Title: Developing an eLearning object library: a user centred approach

Abstract: Information and communication technologies (ICT) have developed rapidly, bringing many benefits as well as opportunities for e-Learning systems. Identifying how best to develop these systems for future requirements is informed by our research and practice using current systems. Interactivity has been identified as one effective method of attracting and retaining students studying online in Australian universities. While there has been an increase in learning technologies, the standard Learning Management System software, however, does not include many in-built interactive learning design options. Thus, this project aimed to research, design and build a friendly and efficient, interactive eLearning object repository using Articulate Storyline. A user centred development methodology was implemented to understand academic and student preferences for a range of different interactive learning objects sourced online. Five participants (three academics and two students) completed a modified usability test to determine software requirements. There were two important findings in this research: the interactive activities do academics want to extend their eLearning course materials and the interactive activities do students want to make their eLearning course materials more interesting. Analysis of the user research showed that academic users found interactive learning objects that require a click and think approach more useful than a click and read approach. Using data from this user research, a total of five learning objects were built using an iterative agile development process that involved ongoing feedback from users. Two variations of click and think interactions were built: a drag and drop interaction; and a branching scenario interaction. Because students also expressed a strong interest in click and read interactions, three variations of the tabs interactions were built for academics to use.

Keywords: eLearning, reusable learning objects, user centred research, user centred design
Developing an eLearning object library: a user centred approach

Introduction

According to the 2013 Charles Darwin University (CDU) annual report, more than 90% of higher education units at the university were available in the CDU’s Learning Management Systems (LMS), Learnline [ref]. Recently, Raspopovic et al. (2016) affirmed what is well known in education – information and communication technology (ICT) has developed rapidly bringing many benefits as well as opportunities for e-Learning systems. However, deeper analysis reveals that while there has been an increase in the sophistication of learning technologies, the standard LMS software that has played a pivotal role in online learning for two decades does not include many built-in interactive learning design options. Cavus and Alhih (2014) consider LMS useful applications for learning and teaching online because they support users in accessing online course materials, manage teaching resources, monitor or test students as well as communicate between course providers and students. One LMS popular in universities in Australia is Blackboard. Blackboard allows lecturers to upload course materials, distribute documents, email, collect assignments, discuss and manage grades (Stony Brook University, 2015). While Blackboard has many advantages for university teaching, there are some limitations surrounding interactive lessons. For example, a lecturer may upload files or share links via Blackboard with students and provide both real time and asynchronous discussion opportunities but it does not support tools to create interactive lessons. This seems to be an anomaly given that the early years of hypermedia innovation in the 1990s focused on the power of self-directed interactivity.

Recent software developed for interactive eLearning is Articulate Storyline. This software assists users build their own online courses quickly by using existing templates, storyboarding, animation, multimedia support, character templates, and a range of other advanced editing features (Articulate Global, 2016).

This paper reports on a project that aimed to provide more interactive learning design options for students by using user-centred research methodologies and Articulate Storyline to create a series of interactive learning objects for academics to include in their learning designs. Interactive eLearning objects were developed using Articulate Storyline and submitted to a library of interactive learning objects so that academics exploring its capability could be further scaffolded. A Reusable Learning Object Repository (RLOR) was therefore created to enable lecturers to easily create online lessons.
and support student learning experiences through embedding these learning objects in their CDU Blackboard site.

The user-centred approach used in this project had two parts, focused on planning and development.

**Part A: Planning, Requirements Analysis** included:

i) Analysing current research about Reusable Learning Objects (RLO) and various user-centred research methodologies;  
ii) Preparing a user-centred research methodology to understand stakeholder requirements;  
iii) Conducting user-centred research with academics and students through a modified usability test methodology; and  
iv) Analysing the research conducted to inform the design of interactive learning objects and develop a prioritized list of work.

**Part B: Software Design, Development, Testing and Delivery** included:

i) Iteratively designing and building interactive prototypes;  
ii) Seeking feedback on the interactive activities and finalising the learning objects; and  
iii) Reusable eLearning Object Repositories Release.

An overview of the project activities and development process to be used are summarized in the diagram below (see Figure 1):
Figure 1 explains the process in which the learning objects are created for CDU academics. Overall, there are eight stages in the process: analysing current research, preparing an appropriate user centred research methodology, deciding how the usability testing methodology will be modified for this purpose, finding the learning objects samples for users to explore, conducting usability tests to inform design of interactive learning objects, creating requirements report and designing the prototypes, seeking feedback and finalising the eLearning objects.

