Knowledge Management & E-Learning, Vol.9, No.4. Dec 2017

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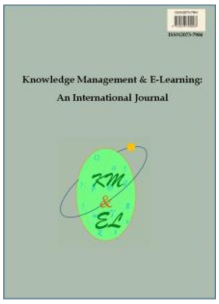

Knowledge Management & E-Learning: An International Journal (KM&EL)
ISSN 2073-7904

Recommended citation:
Day, S., & Erturk, E. (2017). e-Learning objects in the cloud: SCORM compliance, creation and deployment options. *Knowledge Management & E-Learning, 9*(4), 449–467.

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e-Learning objects in the cloud: SCORM compliance, creation and deployment options

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Abstract: In the field of education, cloud computing is changing the way learning is delivered and experienced, by providing software, storage, teaching resources, artefacts, and knowledge that can be shared by educators on a global scale. In this paper, the first objective is to understand the general trends in educational use of the cloud, particularly the provision of large scale education opportunities, use of open and free services, and interoperability of learning objects. A review of current literature reveals the opportunities and issues around managing learning and teaching related knowledge in the cloud. The educational use of the cloud will continue to grow as the services, pedagogies, personalization, and standardization of learning are refined and adopted. Secondly, the paper presents an example of how the cloud can support learning opportunities using SCORM interoperable learning objects. The case study findings show that, while the use of SCORM enables a variety of trackable learning opportunities, the constraints of maintaining the currency of the learning also need to be considered. It is recommended that the SCORM content are combined with cloud based student activities. These learning objects can be used to support alternative learning opportunities within blended and online learning environments.

Keywords: Cloud computing; SCORM; Learning objects; Interoperability; Blended learning

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1. Introduction

Cloud computing has been around for a number of years and is realized in a variety of solutions that promise reliable infrastructure, large amounts of storage and a range of easy to access software and services. In the field of education cloud computing is changing the way learning is delivered and experienced, from providing software, storage, teaching resources and artefacts that can be shared by educators on a global scale. Institutions now offer worldwide learning opportunities, such as Massive Open Online Courses (MOOCs) using cloud based infrastructure, tools and services. In the spirit of sharing, open educational resources (OERs) reside in the cloud and are shared, adapted and reused in numbers showing an ever-increasing upward trend. Entire schools and business enterprises have replaced traditional learning management systems, and software solutions with their cloud based equivalents, reducing the expense of infrastructure, hardware purchase, maintenance and software updates and replacement. The ongoing development of free or open software and services offer new opportunities to develop learning solutions to meet the wider needs of both institutions and their learners.

The National Institute of Standards and Technology (NIST) defines cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources" (Mell & Grance, 2011, p. 3). Composed of several key attributes, cloud computing offers on-demand self-service, network access regardless of client systems, resource pooling and optimization of storage, processing power and network bandwidth, service scalability and adaptability. Cloud computing, hereafter referred to as 'the cloud', can also be divided into three basic service models, Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). The use of the cloud within education spans the three services models, however the focus in this paper is on the provision of software, storage and application engines that support teaching and learning within an educational e-learning environment.

e-Learning has been defined by the Joint Information Systems Committee (JISC) as 'learning facilitated and supported using information and communications technology' (JISC, 2016). e-Learning is available within the classroom with the introduction of technologies such as computers, tablets and mobile devices, and is a required component of blended learning and online teaching models. The level of information and communication technology (ICT) support can differ over a continuum, from learning that occurs totally online, through to a blend of online and face-to-face teaching approaches where the use of technology occurs in the classroom (Bonk & Graham, 2006).

In New Zealand (NZ), the Ministry of Education (MOE) provides guidance on the levels of e-learning and this is tied to curriculum approvals process and helps shape how learning is delivered to students. The MOE also provides NZ schools with a support network as they encourage schools, particularly at the primary level, to incorporate more technologies into their curriculum while maintaining good teaching practice. Best practice dictates that "e-learning enables accessible, relevant, and high-quality learning opportunities that improve student engagement and achievement" (Ministry of Education, n.d.), where technology supports effective pedagogy. As this shift to technology enhanced learning develops, the e-learning opportunities afforded by the cloud continues to grow and its effectiveness explored.

In this paper, an initial literature review is used to highlight some of the general trends in educational use of the cloud. The provision of large scale education opportunities, related pedagogies, the use of open and free services, and interoperability of learning objects is investigated. In doing so, this literature review reveals some of the ongoing issues experienced when using the cloud for education particularly in the areas of currency, control and intellectual property rights.

2. The cloud for e-learning

The use of cloud based tools and services is redefining traditional ways of learning and teaching. The traditional e-learning model had relied on education providers hosting and maintaining their own e-learning infrastructure and systems. However, as cloud based systems and resources become more prevalent, there is reason to take an integrative approach and take advantage of these different learning systems.

The cloud supports effective e-learning by providing infrastructure, repositories of resources, collaborative software, communication software, learning environments and technical standards for learning objects. Electronic knowledge repositories are important for all learning platforms and contexts, including e-learning that occurs totally online, a blended learning model, and physical classrooms where technology supports face-to-face learning (Bonk & Graham, 2006). Best practice dictates that "e-learning enables accessible, relevant, and high-quality learning opportunities that improve student engagement and achievement" (Ministry of Education, n.d.), where technology supports effective pedagogy. The cloud supports a variety of ICT enabled learning opportunities by providing infrastructure to support learning systems, platforms, software, courses and learning activities and resources. As cloud use becomes accepted as part of normal teaching practice and ubiquitous technologies allow learning anywhere and at any time, educators explore pedagogical approaches that support the learner in this environment. These modern pedagogical approaches focus less on instructor direction, and more on the student at the centre of learning. The collaborative and co-creative opportunities offered by cloud technologies are fundamental to these approaches as part of constructivist and connectivist pedagogical paradigms.

