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E-learning in developing countries: suggesting a methodology for enabling computer-aided assessment.

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e-Learning in Developing Countries: Suggesting a Methodology for Enabling Computer-Aided Assessment

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Abstract

Traditional education has shifted towards new methods of teaching and learning through the proliferation of Information and Communication Technologies (ICT). The continuous advances in technology enable the realisation of a more distributed structure of knowledge transfer. This becomes critically important for developing countries that lack the resources and infrastructure for implementing cutting-edge education practices. The two main themes of technology in education for developing countries focus either on aspects of technological support for traditional methods and localised processes, or on the investigation of how such technologies may assist distance learning. Commonly such efforts are threefold, relating to content delivery, assessment and provision of feedback. This paper focuses on issues regarding the implementation of e-learning in developing countries and particularly those aspects of Computer-Aided Assessment (CAA) that could be tailored to satisfy the needs of a limited educational infrastructure. The primary contribution of this paper is a proposed methodology for supporting both formative and summative CAA.

1. Introduction

Education ional practices and knowledge transfer are changing. The instructor-centred paradigm still exists mostly where resources are limited as in the case of developing countries. The main benefits of this paradigm are: (i) it is less time consuming, (ii) it includes a relatively simple process with a few clearly defined steps, (iii) it consists of rigid procedures for delivery and assessment without any need for lengthy iterative sessions, (iv) it involves standardized content with no need of frequent redesign and structure updates and (v) it requires minimum human resources with explicit roles.

However, through the use of the Internet as a communication medium, education is now changing towards the constructivist paradigm or learner-centred paradigm [6] [12] where the instructor acts as a moderator primarily responsible for facilitating learning. Based on this paradigm, learners are able to choose how to learn,

when to learn, where to learn, and what to learn as far as possible within the resource constraints of any education and training provision. On the other hand, distance education refers to any type of educational situation in which the instructor and learners are geographically separated by time or location. The learner-centred paradigm is often supported by e-learning especially through the capability of Internet to facilitate collaborative work in the learning process.

Key advantages of the emerging paradigm are the appreciation of different learning styles and an increase in collaboration and communication among learners. In an e-learning environment, learners who seem to be more timid in face-to-face interactions are willing to participate [9]. Learners are assumed to learn better as they need to discover things for themselves instead of being instructed [12]. One of the main themes of use of technology in education for developing countries focuses on the investigation of how such technologies may support distance learning. Currently most developing countries follow the traditional instructor-centred approach due to the lack of infrastructure and the fact that the implementation and full use of e-learning environments has not yet penetrated the existing educational organisation.

2. Research considerations

E-learning which applies the concept of open and distance learning, in simple definition is the concept of learning through the Internet. Cashion and Palmeri defined e-learning as "learning that occurs when the delivery of education or training is carried out via an intranet or the Internet" [3]. This paper describes part of existing work within the lines of the above and can be graphically described from the model in figure 1. This research is primarily concerned with issues related to the provision of support of CAA by investigating quantitative and qualitative data of several CAA case studies. More specifically this work attempts to provide a variety of performance measuring methods and to evaluate the entire assessment process. The aim is to establish the role of feedback in e-learning and identify any effects that feedback provision has to both instructors and learners.
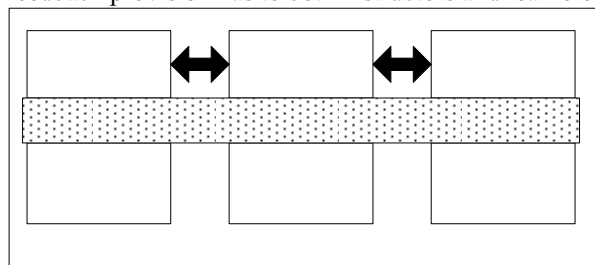

Figure 1: A model for e-learning environments

This paper also provides specific guidelines for designing and performing the various stages of a CAA methodology. Such a methodology becomes essential when CAA is part of an e-learning environment that is used in developing countries. The two key issues are the dispersed nature of resources and the inadequate infrastructure. Previously this study examined several cases of e-learning in developing countries such as the Department of Telematic Learning and Education Innovation at the university of Pretoria, the Open University of Hong Kong, the Regional IT Institute in Cairo, the UNITAR Virtual University in Malaysia and the Global Campus distributed learning project between Middlesex University and a number of institutes in developing countries. The later case study is used in this paper to examine the applicability of the proposed CAA methodology.

Next sections are concerned with key e-learning concepts, provide a brief overview of existing CAA methodologies and discuss the evaluation results of a suggested CAA system.

3. e-Learning and developing countries

As shown in the proposed model (figure 1), four key concepts associated with e-learning are of concern, namely content, interaction, assessment and authentic activities. While the suggested model was previously presented in detail the aspects identified under each one of the above concepts are the ones applicable to developing countries.

In a learner-centred learning environment, content is provided by multiple resources [18 The association between the available resources and delivery of content is dictated by the activities identified within the learning environment [17] Delivery of content could also include access to expertise (e.g. video presentations showing interviews with experts) or even encouraging learners' subscription to list-serves [8].

