

Assessing E-Learning Effectiveness: Developing Strategies for Pedagogy, Resources and Delivery

Indrit Troshani, Sally Rao
School of Commerce
The University of Adelaide
233 North Terrace, Adelaide, SA 5005
Australia

Email: {indrit.troshani, sally.rao}@adelaide.edu.au

Abstract: Although e-learning is spreading quickly across the globe in both educational and non-educational institutions there are problems and misconceptions related to e-learning. Thus, the aim of this paper is to review existing literature, particularly previous research pertaining to the three dimensions on the basis of which online courses should be designed and assessed. Essentially, we argue that e-learning should take a systematic approach and the checklist we have developed can be used to assess online teaching and learning sites and to develop strategies for pedagogy, resources and delivery in e-learning. It is hoped that introducing measurability of online course assessment will help quantify the usefulness of online course.

Keywords: E-Learning & Innovations in Teaching

I. Introduction

The aim of this paper is to review existing literature, particularly previous research pertaining to the three dimensions on the basis of which online courses should be designed and assessed. These dimensions include pedagogy, resources and delivery [20]. This is important because there is significant evidence in literature suggesting that although that e-learning is spreading quickly across the globe in both educational and non-educational institutions there are problems and misconceptions related to e-learning [12,13,15].

As a result, the identified factors can be of significant help to educators who design online courses and who are involved in online teaching and learning. The identified factors are summarised as components of a checklist, which can be used to assess online teaching and learning sites. A method to validate the proposed checklist is then presented. Finally, limitations of the checklist and a future research directions to improve the checklists further are also identified.

II. Pedagogy Strategy and E-Learning

Pedagogy refers to the activities which underpin a learning environment [20]. There are three aspects to any pedagogy

namely, dependant/independent, structured/unstructured, and guided/open-ended, where each choice is independent of the other [47]. No single pedagogy suits all students and all courses. Consequently, educators may use more than one pedagogy in a course to provide variety in order to cater to the needs and abilities of different students.

Recent theory supports the notion that learners learn best in environments that are created from an approach that advocates situated learning which immerses them in an authentic, problem based, goal oriented, open ended learning environment and actively engages them, and uses collaboration in its constitution. In the case of online learning, this approach provides support from the lecturer in the form of coaching and scaffolding to facilitate knowledge construction and self regulated learning.

The use of the social constructivist approach is well documented as the preferred approach to online learning [18,20,28,35,43]. There are seven pedagogical goals that designers of constructivist learning environments should take into consideration [14]:

1. Experience with the knowledge construction process
2. Experience in and appreciation for multiple perspectives
3. Embed learning in realistic and relevant contexts
4. Encourage ownership and voice in the learning process
5. Embed the learning in social experience
6. Encourage the use of multiple modes of representation
7. Encourage self-awareness of the knowledge construction process

Through a constructivist approach, learners can create their own interpretations of the events around them and use existing knowledge and understandings, and construct their own new understandings from these interpretations [28]. As an extension of this, Social Constructivism [44] emphasises that the interaction of learners with others leads to cognitive development and supports collaborative construction of knowledge through social negotiation. There is agreement in the literature that that knowledge building results when learners interact with their peers, challenge their thoughts, beliefs, perceptions and existing knowledge by collaborating, discussing their positions, forming arguments, reevaluating their initial positions, and negotiating meaning [3,22]. The Internet in general and the World Wide Web support many different forms of communication that facilitates collaboration (e.g. online discussion boards, etc.) and should

be used in the online learning environment in a meaningful way relevant to the set tasks. Therefore, teaching and learning activities should be designed such that a smooth progression from socialisation through to information sharing and to knowledge construction can be made [5].

Expert advice can be provided to online students in many different ways, such as, feedback on work submitted, asking challenging questions, correcting misconceptions and through inviting practitioners and other experts to participate in online discussions. By participating in weekly discussions, commenting on students' contributions, adding comments and references that relate to the weekly topic tutors can both feed the discussion environment and guide their students playing a vital role in promoting consistent and relevant interaction between students and tutors [8,43].