The cloud also offers opportunity for educators to provide learning on a global scale. The globalization of education using cloud technologies also encourages awareness of culture, ways of learning and teaching, pedagogies and innovation (Khan, 2014). For example, the Microsoft Educator Community is a community of over 1.5 million educators worldwide who share and connect with each other and their students, empowering "*students and educators to create and share in entirely new ways, to teach and learn through exploration, to adapt to individual learning needs, so they can make, design, invent and build with technology"* (Microsoft, 2016). However, less developed countries often struggle with provision of learning due to national financial restraints leading to under developed infrastructure and lack of opportunity. It was this lack of opportunity in developing countries that spurred the Commonwealth of Learning (COL) to look at ways of encouraging the development and sharing of learning resources using available technologies (Schlicht, 2014). WikiEducator, based on the open-source software Mediawiki, was developed as a scalable system that educators world-wide could use for free to develop and share learning resources and objects. Recognising that 30% of the world population may never have access to the internet, Wikieducator developed a wiki to print feature, so content can be freely distributed to those without web access (Schlicht, 2014). Free courses on using WikiEducator have been available since 2008; these courses set the precedent for what is known as MOOCs (Massive Open Online Course).

The first official MOOC, was an online course called Connectivism and Connective Knowledge (CCK08) in 2008. Stephen Downes and George Siemens, both educators at Athabasca University, facilitated the course sharing their knowledge of Siemens (2005) Connectivism Theory and encouraging large scale collaboration and sharing amongst the participants. From this early, very open course, where anyone could participate for free and student knowledge formed part of the learning, other MOOC models have emerged. Called xMOOCs, these other MOOCs are offered from the likes of Stanford University and consist of highly automated learning, content and assessment. Engagement with a course facilitator and peer feedback are important (Chen, 2017), however there is often little opportunity for engagement, discussion and feedback in MOOCs. Accreditation is also difficult but can be sought and paid for by the course participants (Bates, 2014). The xMOOCs hosted within courseware provided by the Khan Academy, Udacity and Coursera make use of primarily cloud supported video content, reducing the load on institutional infrastructure and providing the flexibility necessary to support the demands of many participants (Ferdiana, 2015). Despite xMOOCs offering little in the way of shared, open or re-usable learning objects, they have continued to gain in popularity.

"Learning how to learn: Powerful mental tools to help you master tough subjects", offered by UC San Diego through the online courseware Coursera, has seen a total enrolment of 1192697 participants a big increase on the reported 2200 who participated in the CCK08 course in 2008 (Fini, 2009). Despite this popularity, the pedagogical effectiveness of the MOOC is also under question. The lack of personalized learning, opportunities for collaboration coupled with the high attrition rate calls to question the viability of the MOOC as a long-term solution to online education (Sonwalkar, 2013).

On a local scale, the cloud offers education providers platforms from which to deliver e-learning opportunities to their own students. Moodle, the open source learning management system offer MoodleCloud a hosting platform specifically designed for small users (Moodle, 2016) and ideal for a single course or small school. Google offers Google Classroom and Google Apps for Education (GAFE). Google Classroom is a classroom management system that connects the student with the teacher and allows collaborative work and progress tracking while GAFE is the cloud based system that integrates with Google Classroom and offers a "suite of free productivity tools to help students and teachers interact seamlessly and securely across devices" (Google, 2016). These services offer an integrative solution where the cost to educators is low in terms of resources and financial liability. These cloud services can be linked at little cost to existing self-hosted learning systems. As well as considering the cloud and its provision of learning environments and opportunities to learn, it has also given rise to repositories of learning objects, the content that makes up any learning, either as a singular entity or an entire course.

2.1. Learning object repositories

Cloud based systems have provided educators with learning object repositories where the content is easily accessed and be used within a chosen learning environment. These repositories are based on database driven systems that allow educators and students to contribute to the contained body of knowledge (Lehman, 2007). A learning object repository is described by IMS (2003, p.3) as *"A collection of educational resources that are accessible via a network without prior knowledge of the structure of the collection"* and by Lehman (2007) as *"electronic databases that accommodate a collection of small* *units of educational information that can be accessed for retrieval and use"* (p. 61). Examples of Learning Object (LO) repositories include Open Discover Space (www.opendiscoveryspace.eu), MERLOT (www.merlot.org) and OER Commons (www.oercommons.org). What also makes these repositories attractive to educators is the licensing agreements for use and re-use of content. Often published with creative commons licences by their creators, these objects are able to be shared freely, reused and built upon in a non-commercial (and sometimes commercial) manner (Creative Commons, 2016).

Other repositories of educational material are contained within wiki environments. Using the open-source software Mediawiki, these repositories offer a scalable solution for managing text and multimedia files. While the most well-known of these is Wikipedia (www.wikipedia.com), several others have been implemented purely with education in mind. Notably these are Wikiversity (www.wikiversity.com) offering educators a platform for developing and sharing open content, and WikiEducator (www.wikieducator.org) with its collaborative community of educators developing open content, offering training and support in the developing world (WikiEducator, 2016). Wikis are not only a platform for managing files, they also allow multiple authorship of pages, giving opportunity for collaborative development of LO's. The benefits for educators include the instantaneous page creation, ease of editing and revision and versioning control (Wikieducator, 2010).

2.2. Cloud supported pedagogies

The ease at which cloud based services integrate with existing learning and teaching, leads to questions about appropriate pedagogies, that is, how these services and related cloud based resources, activities and tools are being employed by educators within their teaching and learning practices. One of the key advantages to learning coming from the shift to cloud computing is the ability to collaborate and co-create. Collaboration and co-creation is a fundamental aspect of the constructivist paradigm where learners learn through their interactions with others and apply joint knowledge to problem solving (Tam, 2000). The sub-set of cloud technologies that allow networking, sharing and user created content is referred to as Web 2.0 and pedagogically reflects the principles of a social constructivism (Cochrane, 2012). Web 2.0 tools such as those offered by the GAFE suit, make social constructivist activities easy to deploy and engage with. User created content can be shared for viewing and/or editing by an unlimited number of learners. Siemens (2005) connectivism learning theory is also heavily reliant on the sharing capabilities of the cloud, where learning occurs "*within nebulous environments of shifting core element - not entirely under the control of the individual*" and is driven by the ability to recognise what information is vital, what is unimportant and to recognise when the landscape of learning has changed (Siemens, 2005). Social networking tools have been used to encourage social constructivism, linking people and ideas and crossing the boundaries of online/offline and visual/verbal connections (McLoughlin & Lee, 2007) as users link their real world with the virtual. The affordances of sharing, collaboration and connectivity give the learner a degree of control over the learning process as an example of a personalized student-centred learning pedagogy. However, sifting through the many available web tools to find what is relevant to a learning context becomes a key learning and teaching skills needed by both the educator and student.

