

IMPACT OF TECHNOLOGICAL INPUTS ON QUALITY OF E-LEARNING PRODUCTS: A REVIEW

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Abstract

As the world shifts from the industrial era to the knowledge era, e-learning is gaining prominence as the preferred method for use in pedagogical education and informal training. Embracing this advance boasts numerous advantages but care must be taken to preserve the aspect of meaningful learning. E-learning systems are built upon technology scaffold (input) however; the focus should never deviate from the purpose of the tool (output) that is a learning experience through use of the tool. Technology from an e-learning perspective refers to the combination of hardware, software and the supporting infrastructure (i.e. internet or intranet and related support service provision).

Technology enables e-learning however, learning will not take place in the absence of the learner, the learners aptitude and their specific needs. A successful e-learning experience is largely dependent on how the e-learning tool's quality factors enhance its usability. The e-learning tool should ideally possess a number of features that will make the users experience enjoyable. It is important to note that technical difficulties, faults and glitches can serve to discourage users from the continued use of a software system.

This paper reviews the impact of technology on the quality in the development process of e-learning tools.

Keywords:

E-learning;
Technology;
Device;
Quality.

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1. INTRODUCTION

E-learning

E-learning is a technology assisted learning mode that has been described as the modern day game changer in this age. There has been a phenomenal increase in the number of e-learning users as a result of the current world trends where technology has become more accessible even to the most rural and marginalized communities. The advent of e-learning however, cannot be viewed as an advance that intends to replace traditional classroom learning entirely but rather augment the method, a practice that is now popularly known as ‘blended learning’. This method acknowledges strength in both approaches and advocates for their synergy.

E-learning tool development

E-learning tools are developed with the user in mind, the infrastructure works together to simulate the best learning environment for the user. An e-learning tool involves the harmonious cooperation of a number of components and can be defined broadly as the point where a user interfaces a device that loaded with the relevant content, supported by appropriate technology for the purposes of learning. There are a number of reported advantages associated with adopting e-learning, the main being the ability to access premium content at a lower cost. The premise of building a technology enhanced learning framework remains similar regardless of the target audience. The system functions to serve the user and enhance their learning potential of the user. For a tool to achieve this, it has to be developed with high quality and usability. Quality in the e-learning context is a complex concept but it basically refers to aspects around the functionality, reliability, usability, maintainability, usability and effectiveness. Usability factors assess whether the product is a good fit for the user. Quality and usability remain a concern through the whole process of developing an e-learning tool.

The development of e-learning material has higher costs when compared to developing normal classroom training materials and equipping the trainers. This is especially true in instances where multimedia and highly interactives are employed. Delivery costs, (including technological considerations such as web servers and continuing technical support) are lower in comparison to those associated with a classroom set up.

When developing an e-learning tool, key design considerations should be made depending on the intended learning outcomes. Training programs have the ability to develop different types of skills a few examples are listed:

- **Cognitive skills**, these involve knowledge and comprehension (understanding different scientific concepts), applying a method to solve a problem (mental skills) or following a set of instructions (procedural skills).
- **Interpersonal skills**, this set of skills is developed by activities that involve active listening, negotiations and presenting.
- **Psychomotor skills**, this set of involves the acquisition of specific movement or physical perception. Activities to develop this will focus on fine motor skill and coordinated activity (e.g. Hand eye coordination).
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A program meant to address the acquisition of cognitive skill is designed in an interactive way and the method is hands on where the user learns ‘by doing’. Interpersonal skills can be developed by activities that encourage role-play and feedback to influence changes. Psychomotor skills can be developed using games like driving a car or activities like 10 key typing.

E-learning devices

For e-learning to be effective, it has to be supported by robust appropriate digital technologies which include infrastructure, digital devices, digital content and support services. A device can be defined as a utility, tool or gadget that can be used to support learning, providing organizational capacity and tracking capability. The device carried out activities that are meant to reinforce learning. There are different types of devices employed in e-learning that range from standalone hand-held devices, application based or a software download connected to a computer or mobile device. We can consider any form of mobile electronic technology to be a device for example, a laptop, a desktop computer, a tablet, or a smartphone. A digital device carries the potential to expand and enhance interaction in the classroom. It can enable real world activities, engaging students in new, exciting ways and improve learning environments. Using a device opens up new opportunities for problem solving as collaboration avenues are extended beyond the classroom on an online platform. When every learner has a device, there can be greater

flexibility in learning pathways. Learner centered curriculums can be developed to give the users a personalized learning experience in which they have a lot more control over their learning. This can potentially empower learners and have them engage deeper in their learning and elevate their achievement potential.