Therefore, educators play a vital role in promoting consistent and relevant interaction with students. Their role as facilitator, virtual or online is crucial to the development of skills required for students to move from dependency on the e-moderator to self-directed learning. However, the educator should not be seen as an authoritarian figure, but rather as a coach and refrain from imposing (their) views on the discussion but carefully guide the students in exploring an issue through multiple perspectives [43]. By providing multiple perspectives or interpretations of reality knowledge can be further integrated into the learners' existing schemata. Thus, a variety of learning activities should be provided to accommodate different learning styles and life experiences of the learner [2,8,21].

Constructivists perceive that students construct different cognitive structures based upon their previous knowledge and interests. Consequently, learning tasks and activities should be centred around problems that have personal relevance to students [42,46]. Moreover, the way in which problems are introduced to the students is critical to the amount of buy-in by the students. The problem presentation needs to be interesting, appealing and engaging and simulates the problem in a context in which it is normally and naturally encountered as the context defines and structures the problem [36]. Problems that are situated in authentic, real world scenarios that are linked to the students own experiences provide an open-ended learning environment that is goal-oriented and often complex by nature. They arouse curiosity, engage the student, and encourage active participation [24-26]. Authentic learning is

active learning. It involves real life situations and problems that have context, depth, complexity and duration. They involve cooperative situations and shared consequences, are worth solving and can provide benefits when solved. They are comprised of a single sustainable complex task that provides the opportunity to look at different perspectives, promote reflection to enable abstractions to be formed and promote articulation to enable tacit knowledge to be made explicit. By providing relevant, problem-based, real life scenarios the learning is situated in the problems that are being solved.

An online learning environment should provide opportunities where the student can actively manipulate available functionality in order to facilitate learning and reflecting [24-26,34,45,46]. This metacognitive process should be facilitated by the teacher who should provide guidance and support in the knowledge construction process with the provision of flexible scaffolding where the instructional design and teaching tactics surround, but do not fill in, the learning by students [20]. This support should be provided in the initial stages and it should be gradually removed as students increase responsibility for their own learning and become more self-directed. Nevertheless, interactions with the lecturer should always be the centrepiece of education, no matter what the medium [27].

The identification and articulation of aims and objective in e-learning is important as it provides the foundation for the instructional design, development, delivery, and assessment of an educational event [19]. These aims and objectives should form part of the teaching and learning plan as they predetermine what is to be taught and learned. Consequently, it can be expected that e-learning activities will equip students with the necessary skills, knowledge, and experience to meet the aims and objectives of the course.

In addition, assessment points throughout the course should reflect the educational growth of the students. Continuous assessment is important for both teachers and students because it provides information on the progress made, it helps measure the accomplishments of learning objectives, while also providing students with benchmarks for monitoring their progress and means of adjusting their learning tactics. Therefore, assessment and measurement strategies should be integral parts of the learning process.

To summarise, we propose the following pedagogy strategy checklist for e-learning:

Authentic tasks:

- | | | |
|---|-----|----|
| • Tasks have a clear purpose | Yes | No |
| • Activities are problem based using real world scenarios [situated learning] | Yes | No |
| • Activities are authentic to the environment in which they are used | Yes | No |

Opportunities for collaboration

- | | | |
|---|-----|----|
| • Activities create opportunities for learners to interact meaningfully | Yes | No |
| • There are opportunities for interaction between student and tutor | Yes | No |
| • Guidance is provided to ensure collaboration is meaningful and relevant to the set tasks. | Yes | No |
| • The tutor promotes consistent interaction | Yes | No |

• Activities support peer tuition and/or assessment	Yes	No
• Activities make provision for industry mentors	Yes	No
Learner-centred environments		
• Activities actively engage the learner	Yes	No
• Problems are complex	Yes	No
• Problems are encourage active participation	Yes	No
• Tutor provides guidance or scaffolding where appropriate	Yes	No
• Learning is based on inquiry or problem-based tasks	Yes	No
• Instructional activities should encourage and required students to actively participate in the acquisition and processing of educational content.	Yes	No
• Activities support and develop students metacognitive skills	Yes	No
• A variety of learning activities are provided to accommodate different learning styles and life experiences of learners.	Yes	No
Engaging		
• Activities and assessments are linked to learners own experiences	Yes	No
• Activities arouse curiosity and are interesting	Yes	No
• Problems are contextualised and complex	Yes	No
Meaningful Assessments		
• Evaluation of performance is directed toward the measurement and assessment of the predefined learning goals and objectives.	Yes	No
• A variety of "low-stakes" assessment and measurement strategies are provided to enable students to gauge their progress without impacting on course grade or performance measurement	Yes	No
• Automated systems (e.g. on-line quiz tools) are provided for immediate feedback, relevant suggestions, and guided support in response to learners' performance.	Yes	No
• Asynchronous technologies such as electronic mail, bulletin boards and/or other technologies support the assessment and measurement activities.	Yes	No
• Opportunities for students to provide feedback regarding the instructional design of the program.	Yes	No

