A Model as a Platform to IT and Cultural Understanding

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Abstract

The central role of information technology (IT) in the digital age is largely unquestioned. This has led to a growing demand for IT professionals to design, develop, implement, and support IT infrastructures in the public and private sectors. However, in recent years there has been a shortfall of IT graduates entering the job market. Nowhere was this more pronounced than in Ireland, where the 'Celtic Tiger' was the fastest growing economy in the world, and a global leader in the software industry. In order to keep up with demand, educational institutions adopted innovative programmes to increase the skill-set and knowledge base of IT graduates. Two such programmes delivered by University College Cork saw a collaboration between industry, a state sponsored organization and third-level institutions. The first, the Diploma in Applied Business Computing, provides socially disadvantaged students with a third level qualification in IT. The second is a masters programme in Management Information and Managerial Accounting Systems. The construction and implementation of any course is very much emergent, given the unique institutional nature of academic programmes and the diversity of the participants involved. This paper reports on an action research study of two contrasting approaches to delivering course modules in both programmes. A conceptual framework drawn from Davis's (1989) work on the acceptance of information technology and the introduction of other necessary components is employed as a theoretical lens with which to describe and analyse this study's findings, which illustrate IT acceptance by students is vital if academic programmes are to fully leverage technology to support educators and learners alike in crossing the digital and cultural divides.

Keywords: Technology acceptance (ease of use, perceived use), Web-based education, IT training

Introduction

Information technology (IT) has moved from the periphery to the centre of everyday business and social life, playing a pivotal role in the transformation of organizations (Scott Morton, 1991). Nevertheless, businesses have not being receiving adequate returns on their IT investments, as evidenced by the low rates of employee productivity in the 1990s. Those who hold a dystopian view of technology acceptance tend to explain this discrepancy in terms of information technologies being difficult to use, thus leading to low rates of acceptance and use. IT has also played an increasingly important role in enabling technology mediated learning in third-level institutions, however it has yet to be employed to its full potential here also (Alavi and Leidner, 2001). One obvious solution to the former problem is to match business needs with education practice and produce graduates with the practical skills required to leverage the potential of IT, in addition to standard theoretical knowledge. However, this paper argues that IT training programs should be designed to include parameters that overcome negative perceptions of technology, thereby improving user perceptions fostering acceptance of IT in educational and business contexts.

This action research study involved the construction and implementation of IT-based course modules for adult learners undertaking an undergraduate diploma and business graduates taking a two-year taught masters. Davis (1989) identified two

constructs as relevant to user acceptance of technology, namely *ease of use (EOU)* and *perceived usefulness (PU)*. These constructs were operationalized into a set of principles to underpin the delivery of the modules, which were delivered in two phases, each specifically addressing one of Davis' constructs. While Davis' constructs have been empirically validated in several quantitative studies, very little research of a qualitative nature has been conducted. Thus, the research approach adopted for the study was a qualitative, reflexive one. Davis' constructs informed the construction of the framework (Figure 2) initially. The evaluation of the success of this initiative will be determined through surveys and in-depth interviews with participants and it is intended that the final framework will provide '*thick description*' and further elaborate the original constructs. This study's contribution is therefore theoretical and empirical in that the experiences of educator's and students are employed to extend Davis's model to help understand how to maximize students' learning experiences in IT.

Research Objective

Given the importance of information technology (IT) for modern business, it is vital that organizations and universities '*work together*' to achieve successful education in the IT area. Thus the primary objective of this research is to extend Davis's (1989) work on the acceptance of information technology and formulate a model that acts to inform educators in the development and application of programmes incorporating IT-based modules aimed at bridging the digital and cultural divide in education. From a research perspective, a secondary goal was to identify the factors that lead to the successful delivery of IT-based education programmes to students from diverse backgrounds that have no previous knowledge of IT. Additionally applying Davis' EOU/PU constructs to a *"live"* educational setting provided the researchers with the potential to deepen the understanding of these constructs, their interrelationships and ultimately their impact on learning. To strengthen this interrelationship, a third construct, web-based education (WBE), was incorporated into the framework to ensure both the ongoing success of the programmes and to strengthen the link between the *ease of use* (EOU) and *perceived usefulness (PU)* constructs. The third construct, formulated by the researchers, additionally facilitated the support of students with different learning styles as well as students from different social standing in the community.