Interaction in this model includes feedback as well as communication and collaboration. Communication and collaboration can be supported by a variety of tools such as email, bulletin boards and chat rooms. From interpersonal communication and collaboration, learners do gain feedback from their peers and instructors. These issues are usually addressed by computer mediated communication techniques.

Qualitative and quantitative assessment should be integrated. In most research based on the constructivist learning model, assessment is associated with learning tasks or activities which usually involve problem-solving. Types of assessment are not mentioned explicitly. On the other hand, in the area of Computer Aided Assessment, much attention is given towards formative objective questions such as Multiple Choice Questions (MCQ).

Authentic activities bond all the previous elements together in shaping an e-learning environment. As mentioned previously, content is decided based on the learning activities defined [17] and there should be integrated assessment of both the learning process and the associated activities [8].

Some of the above aspects are present in several cases of distance learning attempts in developing countries. Kumar studies the effects of CD-ROM based e-learning techniques in comparison to normal classroom environment in order to investigate the benefits of e-learning especially as an innovation to teach courses in science and technology where more emphasis is given towards practical work [11]. This has driven the University of Botswana in installing a video-conferencing infrastructure and acquiring a Learning Management System for developing an e-learning facility.

Similar work attempted a comparison between the conventional classroom and online learning for a 16-week undergraduate module at the Universiti Malaysia Sarawak to record the effects in student participation [20]. In developing countries where there is shortage of human resources and available skills, particularly in the field of science and technology, there is an increasing need to implement e-learning due to increasing student numbers. There is evidence that the learner-centred constructivist model [12] is particularly suitable for e-learning in developing countries [13]. Furthermore, two types of constructivism that are mentioned in the literature and relate to the use of technology in education are cognitive constructivism and socio-cultural constructivism [1] [4].

4. Suggesting a CAA methodology

There are two approaches of using technology for assessment widely discussed in the literature concerned with: (i) providing learners objective assessment and (ii) exposing learners to authentic activities. In the first constructivist learning approach, learners are given objective formative assessment using MCQs. In some cases, both formative and summative assessment is provided, however more focus is given on formative where learners are provided with feedback to further enhance their learning. Technological support is in the form of automatic marking in an attempt to both promote self-paced learning and decrease assessment load for instructors.

The second approach attempts to expose learners to activities that involve immersive scenarios and role-playing that integrate the constructivist learning approach with problem-based and case-based learning strategies. In this case, the authentic activities are seamlessly integrated with assessment. Technological support involves the use of various tools from data analysis techniques to bulletin boards. However, the main theme is on communication and collaboration among learners involving the use of tools supporting computer-mediated communication.

There are several CAA methodologies available in the literature concerned with the impact of assessment on higher education. Bull investigated the impact of CAA on higher education and identified the role of feedback towards motivating students to use alternative resources and identifying those students that might need additional support. More specifically it is argued that quality and speed of feedback could be enhanced by CAA while the instructor's awareness of student progress and deficiencies is increased [2]. McLennay measured students' attitude towards CAA and their perceived confidence pre and post treatment in an attempt to evaluate the role of assessment in e-learning environments [14].

Another two studies are concerned with CAA methodologies and more specifically with issues such as types of assessment, objective testing and feedback. Mogey and Watt focus on the use of IT in assessment to enable self-paced study, increase student confidence and provide faster feedback [15]. They identified three types of assessment namely diagnostic (testing prior knowledge of the subject), formative (assisting learning by providing feedback) and summative (providing a final mark for a certain module). Objective tests can be used in all three assessment types including questions such as MCQs, multiple response questions, as well as matching, sequencing and ranking ones. Finally Hanson in an attempt to provide a methodology for online feedback and assessment identifies that combining summative and formative assessment may adversely affect the quality of the feedback that learners received [7].

Based on the above mentioned methodologies that incorporate assessment a methodology for enabling CAA is suggested that consists of three main stages: (i) planning and design, (ii) development and (iii) performance and evaluation. In such a methodology feedback is included in the first stage, attempting to pace learning, motivate participation, develop the learning process and practice for formal assessment. Feedback involves self assessment, peer feedback, tutor support and available expertise.

Research on CAA, where the constructivist learning approaches based upon, tends to sway to two groups which either provide objective assessment through the use of MCQ, or provide collaborative assessment through the use of computer-mediated-communication tools. In this paper, the term quantitative CAA is used for the former while the term qualitative assessment is used to refer to the latter. Objective assessment takes place through the interaction of individual students with the CAA environment (cognitive constructivism) such as an online testing system. In collaborative assessment, students

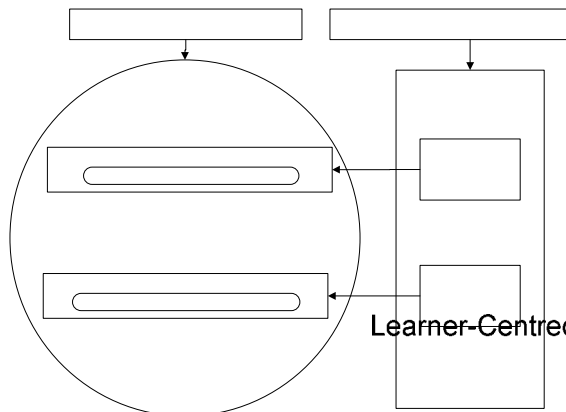interact with themselves as well as the instructor (social constructivism).