E-learning technologies

Technology is a key component necessary in the development and delivery e-learning. Depending on the context, different tech tools can be exploited to produce e-learning content. Key considerations are made around the file formats to be used as well as the nature of the desired final product. For a simple presentation or tutorial, basic resources like Microsoft PowerPoint and Word can be used however, if the aim is to create interactive learning materials, there is need to incorporate tools that are a lot more sophisticated like courseware authoring tools. These are special-purpose tools that are used for the creation of interactive e-learning content. Using these tools enables the addition of text, graphics and other media forms. A key feature is how these tools can also provide a framework, which organizes content into pages, sections and lessons thus ensuring reliable navigation. The tools also help integrate assessment and quiz capabilities into the tool. To create media components such as bitmap graphics, vector images, animations, video and sound compression, the tools use auxiliary software packages like adobe suites. All these considerations are then worked into the creation of a Learning Management System (LMS). This is the system that provides an indispensable instruction surface for technology-based learning.

2. LITERATURE REVIEW

A number of bodies of literature were reviewed in order to understand the inputs of e-learning and their significance in the determination of the quality of the end product.

Prensky (2001b), Clark and Kwinn (2007), Horton (2011), Clark and Mayer (2011), and host of workers and authors have addressed the importance of e-learning as it relates to this new generation of learners. In this regard, e-learning is not just viewed as a teaching methodology but rather as an educational movement for this era and beyond. Electronically assisted learning is no longer a distant future concept but a present reality which boasts a range of advantages such as

the ability to incorporate a various digital media as part of the instructional process and the ability to assess student performance based on data gathered from different learning management platforms. An important aspect of e-learning is how it can be viewed as a reflection of the technological advances and changes that are taking place in our daily lives. E-learning fits perfectly in our life experience as the world becomes more and more digitally inclined.

To reap the full benefits of the innovation, there are a number of areas where quality must be checked and maintained in the development process of e-learning. McNaught (2001) highlights standards in seven areas that are essential for quality delivery in e-learning. These are stated as follows: a clear, concise plan, support system for both the educator and the user, which includes written manuals, reliable and robust infrastructure, clear learning objectives, solid user-instructor communication channels and a platform for strong student input.

Robust infrastructure is a critical factor in the delivery of quality e-learning but, this is often overlooked. Soong, Chan, Chua, and Loh (2001) show in their work that there is need to look beyond the software used to implement an online course as this alone is an insufficient measure, other components such as data management, channel management as well as application management. Selim (2007) notes after a study on factors influencing acceptance that, ICT infrastructure plays a significant role in influencing acceptance and building users perception of e-learning.

DeLone and McLean (1992) emphasized system quality as a fundamental construct in the e-learning success model; this was backed in addition by a number of studies that show evidence on the vital function of system quality with regards to organizational performance Salmela (1997). When we look at this from the point of view of the user, ICT quality has a direct bearing on the learners' needs and perception. This means a learner will evaluate the system quality based on their perception of it. Von Hellens (1997). Eom and Stapleton (2011) in deriving their position on quality define it as, the degree to which a system possesses distinctive information system traits which can be measured using parameters like response time, accessibility, flexibility, usefulness, ease of use and the ease of learning. Bailey and Pearson (1983) use four parameters to assess and assign system quality. The four measures are response time,

convenience, system flexibility and system integration.

Volery and Lord (2000) while investigating critical factors for online education success conclude that system quality can be assessed using two indicators namely the ease navigation and the interaction with the interface. Tella (2011) places emphasis on seven indicators critical for e-learning system quality evaluation, these are: ease of use, availability, user-friendliness, interactivity, accessibility, aesthetics (attractive features) and overall presentation. Because of the subjective nature of the term system quality, it is a difficult construct to evaluate.