2.3. SCORM

Cloud based resources; webpages, video and documents are easily integrated into learning systems. They can be simply linked to or embedded by way of iframe, gadget or widget. Less easily integrated are the learning objects that rely on student interaction within the object, particularly when the student journey through the learning needs to be recorded.

The Shareable Content Object Reference Model (SCORM) provides a technical standard that allows e-learning content within a learning object to communicate with a learning management system or other platform or service (Bohl, Schellhase, Sengler, & Winand, 2002). It is the *"defacto industry standard for e-learning interoperability"* (Rustici Software, 2016). Setting the standard determines how the content is delivered in the physical, what it will look like and how it communicates with the LMS, that is; what data can be passed between the two. SCORM set the standards for e-learning early on and has since evolved into the Tin Can API (or sometimes called xAPI), which enables collections of data across a range of user activity within an e-learning system, either online or offline (LearnUpon, 2016). ScormCloud, www.scorm.com, is an online service that allows SCORM or Tin Can API compliant e-learning objects or courses to be published and have that content available to students across a variety of learning management systems, wikis, blogs and websites (Rustici Software, 2016). Learner interaction reporting such as completion and success status, duration and overall score or grade is also available and integrated into the range of supported systems. This means that a single learning object can be used across a variety of systems (Bohl, Schellhase, Sengler, & Winand, 2002) making it available however and whenever it is required, with each deployment having its own measures and user tracking ability. e-Learning that complies to the SCORM standards offers very structured, sequenced and measurable learning opportunities. To provide learners with collaborative and co-creation opportunities inherent in the connectivist and constructivist paradigms, supporting technologies can be integrated into the SCORM learning package. This encourages learner centric activities, while still providing the boundaries, guidance and framework from the course material. This combination ensures the learner stays true to their learning pathway, particularly in the case of a formal learning situation. Failure to provide the boundaries, may mean the learner becomes lost in the shifting nebulous environment described by Siemens (2005).

2.4. Issues

Although the cloud offers a range of services, its use is not without issues that can affect the provision of learning. These issues fall under the broad headings of: currency, viability, control and ownership.

Firstly, there is the issue currency of information. Learners and educators require the skills to evaluate any information to discern how up to date it is. A study by Walraven, Brand-Gruwel, and Boshuizen (2009) found that in general, students lack the critical attitude towards evaluating information found on the web, although they were aware that not all information on the web was reliable or up to date. As the web continues to grow, the ability to filter information and find that which is most relevant becomes a necessary skill. On the positive side however, is the currency of most web-based software and infrastructure. Corporations such as Google and Microsoft regularly update their web-based systems and software, giving learners the latest versions of the tools they need, others however change their service provision from free to paid, others no longer offer their services.

The lack of control an educator or learner has is emphasized by changes in service provision. Sometimes change happens quickly, leaving educators without the tools to provide a student activity. For example, an online presentation tool that used to be free to use, may become a paid model by the start of or during a semester. The changes to the service provision meant a rethink of the long-term viability of using that tool or system for learning and emphasizes the lack of control a learner or educator has over the cloud. Educator control is also lost once learning moves beyond the realm of an institutional LMS and learners have greater freedom over their learning environments (Franklin & van Harmelen, 2007), however this freedom is the backbone of student-centred learning as part of the current digital pedagogies (Richardson, 2008). The issues of ownership can also be a barrier to use. Although the philosophy of the OER movement is the sharing, re-use and re-purposing of learning, there is no indication that this is the philosophy of all education based cloud users, and there are institutional policies regarding intellectual property and ownership of material generated by their educators (Franklin & van Harmelen, 2007).

2.5. The future

The future is unclear, but the impact of cloud technologies on education will increase, much as it has for any business. Growth is expected, as according to IDG Enterprise (2015), 72% of organisations have at least one application in the cloud and the remaining are investigating how the cloud can be used. The New Media Consortium (NMC) describe some cloud influenced changes on the provision and delivery of education, referring to it as "Education-as-a-service (EaaS)" where students can pick and choose their learning depending on their needs (Johnson, Adams Becker, Cummins, Estrada, Freeman, & Hall, 2016). NMC also refer to the growing demand for measured learning, that is data mining and learning analytics to measure student actions and progress. Although SCORM and its derivatives, Tin Can API/xAPI offer a degree of analytics, there is little functionality to provide personalization of learning and deeper insights (Johnson et al., 2016). Web Courseworks (2015) provide a hype cycle of e-learning (Fig. 1), and this shows Tin Can API/xAPI and MOOCs heading into the trough of disillusionment as interest wanes, but predicts that with backing these will move quickly into productivity and business as usual.

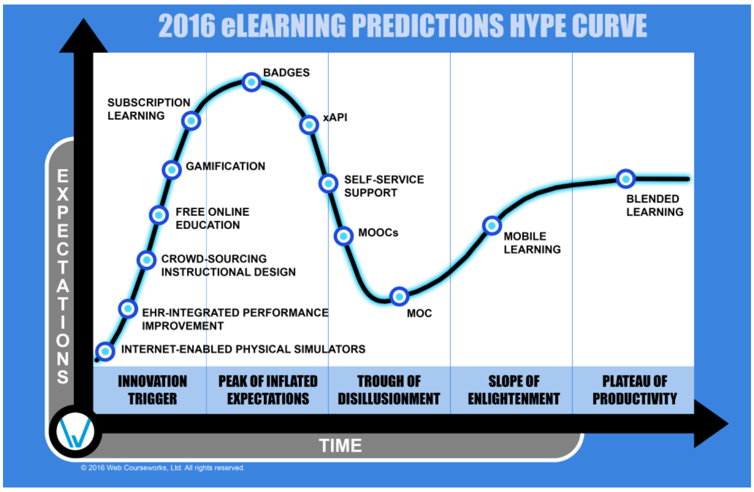

Fig. 1. 2016 eLearning predictions hype curve. Adapted from Web Courseworks (2015).