Learner-Centred Assessment   Constructivism learning Approach

Quantitative Assessment
Online quizzes

Individual
Constructivism

Feedback
(Central Element)

Qualitative Assessment
Use of CMC Tools

Social
Constructivism

Figure 2: A proposed CAA methodology

The proposed methodology accommodates both types of assessment in order to increase interaction among participants with respect to feedback. Feedback is one type of interaction that needs further research, the extent to which feedback is understood has not been researched in online courses or online settings [5]. In addition as Rovai suggested, online learners should feel less isolated and have greater satisfaction if they have stronger sense of community and perceive greater cognitive learning [19]. Figure 2 shows the relation of a learner-centred assessment and the constructivist learning approach. In the learner-centred assessment, both quantitative and qualitative CAA is integrated, with feedback being the central element.

5. CAA methodology evaluation (case study)

This paper, briefly presents a case study of a quantitative CAA where learners were given a non-compulsory online quiz consisting of 20 MCQ. The main aim of the online quiz was to provide students with feedback throughout assessment but also to examine the applicability of the proposed CAA methodology. Data collected can be categorised into: (i) learners' socio-demographic data, scores, time of quiz attempts and (ii) evaluation data regarding the online assessment process. The discussion for the CAA process is mainly concerned with issues such as frequency of quiz participation and learners motivation. The evaluation is concerned with the suitability of such an online quiz for assessing learner's performance in an e-learning environment and the role of feedback. However sue to space limitation these issues are not discussed in this paper.

	Single attempt		Repeated attempts	
Marks	**Frequency**	**%**	**Frequency**	**%**
5	2	2.4	3	4.2
6	2	2.4	1	1.4
7	1	1.2	3	4.2
8	2	2.4	3	4.2
9	2	2.4	7	9.9
10	5	6.1	5	7.0
11	4	4.9	7	9.9
12	13	15.9	10	14.1
13	11	13.4	4	5.6
14	9	11.0	7	9.9
15	13	15.9	9	12.7
16	4	4.9	4	5.6
17	5	6.1	3	4.2
18	6	7.3	1	1.4
19	2	2.4	2	2.8
20	1	1.2	1	1.4
	82 students	100%	71 students	100%

Table 1: Frequencies of CAA performance

Table 1 shows the results of the 153 students that participated on the CAA for the practical Java programming module. The number of participants that attempted the quiz once (82) is slightly higher than the number of participants that attempted the quiz repeatedly (71). The first finding is that the first group showed higher preparation with consistently better results. Also the percentage of passing participation group was higher. There is evidence supporting that this CAA method of quantitative assessment has the expected association with individual constructivism. Since assessment is achieved (i.e. the marks that were deemed as suitable have been awarded) there seems to be no need for further participation in the quiz. Finally, there is a pattern with marks of students attempting more than once, which shows a continuous improvement of the results after each attempt.

6. Applying the CAA methodology

The applicability of the methodology discussed in this paper is currently investigated through a case study of distance education and more specifically the Global Campus project at Middlesex University. The Global Campus combines tutor-supported distance learning based at a local centre with content delivered via CD Rom and the World Wide Web. In addition to student-tutor interaction at the support centre, the student is part of an electronic community, across the world. Global Campus teaching is currently offered at Learning Support Centres in Hong Kong, Singapore, Shanghai, Egypt and the UK.

Apart from the necessary decision for selecting a suitable learning environment (WebCT), the harder issue to face concerned the core of the pedagogy: how to structure the main body of Web-based materials. There was a need for core pedagogy to address these possibly conflicting requirements. The I CARE system, pioneered at San Diego State University, despite being essentially an instructional model, was deemed as most suitable after

modification. The original I CARE system is a five-step instructional model, named to stand for Introduce, Connect, Apply, Reflect, and Extend [20].

The I CARE model provides consistency and a guaranteed level of quality of GC learning units. Academics are content to use the modified I CARE because it follows the familiar directed, transmission model to which their tried and tested assessment methods are added. The consequence for instructors is that they take on a role of facilitators in the delivery of the modules [20]. There is an indication that the proposed CAA is directly applicable to the GC learning model through the provision of online quantitative assessment through quizzes (individual constructivism) and the available qualitative assessment through the WebCT e-learning environment (social constructivism). Further efforts are on the applicability of feedback techniques towards the enhancement of the learning process.

7. Conclusions

This paper proposed a methodology for supporting both formative and summative CAA and focused on aspects of CAA that could be tailored to satisfy the needs of limited educational infrastructures in developing countries. The brief presentation of the GC case study suggests evidence of applicability of such methodologies to enable feedback provision in CAA.

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