Theoretical Foundation

Traditional education/training has incurred criticism from both sides of the classroom (Relan and Gillani, 1997). Researchers are of the opinion that despite huge advances in technology, the classroom will always remain the same, that is, dysfunctional (Reigeluth, 1994) and prejudicial (private and public schools). Many believe that the traditional approach to teaching encourages passive learning that does not develop problem-solving skills and ignores the individual needs of the students (Hannum and Briggs, 1982). Hence such approaches ignore the requirements of its end users—the students. Cuban (1993) identified two models in the traditional structure—the first a teacher-oriented curriculum, the second a student-oriented curriculum. Cuban (1993) argued that the teacher model has been in place since the early 1900's and nothing has changed since. Traces of the student model can be found in private schools where the student numbers are smaller and individual thinking is encouraged. The widely accepted criticism of the teacher-centered model is that the 'what' (explicit knowledge) rather than the 'how' (tacit knowledge) of the instruction (Goodlad, 1984) is encouraged. However, it is also argued that problem-solving and other intellectual skills are difficult to incorporate into the traditional environment due to the very nature of the educational system (McCormack and Jones, 1997). Factors such as space, the grouping of students according to grades and the duration and size of classes all hinder the desired environment (Harassim, 1990; Harris, 1994). IT and specifically the WWW is regarded by many as the solution to the problem (Crossman, 1997). It can be argued that both educators and students alike can increase their practical skills and knowledge through the use of IT and the utilization of mediums such as the Web (Harasim, 1990; Teles and Duxbury, 1992; Kahn, 1997; McCormack, 1997 and Driscoll, 1998) without the limitations of the traditional classroom such as the intimidation of large groups (Neville et al., 2002).

User Acceptance of IT

To incorporate information technology (IT) into any environment, especially in an educational setting, it must be accepted by the users. Davis (1989) is one of the most influential researchers in the area of user acceptance of IT. He synthesizes the findings of a range of diverse research streams to propose a number of constructs that are relevant to technology acceptance and training. These constructs fall into two broad categories—*ease of use (*EOU) and *perceived usefulness* (PU). Davis (Figure 1a) suggests a chain of causality between these categories: greater ease of use leads to higher perceived usefulness (or the application of skills), which in turn leads to more usage of technology. These constructs have been validated through rigorous testing (Adams *et al*.,

1992; Davis, 1989; Davis *et al.*, 1989; Henderson *et al.*, 1998). However, the constructs have generally been, to date, researched in a very quantitative fashion and have never incorporated in the creation of an education programme. When applied to an education programme, the constructs can aid the learners' problem-solving skills through the applications of the skills that the student has gained (Neville and Adam, 2001). To tighten the link between not only the actors of the case but also the EOU and PU constructs a third construct such as Web-based education (WBE) could also be applied.

Web-Based Education (WBE)

Web-based education (WBE) or instruction can no longer be regarded as an innovative approach to support the learning needs of educators and learners alike (see Figure 1b). However, it has become a valuable tool to the provision of most third level education programmes. Web-based Education (WBE) is defined as "*…as the application of a selection of intellectually stimulating lessons implemented within a creative and collaborative learning environment that utilizes the resources of the World Wide Web*" (McCormack et al., 1997). The approach offers numerous benefits to learners (Lebow, 1993; Perkins, 1991). The role of WBE is to provide a useful environment where skills are developed and learners are supported (Ritchie and Hoffman, 1996). WBE systems can and do facilitate group collaboration, provide graphically enhanced material, and enable the learners to control the environment, as they can lead or start discussions (Kaye, 1991; Dede, 1996). The attributes of the Web can enable the teacher to redesign the classroom to incorporate what the traditional classroom lacks (Reeves and Reeves, 1993). Traditional training, as described by Goodlad (1984), occurs in a structured environment. However, WBE operates under a number of assumptions. The first is that it is assumed that the student has access to the Internet and that the learner can work independently. Given this assumption of the system the following are some of the numerous advantages gained through the incorporation of WBE into an education model or programme (Relan and Bijan, 1997):

- The classroom or lab is no longer bound by space and time; the learners have constant access to the learning material, regardless of geographic location or culture (McCormack et al., 1997; Driscoll, 1998)

- WBE can be used to promote experimental learning, for example students can view real world examples of what they are studying.