III. Resource Strategy and E-Learning

One of the important aspects that the educational design of an online unit needs to take into consideration includes the resources that are provided to the learners [20].

Accessibility. Firstly, accessibility is an indication of the ease with which learners are able to locate and access information resources provided by the online unit [38]. Accessibility of online resources by people with disabilities is similar to the accessibility of online resources by non-disabled people that browse in non-standard conditions, such as outdoors, on-the-move, or through devices with limited capabilities [31-33,39].

One of the accessibility rules is the separation of unit contents from the sites appearance. This means that online learning sites should provide users with the capability to override defaults styles with user-preferred styles [1,39]. This should reflected in site design principle that sites should allow for customisation based on user preference. That is, the site should allow for versatility of the way information is presented (e.g. display changes, timing events, etc.).

Another rule is the provision of text alternatives for visual components (images and multimedia features). This

rule is important to accommodate access for learners who cannot afford suitable browsers or Internet connections [39] which can be accomplished by developing sites that are compatible with assistive technologies (ATs) and complete keyboard access.

The contents of the resources provided to the learner should also be given the due attention (Vrasidas & McIsaac 1999). The content structure of an online unit should be sufficiently detailed and meaningful in order to modularise the contents into small manageable chunks [43]. The level of detail and modularisation, however, should not interfere with the organisational logic, clarity and intuition of the provided information. Moreover, users should be allowed to easily navigate through the site hierarchy to retrieve what they require. Therefore site maps and advanced search capabilities, context and orientation information, navigation aids, etc. may be provided to assist easy navigation [1,31,33].

Standardisation. A related issue is learning content standardisation (Hodgins & Conner 2002) which should be based on accredited content libraries or learning management systems with the goal to reuse, transfer or have interoperability between learning systems. It is claimed that learning content standardisation will help answer questions like:

- How will one mix and match content from multiple sources?
- How will one develop interchangeable content that can be reused, assembled and disassembled quickly and easily?
- How can one ensure that one is not trapped by vendor’s proprietary learning technology?

Examples of standards to help answer questions like the above include the IEEE Learning Technology Standard Committee, Advanced Distributed Learning Initiative, Instructional Management System (IMS) Global Learning Consortium, Education and Training in European Society (PROMETEUS), etc [1,21,31,33,38,40].

In this context, online sites need to provide content management tools, like authoring tools for course development and revision (Belyk, Schubert, & Baggaley 2002). They also should contain student management tools like password-protected logins, registration and withdrawal procedures, and other general student tracking functions. These functions will increase the flexibility, extensibility, interoperability, multicultural and multilingual support, etc. with which the provided resources are managed [4,17,31,33,38].

Useability. Useability is not only based on a set of best practice principles developed by Jakob Nielsen but also comprises a new principle according to which the content of an online learning web site should be matched to its audience [40]. This means that the target audience should be the determinant factor to define the communication style of the website. Specifically, Smulders (2001) argues that e-learning websites should steer from jargon and culture-specific perspectives. This, however, appears to be at odds with Herrington et al.’s (2001) guideline of resource inclusivity which suggest that resources should include a variety of cultural perspectives, where possible [17,31,33,38,43].

Another aspect of Smulders’ (2001) useability notion includes content organization adherence to consistency and observance of tried-and-true standards. The rationale behind this is to systematically standardise website look and feel by making learning sites more predictable environments in order to allow learners to know what to expect. This aspect of Smulders’ (2001) useability appears to be supported in [23,31,33,38] too.

