for learning *assuming a voluntary choice is involved* can be expressed in terms of four groups of factors. One, perceived Educational Effectiveness. Two, Ease of use. Three, personal Engagement and Environment. Four, depends on influences related to one's educational organisation, social environment and perception of technology push in daily life.

O'Malley and McGraw's (1999) Student Perception Model, which is adapted from Roger's Diffusion of Innovations model (1995) highlights influential factors on student's perceived effectiveness of computer mediated learning (CML), taking into account important factors such as characteristic of the student and perceived characteristic of CML or Online learning,

and prior educational conditions on the perceived effectiveness of CML (figure 4). However, the model does not specifically focus on the 3-different learning interactions.

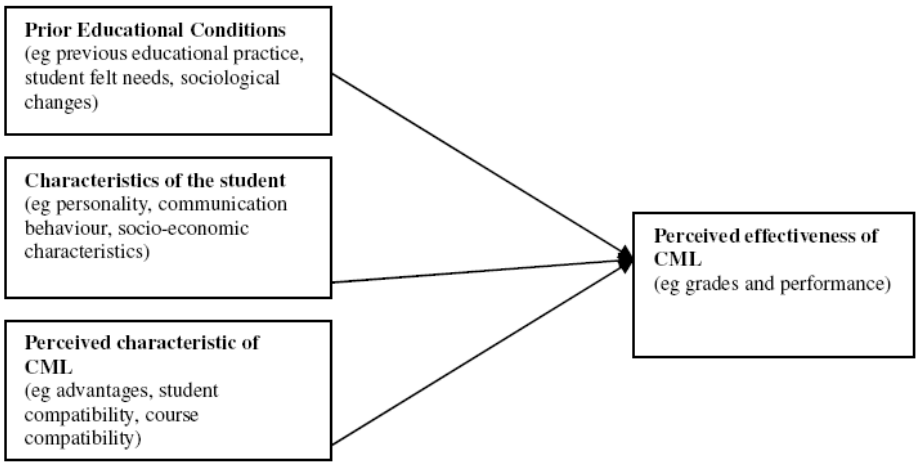

Figure 4- Student Perception Model (O'Malley and McCraw , 1999)

A research conducted by Sabry (2005) focused on learning styles and highlighted the importance of active learning processes and visual presentations in terms of proportion of learning styles exhibited by students. The research also explored common attitudes towards the 3-ELI in relation to learning styles. It proposed a Learning Styles Interaction Model (LSIM) that relates LSs and other possible influential factors to students' attitude towards ELI (figure 5). The model focused on the interactivity perspective of learning systems with a particular focus on learning styles and the 3-ELI. It comprises some elements from: Biggs' 3-P Model of Learning in terms of the two influential components presage (personal and situational factors) that exist before starting a particular course of learning and the *Process* (approach the student adopt to learning tasks); the TAM model (Davis, 1989) in terms of the influential factor on students' attitude towards the use of technology such as 'perceived usefulness'; the Student Perception Model (based on O'Malley J and McCraw H (1999) and Rogers's(1995) Diffusion of Innovations model) in relation to the influential factors, characteristic of the student and perceived characteristic of e-learning, and prior educational conditions. The model draws upon findings (Sabry, 2005) of possible relationships between factors such as learning styles and prior knowledge; learning styles and voluntary/non-voluntary choices of the use of 3-ELI; and the degree of augmentation between ELI and traditional learning interactions (TLI).