- The environment encourages social interaction that is geared towards learning (Johnson and Johnson, 1990).

- The content of the information under study becomes more dynamic. For example students learning about information systems can view and operate examples through the WBE environment.

- Students can also, through the environment, contribute to the class by using resources such as discussion forums.

Damarin (1993) states that, "*…knowledge is no longer simply an individual acquisition, but resides also in groups or communities that share a situatedness*". The World Wide Web, unlike the traditional environment, is a rich and creative environment that can facilitate the creation of "*learning communities*" (Lin et al., 1996). The WWW can enable instructors to generate new environments to cope with the limitations of the old (Reeves and Reeves, 1997; McCormack and Jones, 1997). The two approaches are different however both require careful planning to deliver effective training (Dick and Reiser, 1989). The traditional approach requires as much thought in its design, as does the Web-based format (Relan and Gillani, 1997), however it is limited by both time and space as more and more students and employees require training. Web-based education (WBE) cannot replace the traditional approach but it can provide a necessary balance to its limitations (Driscoll, 1998).

The objective of this research was therefore to operationalize both Davis's constructs and WBE into an education programme that could be used in any academic course. To be successful an education programme must increase the skill-set of the learners and to expand the learners understanding skills must be applied or regarded as useful.

Research Approach

The research method involved two longitudinal action research case studies of the creation and implementation of IT education programmes in a third level institution. Research began in 2000, and is ongoing. The conduct of this research project was informed by Baskerville's (1999) work on action research in organizations. A framework incorporating Davis' constructs as preliminary 'seed categories' was created and implemented to help instructors increase students' learning and their development and application of skills in both practical and theoretical subjects. The intention is to further corroborate these constructs and to elaborate the framework (presented later in Figure 2) as the research progresses.
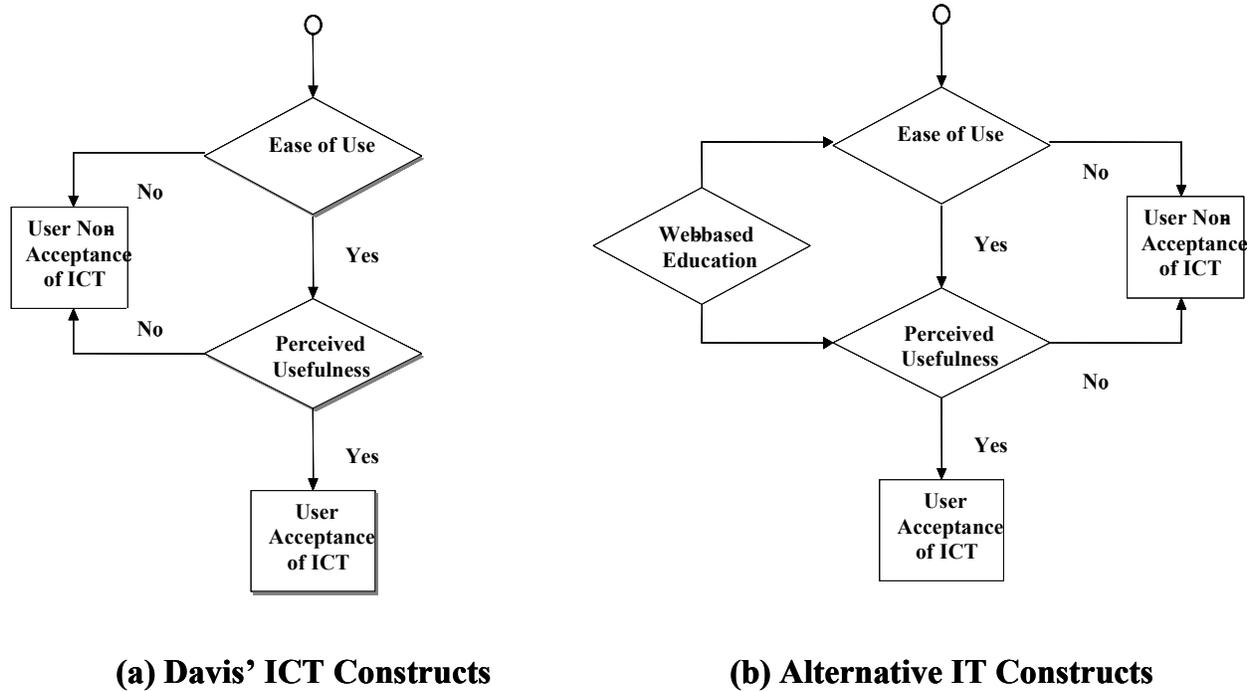
(a) Davis' ICT Constructs   **(b) Alternative IT Constructs**