Content quality is an important consideration and it aids in the effective performance of organizational functions. Decisions and action depends on the exposure to quality information. Wang and Strong (1996) put forth a strategy to measure data quality. Here they provide four categories of data quality:

- (i) Intrinsic quality: accuracy, objectivity, believability, and reputation;
- (ii) Contextual quality: value added, relevance, timeliness, completeness, and appropriate amount of data;
- (iii) Representational quality: it is interpretable, it is easy to understand, there is a consistency in the representation, and the representation is concise.
- (iv) Accessibility: the content is accessible and secure.

From an e-learning perspective, information quality is essential in that construction of high quality e-learning tools. According to Roca, Chiu, and Martínez (2006), information quality has a direct bearing on user satisfaction, which directly influences a learner's intention to continue or stop using the e-learning system.

Holsapple and Lee-Post (2006) in their investigation used parameters such as course organization, effective presentation, appropriate length, clarity of thought in the writing, relevance and whether the work was up to date. From the data they collected, the results revealed the relevance that information quality is a critical construct in the development of e-learning material.

Broadbent and Weill (1996) developed measurements for IT infrastructure services. The

measurement focused on the range and the reach of the infrastructure. Here, functionality and connectivity are the main parameters. There are some aspects of infrastructure quality that cannot be assessed from a student's perspective like ICT architecture, standards, research and development. From a student's perspective, we can measure ICT channel management, ICT security, IT advice and consultancy, IT communication infrastructure, IT application infrastructure, and support services.

McLean and DeLone state that an e-learning system quality measurement instrument cannot be similar to one that measures IS success which focuses on one variable. E-learning system quality measurements assess the following variables to gauge system quality:

- (i) Is it easy of use,
- (ii) Is it easy to learn,
- (iii) User requirements,
- (iv) System features,
- (v) System accuracy,
- (vi) Is it flexible,
- (vii) Sophistication,
- (viii) Integration.

From the work of Ong & Lai (2007) and Parasuraman et al. (2005), service delivery quality is a key component that is worked in to the development of an e-learning tool. On the e-learning platforms, students use the systems frequently as a means to achieve learning outcomes, to ensure success; contact and responsiveness are key elements for service provision. Service delivery quality is measured using the E-S-QUAL method on the basis of the following:

- (i) Efficiency,
- (ii) Availability
- (iii) Fulfillment
- (iv) Privacy
- (v) Responsiveness
- (vi) Contact.

From the above literature review, a number of perspectives have been probed on the inputs that make up an e-learning system as well as the parameters that are used when assessing e-learning

quality.

3. DISCUSSION

Technology is meant to enable e-learning, but when not addressed, it can be the biggest impediment to e-learning. Before a user gets to the learning aspect they must understand as well as be able to use the software, hardware and bandwidth. Technology can serve as a barrier to entry hence all the learners need to be trained to ensure they are comfortable with the technology. When learners have mastered the technology, it is easier to carry out secondary functions like online collaboration. E-learning technology must be advanced enough to carry out the requisite function but be simple enough to be understood by learners across the social divide and age-spread.

TECHNOLOGY IMPACTS ON QUALITY OF E-LEARNING

Based on literature review, we seek to establish the effect of technology components such as hardware, software, support and infrastructure (internet or intranet) on the E-learning quality.

The widely accepted model used to assess e-learning quality is the DeLone and McLean's model that assesses six parameters: information quality, use of information quality, user satisfaction, system quality and net benefit. The ISO/IEC 9126 model on e-learning quality highlights the following quality characteristics, Functionality, reliability, effectiveness, usability, maintainability and portability as they apply to modeling both internal and external software quality. Based on these measures the following can be said about the impact of technology on quality

Device choice and e-learning quality

When developing e-learning material, there are a lot of devices such as desktop computers, laptops, tablets, smartphones and phablets. The choice is decided in the context of the user or the expected outcome. For a device to "add" to e-learning quality, the device must support expanded community and enable both face to face and online training, it should allow the user to learn, create content, share and collaborate anytime regardless of where they are. The device should allow the user access to a new world of resources providing much more knowledge than a single teacher or school library could have done. A digital device that adds to e-learning quality should

allow students to personalize the learning experience because learners have different strengths, talents and needs. This initiative helps build on a student's identity, language and culture. These factors will result in learners being more forthcoming, focused and engaged. They are more likely to enjoy learning and achieve better results. Device choice and the specifications on it can influence the e-learning quality characteristics viz portability, usability, functionality and effectiveness.