Traditional self-hosted learning environments such as the institutional LMS are increasingly being integrated with the cloud based service models, thereby extending the capability of the learning environment, use of software, storage and provision of learning objects. Large scale learning opportunities are being offered that are free, accessible and open. MOOCs, despite their large attrition and often poor engagement, opportunities are continuing to grow and will soon enter into mainstream acceptance and business as usual. On a smaller scale, educators can take advantage of a cloud hosted LMS to offer courses to small numbers of learners.

The OER movement continues to grow, with a multitude of learning object repositories that encourage contribution, sharing and re-purposing of their content by both learner and educator (Sampson & Zervas, 2013). On the other hand, some of the content on the internet may be exposed to lack of ownership, and being at odds with intellectual property policies (Erturk, 2013). Loss of control may also be experienced when service provision interferes with planned collaborative learning opportunities. Educators often refine the way they teach as they experience cloud supported learning and interruptions to service provide a level of distrust that can interfere with future adoption and use.

The ability to offer learner personalization and analytics of learning is seen as the way of the future. Existing e-learning standards such as SCORM, Tin Can ApI/xAPI are seen to provide some of what is required, but further development in these areas are needed before these standards become business as usual. Educational use of the cloud continues to grow, and it can be considered as a maturing model of learning as services, pedagogies, personalization and standardization of learning are refined and adopted as part of the norm.

3. Methodology

This study adopted an exploratory case study methodology where a contemporary phenomenon is investigated within its real-life context (Yin, 2003). The researcher designed and deployed a learning object which was then used as part of an online teaching and learning session. This enabled full exploration of the range of events, problems and successes experienced during the creation and deployment of the learning object in this context. Evidence is gained through the documentation of processes, observation of events and participation in the teaching session. The teaching session was recorded for future reference. Fig. 2 provides the conceptual framework and process requirements for the study.

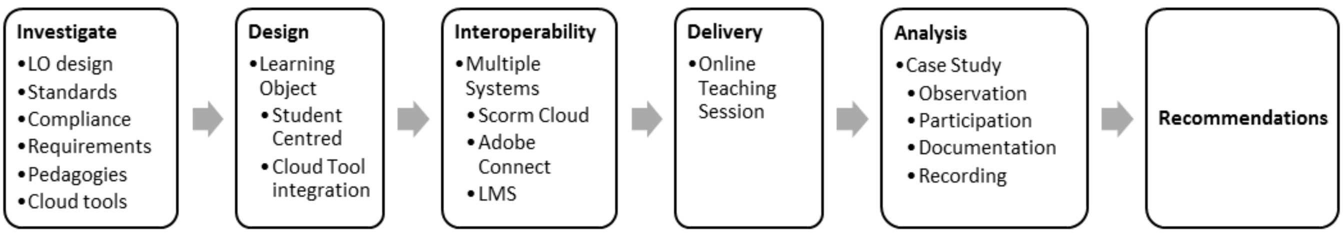

Fig. 2. Process requirements framework

4. Case study background

At the Eastern Institute of Technology, students studying in the Bachelor of Computing Systems (BCS) degree have the opportunity to take a course in Digital Learning Technologies (DLT). This course is delivered at both the Taradale (main campus) and the Auckland remote campus. The DLT course aims to provide students with core knowledge and practical experience in using digital learning technologies so they may apply this in an educational or training environment. As part of this course, students learn about online pedagogies, learning design, and how technology can be used to support both. Students are then required to develop a learning object that demonstrates the integration of pedagogy, learning design and technology as part of the course assessment.

One of the authors of this paper (based in the main campus) was invited as a guest lecturer for the remote campus students and to talk about online pedagogies and learning design. As the lecture was to be delivered remotely, communication was facilitated by using the Adobe Connect web conferencing system. The guest lecturer was able to utilise a SCORM based learning object to provide the remote students with activities to complete as part of their learning. The object not only provided students with activities, but also demonstrated how different technologies could be integrated into a learning package. The Adobe Connect reporting facility and the online activity features were then used to monitor student participation and offer feedback.

The use of Adobe Connect was unique to this context, however there are other ways to deploy SCORM content. As an alternative, SCORM Cloud was also used as an option so comparisons of the various features could be made for this case study.