Figure 1. IT Constructs

Case Studies

This study focuses on the implementation and the utilization of an education model (Figure 2) in two very different programmes yet with similar objectives, that is to provide the participants with the qualifications necessary to follow their chosen career paths. The objective of the education programme, in both cases, is to expand both the tacit and explicit knowledge bases of the two groups of students.

Diploma in Applied Business Studies

University College Cork (UCC) offered the Diploma in Applied Business Computing in association with the Cork Institute of Technology, and the Cork City Partnership Ltd. in the academic years 2000/2001 and 2001/2002. The Business Information Systems Group at UCC delivered this two-year fulltime course in association with staff from the Cork Institute of Technology, the Centre of Adult Continuing Education, FAS (the national training agency) and several Cork-based IT firms, notably Motorola, eircom and Cara Training: Microsoft and Oracle also supported the program through the provision of teaching and study materials. The Higher Education Authority (HEA), the Department of Social, Community and Family Affairs, and an anonymous local businessman provided financial support for the program. The diploma course seeks to provide adult learners with practical IT skills and industry with graduates capable of solving IT specific problems.

The diploma course is two-year intensive program targeted at individuals from the Cork Region who would not otherwise, due to social standing, acquire an IT qualification at this level. The programming, database, and web-based IT skills acquired on this course will enable students to obtain employment as skilled workers in the IT industry. The course's main objective is to provide students who would not normally have been able to pursue a career in IT with a learning experience and academic qualification to so do. The academic diploma will also allow students to further their education at undergraduate level and attain a full degree in IT. The course encompasses five closely related topics viz. IT infrastructures, database theory and practice, programming, web-based design and development and communication and personal development skills. In order to enhance the student's learning experience, and to help them in choosing future career paths, a four-month placement programme will operate throughout the

summer recess. It is intended to adopt a team-based approach to the learning on this course and to the broader aspects of the development of application-based systems software.

MBS in MIMAS (Management Information and Management Accounting Systems)

The MBS in Management Information and Managerial Accounting Systems (MIMAS) is a two-year full-time degree programme, which includes six months industrial internship in the second year. Students attend lectures, seminars and tutorials in a variety of subjects relevant to both management accounting and management information systems. The IS courses give students an appreciation of how technology can be used to support the operations and transactions of modern organizations (EOU/PU). The managerial accounting courses provide students with a thorough understanding of accounting concepts and techniques. The second year of the programme is structured to re-enforce this "classroom" learning via a six-month industrial internship with companies such as Fidelity Investments, State Street Bank, Pepsi and Musgraves.

Integrated Systems Design /Management Accounting/Programming Project

One of the many pedagogical features of the programme is the joint project, which involves the application of management accounting and IS theory. It enables the students to apply all of the knowledge (EOU) gained through lectures and the skills necessary to apply the knowledge (PU) to a real world example. Students are expected to form companies and develop a system to solve the requirements a fictitious company (HANS Limited).