Technology interface and e-learning quality

The e-learning tool interface design and dimensions influences five sub-dimensions relating to the overall look and feel of an e-learning course or program. These dimensions are web design, content design, accessibility, navigation and usability. The user interface is the first thing that users see when they login to take a course. The first impression as well as ease of use have a bearing on a learner's attitude and perception, the user interface can augment e-learning quality if it is more functional, usable, reliable and flexible enough to allow a degree of personalization.

Software impacts on e-learning quality

When choosing technology (software) for e-learning, regardless of the intended application, there are five quality characteristics that a chosen software package can influence. These are stated as follows maintainability, usability, compatibility, modularity, and accessibility. Each one of these quality aspects is critical for e-learning success. Many of these characteristics overlap but looking at them individually helps to ensure a broader understanding on how technology influences the quality of e-learning solutions.

- i. **Maintainability:** Maintenance of e-learning technology over time is critical. A system must be designed in such a way that it can add new users and delete old ones, add content and recycle material. It should be easy to update and increase capacity as need arises. A technology tool that adds value should not require vendor assistance for the administration and maintenance of the system. It should be easy to maintain both the software and the content. Technology can impact e-learning quality by designing with tools with high maintainability.
- ii. **Compatibility:** Designing software that is compatible with other e-learning solutions on

the market helps with interoperability. A good software choice is one that is recognized and utilized widely. Depending on the standards and expectations relevant for one's situation. This is considered an increase in quality because it enables key processes as listed below:

- a. Compatibility will allow users to move content from one Learning Management System to another.
- b. It will help create content that can be placed into many learning management systems.
- c. It will not restrict authoring package use to the LMS that it is purchased with.
- d. It removes the need to seek specialist help to create courses every time new software is purchased.

Compatibility can be ensured if e-learning software is designed in adherence to certain standards that are emerging within the e-learning industry.

- iii. **Usability:** E-learning systems should be easy to use. This is vital because potential users and instructors will never use the tools if they view technology as cumbersome and difficult to navigate. Technology should make the applications intuitive where it is easy for a new user to find the menus and move from one section to the next one. The tools should have easy communication platforms to connect with instructors for feedback, which is easy and accessible for both parties. Technology can increase this quality aspect by making software that is simple and straightforward for the benefit of the learners, instructors and administrators.
- iv. **Modularity:** E-learning material can be developed as modules, these are small self-contained units that have instructional content and can be used as building blocks to construct a more complex instructional structure. These small chunks can be moved from one lesson, course or program to the next one easily and the benefit is that it saves time that is used on product development. It is convenient because once the block has been made; it can be used and reused over again.
- v. **Accessibility:** The accessibility quality is two-fold; in the first instance making software accessible is creating programs that are accessible to all individuals regardless of physical obstacles. This is ensuring that even people with disabilities can use the technology. The second instance refers to developing software that will function on platforms available to all users. Technology will negatively impact quality for example if you launch an application that requires the latest Macromedia Flash plug-in. If a section of the target audience does not have access to

the plug-in, this can be viewed as a technical obstacle hence making a software application that is highly accessible increases the quality of e-learning.

4. CONCLUSION

Technology is critical for the success of an e-learning tool and careful consideration must be made when developing e-learning software. E-learning tools can be in the form of a simple web page that can add value to a lesson or employ a full scale learning management system including both lesson delivery and course content development. Regardless of the scale and magnitude a developer must consider the five e-learning technology elements as they have a bearing on the overall quality. If a developer considers maintainability, compatibility, usability, accessibility and modularity when crafting an e-learning solution, they are likely guaranteed a flawless, effective e-learning implementation experience.

Technology enhances our ability to convey learning across our organizations. Its effective use lays the foundation for creating online programs comparable to traditional learning and training events. Its success in achieving this objective lies in not focusing on the latest tools or devices but rather building well designed programs that efficiently and effectively meet performance objectives. This will help both the users and instructors focus on the learning in e-learning and not only the 'E'

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