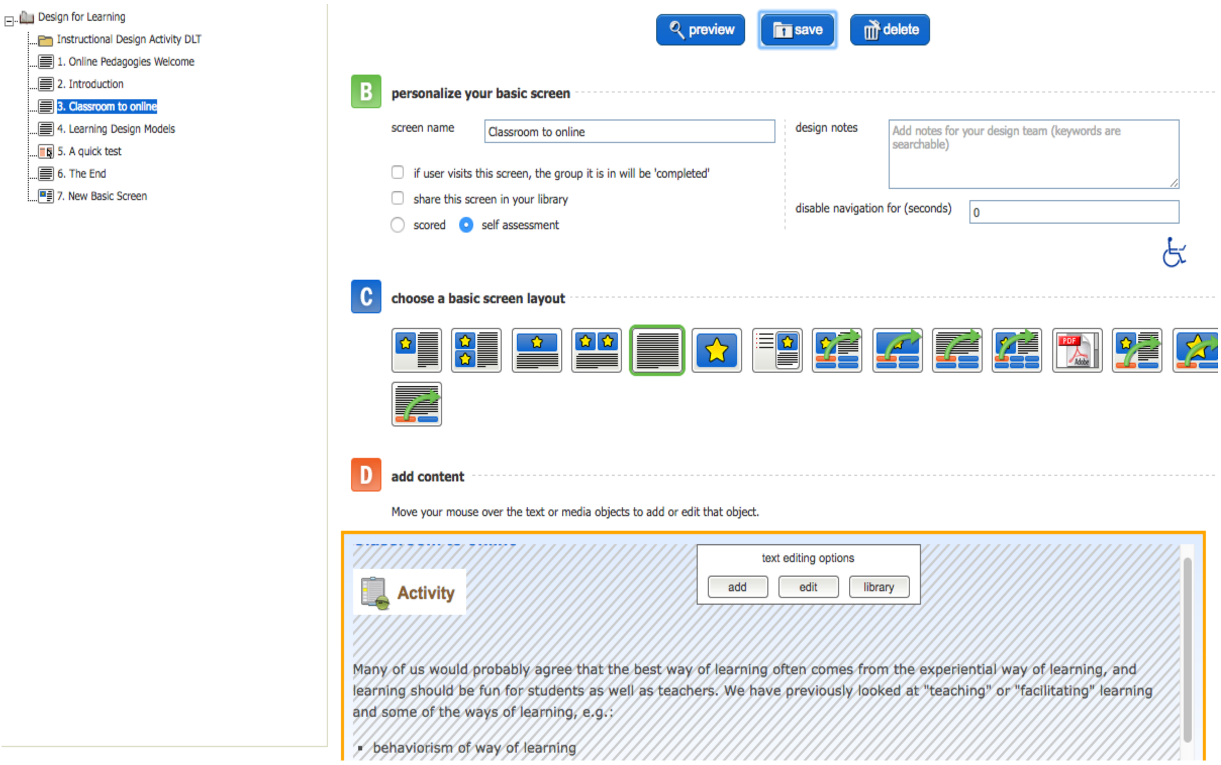

Fig. 3. UDUTU authoring interface

4.1. Learning object

The learning object was designed to provide learning content and activities aligned to three learning objectives within the DLT course. On completion of the learning object, students would have the knowledge and understanding of both pedagogical approaches and technological implication to prepare their own learning object as part of an assessed activity.

The learning object was created using the cloud tool UDUTU. UDUTU is an online and free course creator tool that allows designers with no programming skills to produce media rich and engaging online courses (UDUTU, 2015). The service is free, comes with pre-designed templates and can be exported in a SCORM compliant format for use in an LMS or another platform that supports the SCORM standard. UDUTU courses/learning objects are developed in a workspace where pages can be added following a template then customised to suit the course content. Interactive media and other cloud based tools can be integrated as required (see Fig. 3).

A variety of assessment items can be embedded in a course page, including; multi-choice quizzes, drag and drop activities, picture and word matching, and look, hear, read and talk activities.

The first content page included the introduction to the learning object and a brainstorm activity (see Fig. 4).

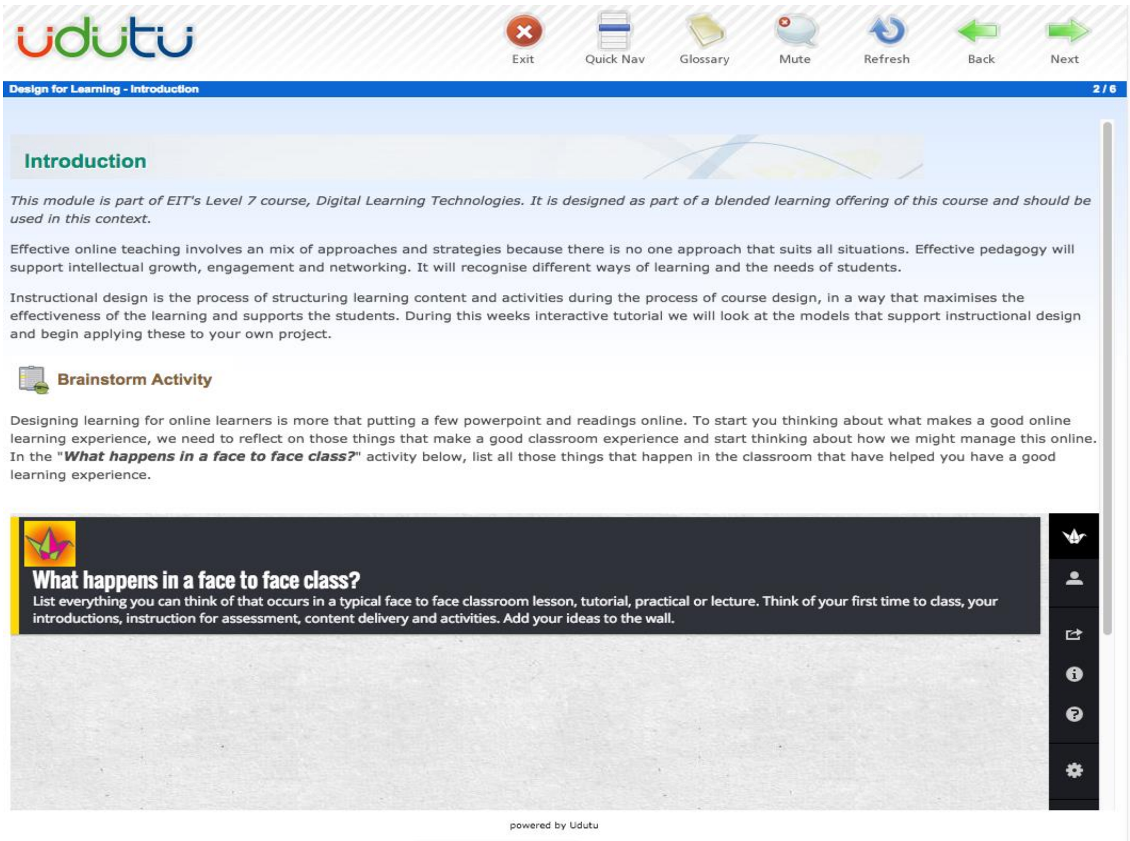

Fig. 4. First content page of the learning object

The brainstorm activity was created in Padlet, a free brainstorming cloud tool. This tool allows users to click onto the 'wall' and add post-it note type content to the page. On completion of this activity students and the lecturer can use the notes as a basis for discussion and reflection.