To summarise, we propose the following resource strategy checklist for e-learning:

Accessibility of Resources

- | | | |
|--|-----|----|
| • The online site separates unit contents from the sites appearance | Yes | No |
| • The online site offers text alternatives for visual components (images and multimedia features). | Yes | No |
| • The online site offers auditory contents alternatives for visual components (images and multimedia features). | Yes | No |
| • The online site offers keyboard access options to all features. | Yes | No |
| • The content structure of the online unit is sufficiently detailed. | Yes | No |
| • The content structure of the online unit is sufficiently meaningful. | Yes | No |
| • The content structure of the online unit is logically organised. | Yes | No |
| • The content structure of the online unit is clear and unambiguous. | Yes | No |
| • The content structure of the online unit is intuitive and easy to follow. | Yes | No |
| • The contents structure of the online unit is based on tried and true standards. | Yes | No |
| • The resource have the learning content metadata feature in order to allow quick and advanced search capabilities of material provided. | Yes | No |

Standardisation of Resources

- | | | |
|--|-----|----|
| • The learning content is sufficiently standardised to allow to easily mix and match from multiple sources. | Yes | No |
| • The learning content is sufficiently standardised to allow one to develop interchangeable content that can be reused easily and quickly. | Yes | No |
| • The learning content is sufficiently standardised to allow that users are not trapped by vendor’s proprietary technology. | Yes | No |
| • | Yes | No |

Modifiability of Resources

- | | | |
|---|-----|----|
| • The online learning site contains contents management tools allowing contents changes to be flexibility. , extensibility, interoperability, multicultural and multilingual support, | Yes | No |
| • The online learning site contains contents management tools allowing contents changes to be extensible. | Yes | No |
| • The online learning site contains contents management tools allowing contents changes to be provide for multicultural and multilingual support. | Yes | No |

<i>Inclusivity of Resources</i>	Yes	No
• The resource in the online learning web site are matched to all possible audiences, or provisions for different audiences are made.	Yes	No
•	Yes	No
<i>Richness</i>		
• The subject matter resources provide for multiple views on the subject matter.	Yes	No
• The subject matter resources encourage critical appraisal of what is available.	Yes	No
• The subject matter resources encourage empirical evaluation, where possible.	Yes	No
• The subject matter resources encourage creative thinking based on existing works.	Yes	No
<i>Currency</i>		
• The resources contain seminal works on the subject matter.	Yes	No
• The resources contain recent developments in the subject matter.	Yes	No

IV. Delivery Strategy and E-Learning

The ways in which an online course is delivered to students need to be anticipated in its design to ensure its quality [20]. As students come with a variety of backgrounds and technology experience, an online course needs to cater to these differences to ensure each student becomes involved in the learning experience in their own terms. The site should be reliable and have a robust interface that provides the student with a sense of adventure while being motivating, a confidence in tackling the technology, and support their efforts for knowledge acquisition without any barriers.

Online courses, should not be restricted to one delivery platform and should be flexible and easily customisable based on the following characteristics:

- use of software that is readily available;
- use code that can be customised easily and the use of development software for more sophisticated usage (eg Flash) for components that will not change;
- the development of resources that can be used in various delivery platforms;
- site structure that allows a student to progress through the learning material in a variety of pathways;
- site can be extendable and scalable.

The technology should be transparent to the student (Herrington et al (2001)). The layout and navigation should be clear and follow one's common sense. Therefore, sufficient technical instructions should be provided to assist students in the use of the site or details of how to obtain, support and assistance, e.g. technical help desk, student administration and other support services. An online learning site should be created with students in mind. Assumptions should be made that students do not have a high degree of technical expertise.

Influences affecting interface design that should be considered include: usability testing to gauge user

comfort/connectedness; user control/user centredness so that users can control their learning pathway and the activities are linked to their learning requirements; the interface design is consistent with the content structure; and the interface design supports the learning approach; and the interface provides for the students' individualised needs [37].