Project Context

HANS Limited is a newly emerging player involved in the manufacture of computer equipment. Three products are made in the Cork facility: El-Cheapo, Corporate and Executive. A major condition attaching to recent funding applications for European and other grant aid centers on the need to develop adequate budgeting, control and audit trails within the Cork plant and across the organization as a whole. To maximize its investment in the development of same, the Board of the Company has decided to commission a complete budgeting and responsibility system for HANS, to be developed and piloted in the Cork plant. Specifically, HANS required the development of some means of tracking the movement of goods from their point of entry into any form of finished goods stock, through to the point at which the sales transaction is closed, the goods have left the premises and all monies have been collected. Given their relative inexperience on such matters, they approached Elbat Planners Limited for help. Unfortunately, six months into the project Elba Planners suffered a number of financial setbacks and have since gone out of business. Under the terms of the existing arrangement with Elbat, all work carried out to date is the property of HANS Limited. Given the extent of disruption and inconvenience caused to the workings of the organization over the past number of months, HANS Limited is unwilling to begin this project again from first principles; therefore the incoming consulting firm will be required to evaluate and complete the design and building of the system as it stands following the untimely departure of Elbat.

A number of objectives have been articulated for the project:

- Considering the issues involved in the design of the system groups are expected to resolve the managerial accounting requirements.
- Graphical analysis of key trends and possible items of interest should also be available.
- It is to be assumed that all users will have a cursory knowledge of computers, but are not technically orientated; thus all support documentation and 'trouble shooting' advice should be tailored accordingly.
- The Plant Accountant has flagged the use of password levels to control access to the system and its data as being extremely important.

Project Procedure

Students are divided into teams and set the following requirements to apply the knowledge they have gained in the classroom to a 'problem'. Each project team is required to complete the following in accordance with the accounting, technical and individual requirements listed in the project context section:

- Develop a group identity and mission statement, and assign the project team to complete the overall assignment.

- Construct and submit a preliminary tender for the above described system.
- Prepare the necessary database structures and entity relationship diagrams.
- Develop test data for the databases, toward the ultimate aim of an overall working prototype of the system available for demonstration, and capable of meeting the accounting requirements of HANS Limited.
- Document the design phase. Produce subsequent support documentation for users, explaining the system, and giving some general trouble-shooting advice and tips.
- MS Project must be used to co-ordinate and document the group effort.
- Groups are then required to submit a final tender document and demonstrate the working proto-type to the Management of HANS Limited.

Implementing the Education Program

Ease of Use (EOU) Construct

The items identified by Davis (1989) as being significantly correlated with ease of use (EOU) include easy-to-learn, controllable, clear and understandable, and surprisingly easy to use. As already mentioned, most previous studies have sought to validate these in rigorous quantitative experiments. In this study, the authors were concerned with operationalizing these in practice or in a real situation, and thus a more qualitative approach was deemed appropriate. The following facets of the programmes indicate how this 'ease of use' construct was operationalized:

- Stage one, the initial generic education/training phase, was intended to ensure that all participants achieved a reasonable level of proficiency in IT or knowledge in for example managerial accounting in MIMAS, due to the learners diverse backgrounds.
- Participants of both programmes were divided into a number of groups, for assignments, based on their current level of IT capability to collaborate. This ensured that the common denominator for education in each group was uniform, thus reducing the possibility that participants might be too embarrassed to reveal their lack of understanding of education material.
- All practical sessions were held in a very well equipped education laboratory, with state-of-the-art technology for both the instructors and the students.
- The education laboratory was in a 'neutral' venue, a short distance away from any distractions. This helped the students to focus on the material at hand.
- The maximum duration of education sessions was restricted to two hours, thus ensuring that the students did not become overwhelmed with complex material, or bored with repetition of material already understood.
- The number of participants to gain entry into both course was kept low—a maximum of twenty-five students. This was intended to ensure that all students' performance and progress could be monitored to ensure they understood the concepts and promote the student-oriented model of teaching (Cuban, 1993).
- Two instructors were in attendance at each practical session, thus achieving a trainee-instructor ratio of 12:1. One generally led the instruction, while the other had a roving role, visiting each workstation to ensure that all of the students understood the material. When difficulties were encountered, the instructor would provide one-on-one instruction in a discreet manner until the difficulty was fully resolved.
- The education material was designed to be user-friendly (EOU). Different booklets or case studies were prepared or provided for each element of the education/training. Exercises were also chosen from 'real life' examples to demonstrate the application of skills (PU) or knowledge and also to retain interest.