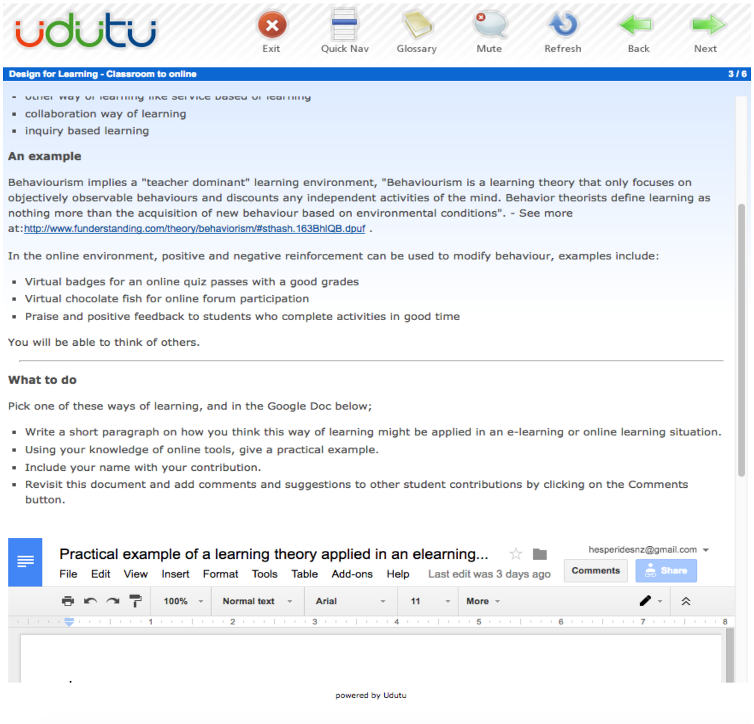

Fig. 5. Collaborative inquiry activity

Page 3 of the learning object included a pre-knowledge reading section, followed by a collaborative group activity created in Google Docs (see Fig. 5). This activity requires small groups to use the internet to research a teaching pedagogy and describe how the pedagogy could be supported using a tool with which they were familiar. An example is given to start the thinking process.

Page 4 included a review of learning design models and a short YouTube clip for the students to view (see Fig. 6).

The last page demonstrated a small inbuilt quiz (see Fig. 7), where the students are required to put the stages of the ADDIE instructional design model in order. The purpose in this case was not to test the student knowledge, but to demonstrate a fully formed learning object used in the context of an educational setting.

On completion of the Learning Object, UDUTU offers an export facility where it can be downloaded in SCORM compliant format for use in other systems. For this case study, the object was exported and deployed in two discreet systems; Adobe Connect and SCORM Cloud.

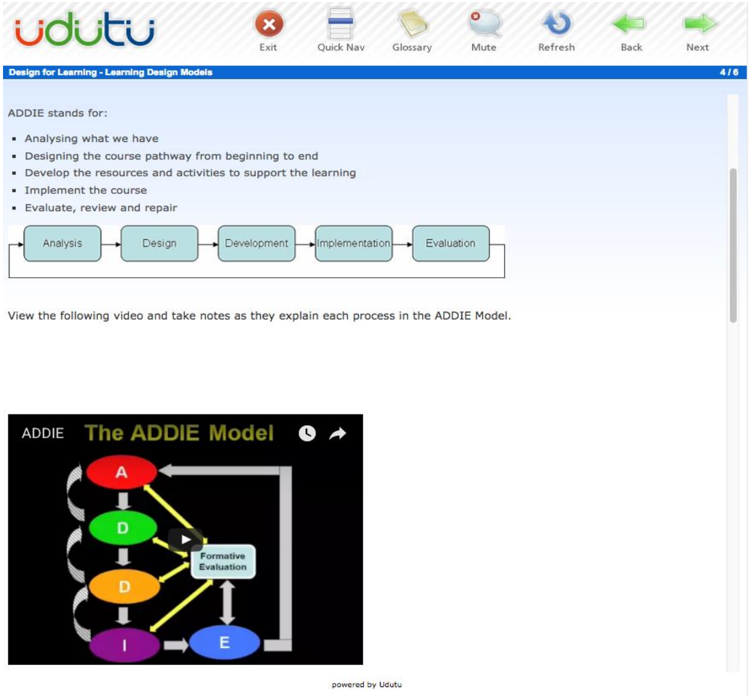

Fig. 6. Page four of the learning object, including video

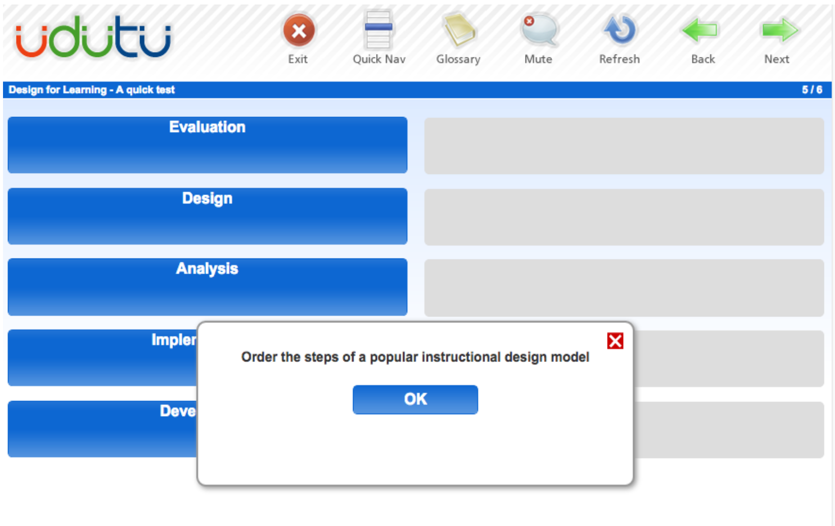

Fig. 7. Short quiz

4.2. Adobe Connect

Adobe Connect is a fully featured web conferencing system. It can deploy SCORM content packages uploaded to it, and track any assessments included in the package.