Online learning sites should provide students with clear goals, directions and learning plans and relationships should exist between learning outcomes, resources, activities and assessments (Herrington et al (2001)). The literature is consistent that the following should be unambiguously displayed in an online learning site:

- a unit outline that provides students with the aims, objectives, learning outcomes and learning approach used;
- the interaction required – details and times ;
- assessment – criteria, quality elements, length and weighting;
- texts (where the purchase and costs), references and websites – include textbook chapters, articles to consult, supplementary readings;
- suggested study schedule;
- links to student support material – eg institution handbook, student portal, learning centre, technical helpdesk;
- information written in greater detail so that the student can proceed independently or with need for little clarification by teaching staff;
- contact details (email, phone and fax) – teaching staff as well as student support areas.

As indicated earlier in the paper, knowledge building occurs through interaction with other students. Consequently, in an online environment, opportunities need to be provided for students to communicate with each other and their teacher. A variety of way can be used to accomplish this: asynchronous interaction, synchronous interaction and email. Asynchronous interaction enables students and teachers to participate in online forums where the entire learning community can partake in scholarly exchanges of mutual

benefit [9]. Synchronous interaction enables students to participate in real time interchanges that provide students with an immediate response to questions or comments. Email communication is useful for interchanges between the student and their teacher such as the student requesting assistance of a personal nature. Alternatively, email can also be used when the teacher advises feedback and grades, administration issues etc. (Chellman & Duchastel; 2000). Therefore, the learning channels should be open to all students, and encourage collaborative learning and knowledge construction.

When delivering e-learning bandwidth considerations should also be made. Bandwidth is defined in the literature as the amount of data that can be carried in the unit of time. Bandwidth considerations are important because they affect download times which also depend on connection speed for file size. Different students might have access to different types of network or Internet connections, therefore, the delivery of the online materials is likely to be affected [31,33]. For example, narrowband internet connections would be limited to [6]:

- Provision of materials – text, stills, limited low quality video
- Interaction with materials – text, stills, low quality video
- Interaction with teacher – email, chat, online discussion, low quality streaming
- Interaction between students – email, chat, online discussion, low quality streaming

Whilst broadband internet connections would offer [6]:

- Provision of materials – text, stills, video streamed from server (quality dependent on bandwidth)

- Interaction with materials – text, stills, high quality video
- Interaction with teacher – email, chat, online discussion, streaming (depending on bandwidth)
- Interaction between students – email, chat, online discussion, streaming (depending on bandwidth)

Students undertaking online learning should also be provided with recommended requirements for undertaking the online course. These requirements include minimum hardware and software specifications, internet connection, additional plug-ins as well as the details of how such plug-ins should be obtained. Online learning materials which are too large for downloading over the internet should be delivered to students via alternative means (e.g. CD-ROM mail-outs etc.)

An online learning site should also ensure equitable access by vision and hearing impaired students. Therefore, the design of the websites should comply with W3C Web Content Accessibility Guidelines 1.0 (<http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505/#Guidelines>). Designers of online learning sites should also ensure that local standards are met. For example, in Australia, online learning sites should comply with EdNA (Education Network Australia). Metadata standards should “support interoperability across all sectors of education and training in Australia in the area of online resource discovery and management” (<http://standards.edna.edu.au/metadata/>). In addition, copyright materials that are made available online for educational purposes must comply with the Copyright Act 1968, which imposes obligations regarding the electronic communication of Copyright material. To summarise, we propose the following delivery strategy checklist for e-learning:

Reliable and robust interface:

- | | | |
|--|-----|----|
| • Content can be created using software that is readily available. | Yes | No |
| • Content can be used with other delivery platforms. | Yes | No |
| • Site is flexible and can be updated for currency/changed easily. | Yes | No |
| • The use of html code can be customised easily. | Yes | No |
| • The use of development software for more sophisticated usage (eg Flash) for components that will not change. | Yes | No |
| • The site structure allows a student to progress through the learning material in a variety of pathways. | Yes | No |
| • Layout and navigation is clear . | Yes | No |
| • Site has been created with students with little technical experience in mind. | Yes | No |
| • Useability testing has been undertaken. | Yes | No |
| • The interface supports the learning approach taken for this unit. | Yes | No |
| • The interface is consistent with the structure of the unit. | Yes | No |
| • The interface enables the students to complete their learning requirements. | Yes | No |
| • The site provides access or details about support and assistance available to students. | Yes | No |