Perceived Usefulness (PU) Construct

The items identified by Davis (1989) as reflecting the '*perceived usefulness*' (PU) construct include, rapid application development (RAD), increased productivity, improved effectiveness and job related examples, and again the obvious item, useful. These were operationalized in the study in the following way:

- At a high level, the separation of the initial generic education phase from the subsequent applied education phase (Stage two) ensured that the usefulness of the technology or managerial accounting could be demonstrated in the second stage. Students had achieved a base level of capability, and the instructors had several group sessions with them to see how

technology could be incorporated into their everyday work routines to solve problems especially in the case of the MBS integrated project.

- Examples include the creation of templates and databases to automate manual activities like creating budget accounts. Systems, already in existence, were also demonstrated to highlight the application of technology within the main university. These exercises stimulated ideas in the perceived usefulness of the skills (PU) developed by the students from the programme.
- In addition to the examples and assignments suggested by the instructors, participants were encouraged to identify ways in which the technology could be applied to cases.
- The students were, like the general public worldwide, very interested in the Internet and World Wide Web, but felt their knowledge in the area was very limited. It was decided to leverage this to get participants to buy into the education process. Thus, the first introductory session for the students was a '*web surfing*' session. This served to break the ice between instructors and the students in a friendly atmosphere. Participants were shown the rudimentary details and then began surfing the web themselves using various search engines, and visiting sites recommended by the instructors. This session was also used to demonstrate the Web-based education (WBE) system, which had been constructed specially to support the programme both the students and the educators.

Web-Based Education (WBE) System Construct

A customized Web-based education (WBE) system (Figure 3) was also constructed to support the education/training in stages 1 and 2. The education material was available on-line, but in addition, a discussion forum was implemented. This enabled participants to provide feedback (anonymously, if desired) to the instructors/lecturers. It also allowed them to pose queries, which other participants or the instructors could answer to encourage collaboration. All of the participants could see the initial queries and the discussion stream of answers from other students and the instructors. This further extended the reach of the education as workers could log on to the Web system at home or at their work and pose questions for which answers would be available when they next logged on. The facility also allowed the students to voice their satisfaction regarding the different elements of the education programme. This provided the students with the opportunity to take part in the ongoing customization of the system (EOU), and therefore increase the likelihood of user acceptance (Whitten et al., 1994; Avison and Fitzgerald, 1995). Education or training to be effective, should follow a framework that can stimulate the mind (Kyllonen and Shute, 1989; McCormack et al., 1997). Figure 2 should be read like a flow diagram, moving from left to right and gradually feeding back to the start (through the WBE system). It begins, on the left-hand side by outlining the components ensuring ease of use (EOU). The characteristics described are those that can and do influence the education or training process of IT. These characteristics or components are relatively obvious and modifiable depending on the experiences of the instructor. The perceived usefulness (PU) components describe the reaction that the student will have to the skills gained from stage one of the framework. Each student has a unique level of skills and knowledge pertaining to any of the modules studied. They are motivated differently, may or may not be interested in the module in question; they may have their own style of tackling the assignment and expectation of the outcome of the lesson (Driscoll, 1998). Therefore the task or demonstration is perceived differently as a result of the student's background and the very assignment itself. The task will be perceived, in terms, of what the student thinks the instructor requires as well as the other factors such as the level of difficulty.