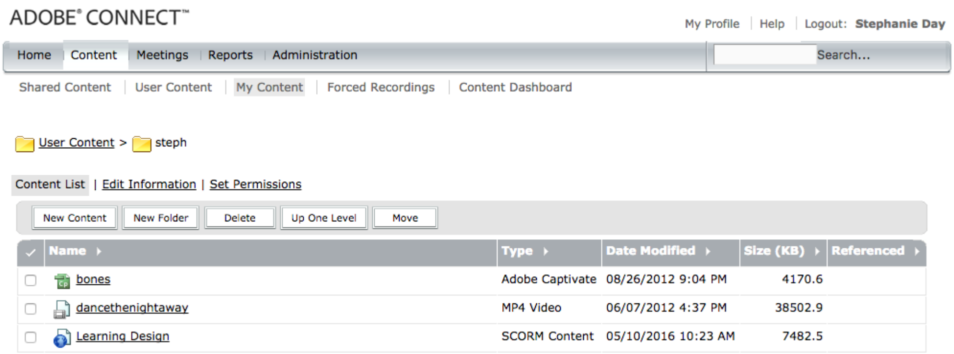

Fig. 8. Adobe Connect content area

The SCORM content is uploaded into the user content area (see Fig. 8 above) and the link is provided to students. Reporting in Adobe Connect only gives totals of completion and results (correct vs. incorrect), rather than individual results.

The learning object deployed in Adobe Connect was used by the remote campus Digital Learning Technologies students during the guest lecture session. The Adobe Connect host (teacher) remotely launched the learning object in each student's browser using the systems 'Browse to URL' feature. Students then worked their way through the learning object and the teacher followed progress by viewing the 'live' activity in Padlet and Google Docs. Fig. 9 shows a screenshot of the session in progress and the learning object being shared. The learning object can be viewed at http://eitconnect.eit.ac.nz/ld.

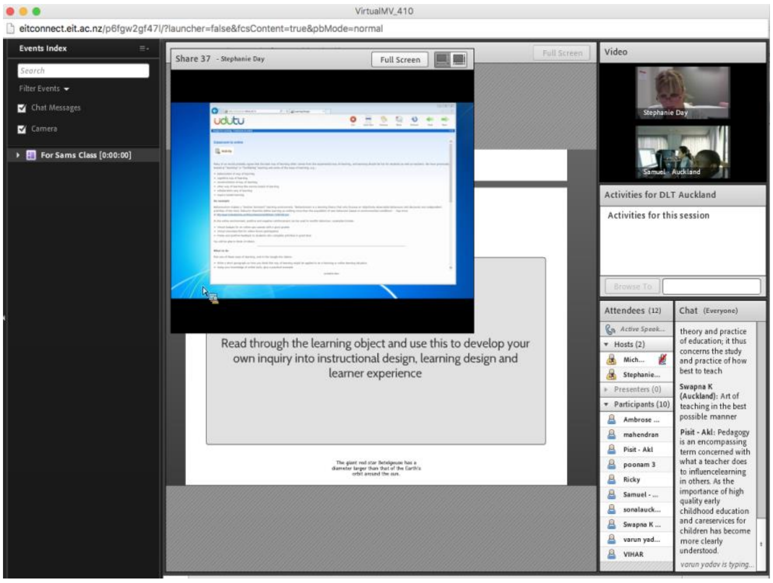

Fig. 9. Learning object being used by the remote DLT students

4.3. SCORM Cloud

SCORM Cloud is an online system that enables SCORM content to be distributed to learners. Unlike the limitations of Adobe Connect, SCORM Cloud has a fully featured learner tracking system as the distributed URL invitations are unique to each learner. SCORM Cloud offers a limited trial account to test features and deploy content to a limited number of learners. SCORM content is stored in a library and learners can be invited using their email address (see Fig. 10).

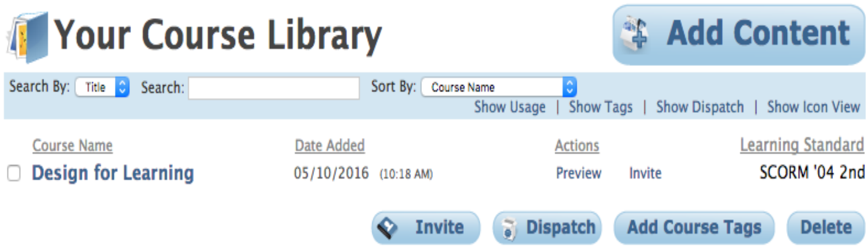

Fig. 10. Courses in SCORM Cloud

SCORM Cloud tracks individual user progress within the learning object and provides comprehensive reportage data (see Fig. 11).

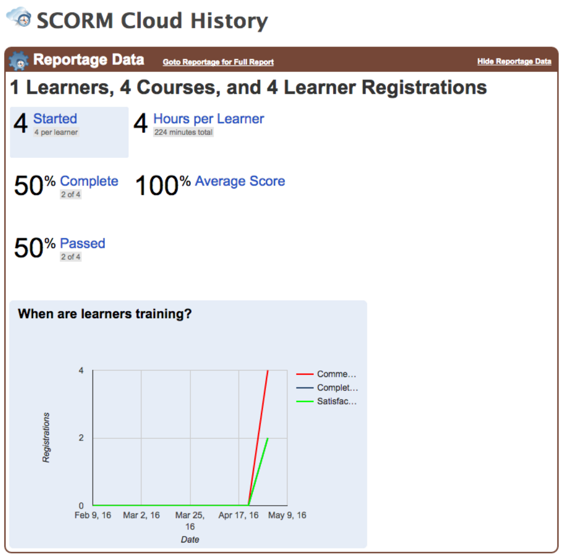

Fig. 11. SCORM Cloud reportage data

Results are also presented back to the learner at the end of progression through the learning object (see Fig. 12).

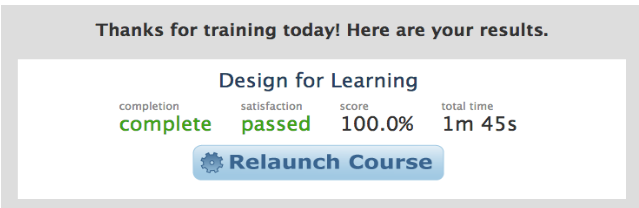

Fig. 12. Learner results

5. Case study discussion and analysis

This case demonstrates the use of cloud based tools to prepare a learning object for use in online or blended learning situations. The UDUTU course creation software was used to create a learning object with SCORM compliance enabling integration with wide variety of platforms or learning situations. The learning object included cloud tools that encouraged collaboration and sharing, and was deployed to students using the Adobe Connect Webinar technology and tested independently in SCORM Cloud.