Clear goals, directions and learning plans:

- | | | |
|--|-----|----|
| • Unit outline is available that provides student with aims, objectives, learning outcomes and learning approach used. | Yes | No |
|--|-----|----|

• Details are provided about interaction required of students.	Yes	No
• Details are provided about assessment including criteria, quality elements, length and weighting.	Yes	No
• Details are provided about texts, references, websites and other sources of information.	Yes	No
• A suggested study schedule is provided.	Yes	No
• Links to student support material are provided (eg administration, helpdesk, learning centre etc.).	Yes	No
• Information provided for the online student has been written in greater detail.	Yes	No
• Contact details have been provided for teaching staff as well as student support areas.	Yes	No
• Students have choices in the resources they use from the site.	Yes	No
• The site is not wholly based on content as a resource for learning.	Yes	No
• The site provides facilities for the student to interact with their learning.	Yes	No
Communication:		
• Communication is used to encourage active and collaborative learning and knowledge building.	Yes	No
• Provision is made for students to interact with the teaching staff and other students.	Yes	No
• Students are provided with email facilities or email addresses of teaching staff and other students.	Yes	No
• Students are provided with asynchronous discussion facilities.	Yes	No
• Students are provided with synchronous discussion facilities. (<i>Optional</i>)	Yes	No
Technical issues:		
• Technical instructions/support are readily available.	Yes	No
• Site can be assessed via an internet connection using a 28Kkbp modem.	Yes	No
• The site does not use large files for streaming video, online simulations and multimedia that distract or hamper the learning experience.	Yes	No
• The site can be viewed using a standard internet browser.	Yes	No
• Access or details about additional plug-ins the student may require has been provided.	Yes	No
• Details have been provided to students about the recommended requirements for undertaking the online unit (eg. minimum hardware and software requirements).	Yes	No
• Students have access to offline content (eg CD-Rom with large video or audio files; hard copy print based reader). (<i>Optional</i>)	Yes	No
Equity, accessibility and legal requirements		
• Unit materials and activities are available and are accessible by all students especially disabled students.		
• Site complies with the W3C Web Content Accessibility Guidelines.	Yes	No
• Site has been put through the Bobby tool to ensure web accessibility guidelines have been met.	Yes	No
• Site complies with EdNA (Education Network Australia) Metadata Standards.	Yes	No
• Site complies with the Copyright Act 1968.	Yes	No

V. Proposed Methodology

In the previous sections checklists assessing the effectiveness of online learning sites were proposed. In their current form, these checklists are based on current e-learning literature alone. For them to have practical value, empirical validation is required. We propose that validation should be carried out in two stages. In the first stage popular online learning sites will be reviewed in an attempt to enrich the

current checklists or identify items which are not supported. With the second stage, we believe that focus groups with students and educators are appropriate as a means of further validation. Focus groups allow for group interaction and have the potential to generate synergistic effects and, therefore, can produce data and insights which would otherwise be less accessible [7,10,11,16,29,30,41]. This, we believe, will enhance the quality of the data.

VI. Conclusions and Future Research

The checklists recommended above constitute an attempt to comprehensively and effectively assess online course for teaching and learning. As online teaching and learning becomes more popular and is used for teaching various fields of knowledge there is a growing need to standardise pedagogies, resources and delivery strategies which constitute the three most important components of online learning. In addition, with an increasing number of course delivered online less ambiguous assessment is required. In this paper, we have developed checklists which assess the three components of online learning.

Further research needs to be conducted in order to determine the relative importance of the proposed checklist items. This is important because the current checklists weigh all items equally. The reviewed literature indicates that certain checklist items may be more important than others. In addition their importance may vary for online courses of different fields of knowledge. Once determined, the relative importance of the checklist items may be quantified in terms of weights. The assessors of online course may then rate each checklist item depending on the assigned weight, to obtain a final score. Different online courses may then be compared on the basis of the calculated score. It is hoped that introducing measurability of online course assessment will help quantify the usefulness of online course.

Acknowledgement

The authors acknowledge that parts of this paper are based on the results of the work carried out by V Robinson, K Goldsworthy, and I Troshani in 2002 as part of the Online Learning Project, Edith Cowan University, Western Australia.

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