Conclusions

A number of important conclusions can be drawn from this research, which presents clear guidelines for course delivery and technology acceptance among students, whatever their age profile or backgrounds (see Figure 2). The development of the model presents enormous challenges and opportunities to both academics and management in developing IT (EOU) and problem-solving skills (PU) to satisfy the needs of all of the varied stakeholders who required additional support due to diverse backgrounds. It provides the learners with third-level qualifications geared to industry and therefore providing industry with the type of graduates they require.

The cases described herein are examples of courses that leverage technology to successfully mediate learning. Prior to the introduction of the WBE system, the courses lacked an efficient Web-based support system, which would complement and reinforce both stages (EOU/PU) of the learning process, thus strengthening the link between the '*seed constructs*' and eliminate any cultural factors that may hinder learning. This study notes Davis' assertion that the chain of causality separating *ease of use* (EOU) the *perceived usefulness* (PU) operates in a linear fashion, and that EOU is a necessary pre-condition before for PU. However, this empirical study indicates that this relationship is more complex than that suggested by the model. For example,

it is clear that the current emphasis on Web-based education (WBE) constitutes a third construct or a digital bridge between the two other constructs. However WBE acts to stimulate and preserve students' level of interest in the first stage where the threshold level of literacy is established by concentrating on *ease of use* (EOU) issues, before the *perceived usefulness* (PU) is addressed in the second stage of the programme. Initial findings suggest that the relationship between *ease of use* and *application of skills* is not a linear one with user acceptance of the technology being the pre- and post-conditions (Figure 1). Rather, it appears that these are much more disjoint constructs, and user acceptance of information technology will not be achieved if *ease of use* and *perceived usefulness* are not addressed and reinforced by the WBE in order to take factors such as learning styles and the diverse backgrounds of the learners into consideration which must be incorporated into the design of an educational model.
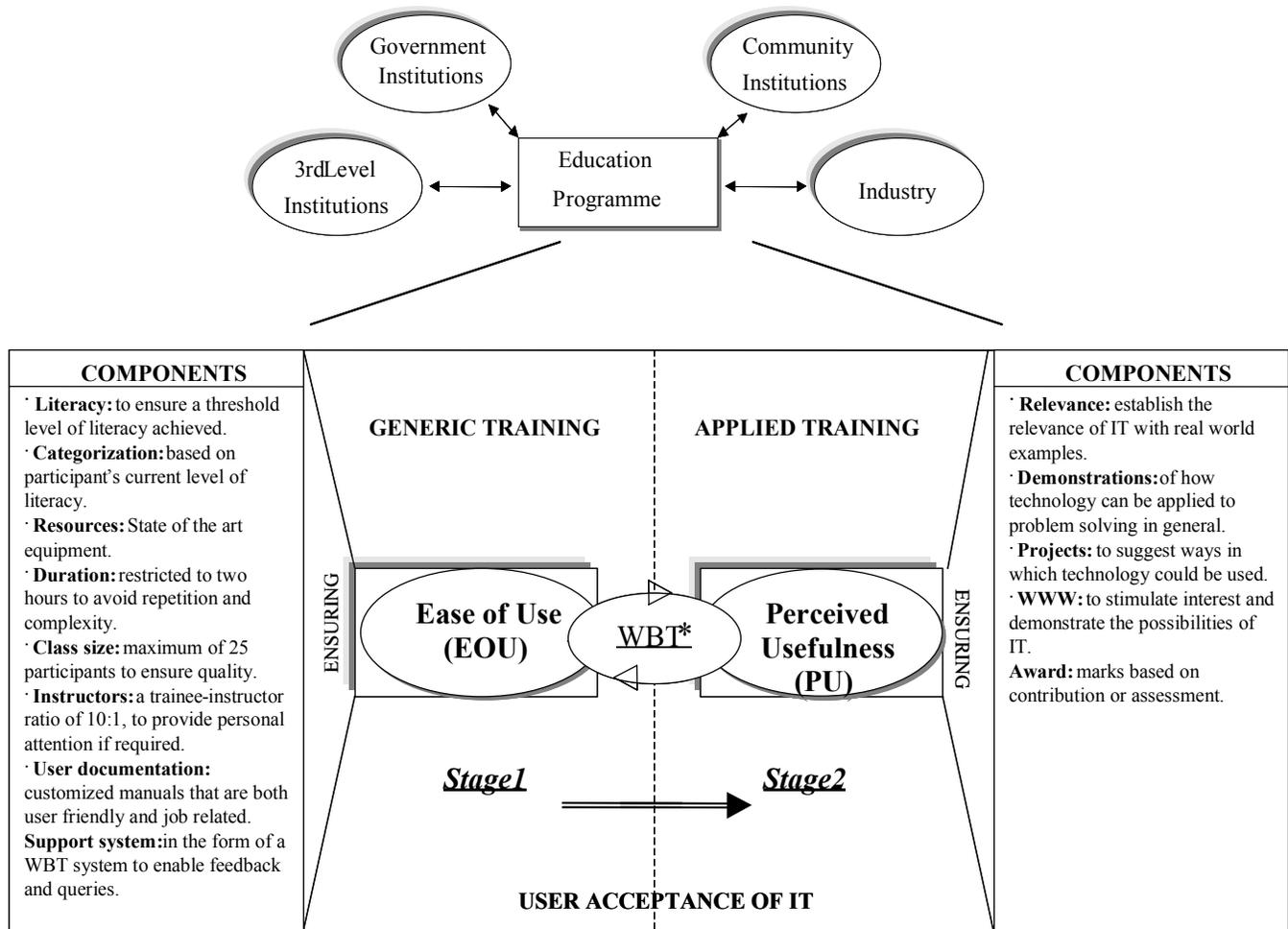