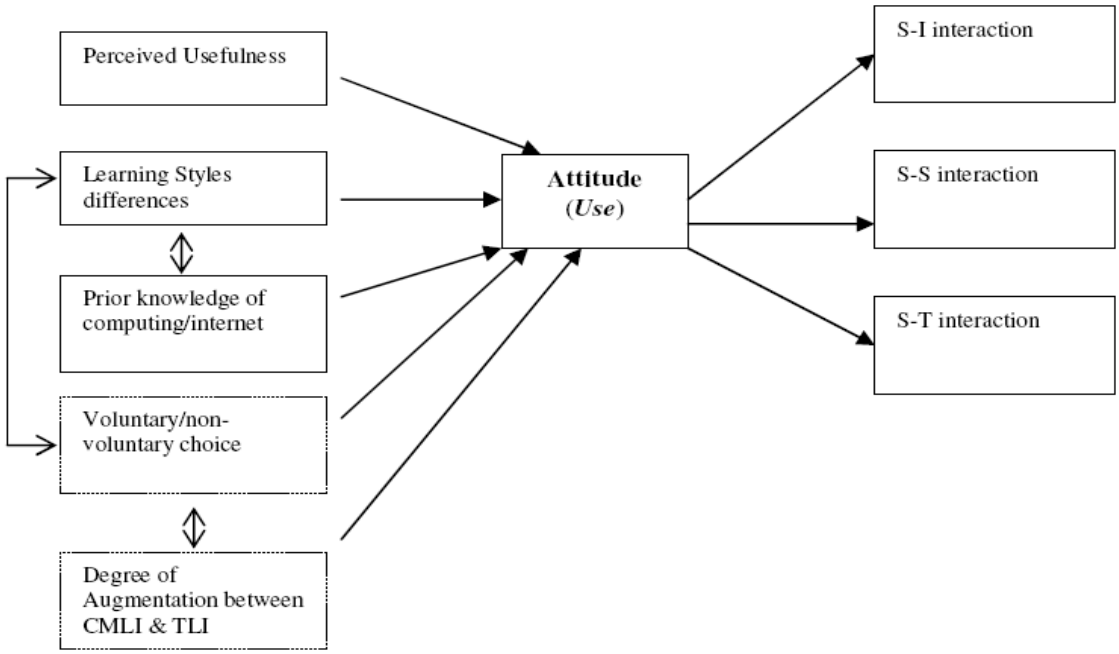

Figure 5- LSIM Model (Source: Sabry, 2005)

5. ATTITUDE TOWARDS 3-ELI AND DESIGN GUIDELINES

Based on the above models, a possible list of factors that may influence student's attitude towards the use or non use of some or all the 3-ELI can be drawn (table 1). The list is not an exhaustive one, but a step towards compiling different factors that can be taken into consideration when designing interactive learning systems.

Factors that may affect attitude towards 3-ELI
1. perceived usefulness
2. prior experience of computing/internet & prior education practices
3. different learning style
4. degree of augmentation between 3-ELI & TLI
5. perceived ease of use
6. other individual difference factors (eg. culture, gender, financial aspects, accessibility, need & motivation)
7. educational organisation readiness, social environment aspects and perception of technology push in daily life
8. technology availability and advances of mobile technology

Table 1- Factors affect attitude towards 3-ELI

Relevant to the above factors, are some interactivity design considerations based on the LSIM model (Sabry, 2005). These factors include the use of multimedia for learning in terms of its relevance to different learning styles and the balance between them.

Interactivity Design Considerations
1. Balanced use of multimedia to accommodate different learning styles (eg Visual and Verbal)
2. Providing opportunities for reflection to accommodate Reflective learners
3. Injecting active learning elements to accommodate Active learners
4. Considering the nature of the learning environment and the degree of integration between 3-ELI and TLI
5. Considering the different levels of study and learning styles strength levels
6. Considering the difference between students' actual use and perception they hold of each interaction
7. Engaging the students in the learning process
8. Balancing between accommodating existing learning styles and skills required to be developed by the course
9. Considering learners' other individual differences (eg student prior experience, cultural issues, etc.)
10. Easiness of use (technology), training needed and its suitability for the purpose

Table 2 Interactivity Considerations (modified and adapted from: Sabry, 2005)

Also, allowing for reflection to cater for Reflective students; increase of active learning elements to cater for Active students and to allow students to respond to activities and receive feedback as an important part of ELI; taking into account the learning environment, whether compulsory or voluntary virtual and its implication on (the intrinsic) level of use of the 3-ELI for each LS; taking into account difference between levels of study, that is, whether the student is at the beginning middle or end of course and its effect on students use of the 3-ELI; degree of integration of ELI into TLI and its impact on students' attitude towards ELI; engaging the students, through the use of variety of ELI and through maintaining the appropriate balance between them in relation to LS; balancing between accommodating existing LS and skills that are required to be developed by the course; Identifying the LS' profile of students (Learner component of an ILS- see figure 1) should not be treated in isolation from, for example, other individual differences such as prior knowledge (which are subcomponents of the 'Learner' component of an ILS), the objectives and aims of the course (Subject Information component of an ILS), technology to be used (Technology component of an ILS), and different instructional approaches (Pedagogy component of an ILS) without advocating a particular pedagogical model, but advocating flexibility to incorporate variety of pedagogical approaches to suit and accommodate different students' needs without ignoring the skills to be developed by different subjects.

6. CONCLUSIONS

This paper explored some of the models relevant to interactive learning designs. It particularly focused on the importance of students' differences which may in turn help to improve students' perception and attitude towards the use of the 3-ELI. There is no doubt that interactivity and adaptation of learning systems to students' differences is a complex and challenging task and that the complexity of human learning, as a product of such differences, in addition to the diversity of learning tasks, make it very difficult to find one universal design that fits all learning situations, all learners, and all instructional tasks and objectives.

This paper compiled some of the factors that may influence students' attitude towards use of the 3-ELI and also listed some design considerations in relation to interactive learning systems. Research will be needed to investigate students' attitude towards the 3-ELI in relation to other learning styles and individual differences including but not limited to *gender*, *culture, prior knowledge*, *special needs*, *motivation* and *language fluency*. Furthermore, investigations of contextual or situational factors (such as *mood*, *idiosyncrasies*, *fashion*, *and emergence*) as well as the effect of usability, navigation and interface design on students attitude towards the use of 3-ELI. Another dimension that is essential to explore and investigate is lecturers or tutors' different teaching styles and attitude towards the 3-ELI. Through further examinations of different factors and variables of students' differences and teachers' differences we may be able to derive more comprehensive frameworks for more interactive learning systems in terms of striking the right balance and flexibility to accommodate as well as develop the skills required to achieve the required learning objectives.

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