5.1. Learning object deployment

The use of the SCORM standard included with UDUTU provided the ability to port the learning object from one system to another while maintaining its feedback and tracking functionality. The advantage is providing learning using these compliant standards is addressed in the interoperability, reusability, durability and accessibility capabilities (Advanced Distributed Learning, 2015). When the SCORM learning object is hosted in the cloud, these advantages are multiplied as only one instance of the learning object is needed across the variety of systems, no porting or duplication required. This type of deployment would be useful when learning is occurring in shared environments outside the control of traditional learning management systems. Examples include Massive Open Online Courses (MOOCs) and Open Educational Resource (OER) learning. The one learning object can be used independently in face-to-face, online or blended learning teaching approaches while maintaining student records of progress if required. Integrating collaborative activities in cloud tools such as Google Docs and Padlet ensures alignment with student centred pedagogical approaches.

Deploying the SCORM based learning object in the institutionally hosted enterprise environment of Adobe Connect was straightforward process. The learning object was easily accessed and easily used by the participating students. However, as the lesson in this case study progressed, it became apparent that working through a learning object in this blended environment took a lot longer than planned. This was caused by the nature of the working environment, lack of immediacy with the learners and the learners had English as a second language (in most cases). In future, the use of a learning object may be better served as a homework item, or as part of a flipped classroom model, where completion of the learning occurs before or after the synchronous event. It would also serve well embedded into an online course where Adobe Connect is used as a communication channel for class discussion and review rather than a teaching channel.

Deploying the learning object from the SCORM Cloud environment was more successful from a teacher point of view. Each student gets a unique referral URL via email; therefore, the learning can be tracked on an individual basis. There is no integration with synchronous technologies so each course or learning object is completed in the student's own time and the teacher can view progress by way of the teacher dashboard. The student also sees their own completion status and can revisit the learning object at any time. SCORM Cloud would be an ideal solution for small e-learning based training programs and one-off learning objects.

5.2. Advantages and disadvantages

Cloud deployed learning objects offer a variety of advantages over the traditional learning available in learning management systems. Platforms such as SCORM Cloud allow learning objects to be shared across a range of systems and the SCORM Cloud API enables student tracking outside the SCORM Cloud environment within supported systems such as Facebook and WordPress. These alternative systems may have appeal when fully featured learning management systems are deemed unwarranted, or where learning is provided in an informal or ad hoc manner. Other cloud tools are easily integrated into the learning object and these are not limited to the ones demonstrated in this case study. A suggested framework for use of a cloud based SCORM learning object is shown in Fig. 13.

The disadvantages of using a learning object compiled into a SCORM compliant package is that like any compiled package, editing cannot be achieved as easily. This presents a lack of immediate flexibility when updating the learning object. However, if the package is cloud based, editing needs only be done once, and the changes will be reflected everywhere the learning object is being used.

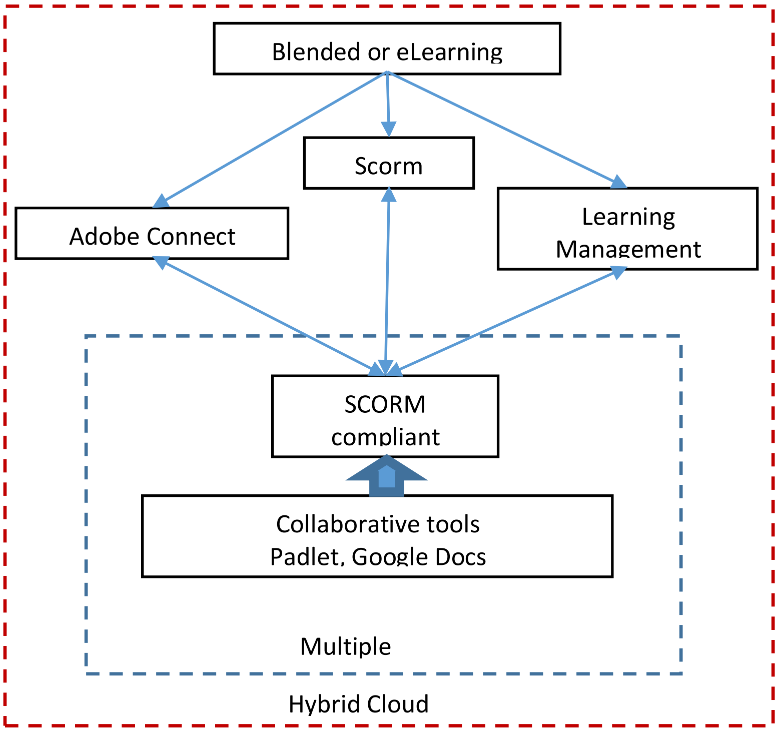

Fig. 13. Framework for a cloud based SCORM learning object deployment

6. Conclusion and recommendations

This case study investigated the use of a SCORM compliant e-learning object deployed in two alternative manners. By using cloud tools for both the design and development of the object, as well as providing the learning objects to students in an authentic context, several conclusions can be drawn, and recommendations can be made.

Cloud based SCORM compliant e-learning packages can enable a range of pedagogical approaches to learning and teaching. SCORM based e-learning editing tools such as UDUTU, allow an integrative approach to designing learning, where other cloud tools can be included to support collaborative and constructivist teaching approaches. The linear approach to preparing the learning package ensures opportunity to include resources that support student learning in a structured environment while also providing the freedom to embed these other activities within the learning. The SCORM features ensure student participation, progress and completion can be tracked and reported back to the teacher and learner. One SCORM compliant package can be used over multiple systems. While updating a compiled package cannot be done in the moment, any changes are reflected over all the systems involved once they are completed.

It is recommended that SCORM e-learning packages be used as part of blended or online learning scenarios, as the advantages include the ability for students to work through the material in their own time, while giving teachers tracking and monitoring abilities. The e-learning packages are easily ported between systems, contributing to the OER movement. It is not recommended that SCORM based e-learning take the place of traditional LMS in formal educational settings, but rather supplement it and enable alternative approaches to learning.

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