Figure 2. Framework for the Education Programme (Fitzgerald and Neville, 2002)

*A WBE System was developed to support both stages of the education programme. It enabled the students to participate in the customisation (EOU) of the system and to add to the programme through the discussion forum (PU). The arrows used in the diagram highlight the complexity of the inter-relationship between the two constructs (EOU/PU), suggesting that not only does EOU lead to PU but that *perceived usefulness* increases the level of ease of use.
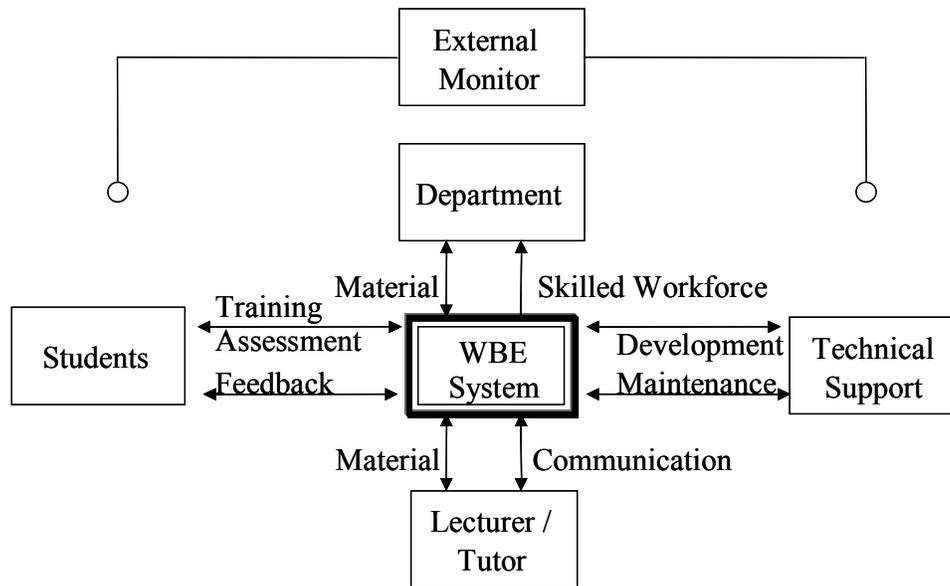
Figure 3. The Web-Based Education (WBE) System (Neville, Adam and McCormack, 2002)

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