**Project aim**

The primary goal of this project was to build the RLO by using a User Centred Research (UCR) approach. UCR is useful in identifying and understanding the requirements of academic staff who want more interactive tools to create interesting online lessons for students; it also helps to identify student expectations about the interactive lessons in the future. From this user-centred research, a library of generic eLearning objects was built using Articulate Storyline. User research in the first
phase of this development process was used to determine the needs of users (academics and students). To do this, the following questions were explored:

1. What is User Centred Research and why is it important in this project?
2. What methods of User Centred Research can be used in this project?
3. What do users believe are interesting eLearning objects?
   a. What interactive activities do academics want to extend their eLearning course materials?
   b. What interactive activities do students want to make their eLearning course materials more interesting?

Based on the findings of this user research, the library of interactive eLearning objects was developed. In the second part, throughout the development process, there was a need for ongoing usability testing with volunteer participants to ensure that the software was useful in achieving appropriate goals.

The motivation for pursuing this research was driven by several perceived benefits. Firstly, the reusable learning objects could be integrated into Learnline saving time and resources when lecturers are developing and maintaining their online materials. Secondly, the reusable learning objects provide CDU students with an option to self-assess their skills and knowledge utilising multiple delivery types, media types, and presentation styles to fit with student needs. Finally, this research should inform CDU in how to reduce the costs for development and maintenance time by using such a library of learning objects.
**Project Scope**

This project collected data from three academics and two Information Technology students in order to understand what they expected for an interactive learning object. Three learning object templates were created by using *Articulate Storyline* according to participant requirements. The modified usability tests were conducted with only six users (three academics and three students) making it impossible to generalise.

**Reviewing the Literature**

To conduct this project, it was important to develop a foundation understanding of some of the key concepts (i.e. user centred research processes) as well as understand current information concerning eLearning and reusable learning objects. To do this, a modified systematic quantitative literature review was conducted. According to Fakis et al. (2013), a systematic quantitative literature review involves finding high-quality information that addresses a research problem. Usually these authors *(op cit)* argue, in a systematic review it is necessary to explain what databases have been searched, what keywords have been used to search and how to include or exclude the previous results. Kitchenham (2007, p. 3) writes that a systematic literature review is a method used to focus on “identifying, evaluating and integrating all previous resources related to the research questions or study or phenomenon of interest”. Kitchenham further describes the benefits of systematic literature reviews: these reviews summarise the benefits as well as limitations of the previous research; suggest areas for further investigation based on the gaps between old and new research; and provide a framework for new research activities. According to Lavallee et al. (2014), searching relevant research, compiling the results, analysing the major information and synthesizing the state of the knowledge are extremely important when performing a systematic literature review effectively. However, systematic literature reviews need significantly more effort than the traditional literature reviews that is a major disadvantage of this approach (Kitchenham, 2007). Lavallee et al. (2014) suggest that the process of systematic literature reviews should be defined in eight steps: review planning, question formulation, search strategy, selection on process, strength of the evidences, analysis, synthesis and process monitoring.

This project used a modified systematic literature review to understand the current practices in developing reusable learning object repositories. Three major questions were explored: what are reusable eLearning object repositories, how can a user centred development approach be used to
develop a repository, how can Articulate Storyline help to create interactive lessons? Using these three questions, this literature review sourced articles from the IEEE (Institute of Electrical and Electronics Engineers) and EBSCO-Host databases because both these digital libraries are powerful resources for research and discovery. Each database was searched using keywords such as “reusable eLearning”, “interactive learning object”, “user centred research”, “user centred design”. Academic resources included in the review were limited to articles published in the English language published between the years 2000-2016. Table 1 shows the results of the literature search and selection. Results from the literature review will be discussed in the following sections.

<table>
<thead>
<tr>
<th>Keywords</th>
<th>Academic sources</th>
<th>Professional sources</th>
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<tbody>
<tr>
<td>Reusable eLearning object repositories:</td>
<td>21 sources (includes books, academics articles, journals, and conferences)</td>
<td>11 sources (Technical websites, Online News, and University websites)</td>
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<tr>
<td>“learning objects”; “learning object repositories”</td>
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<td>User centred development approach:</td>
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<td>“user centred design”; “definition of user centred design”; “advantages of using user centred design”</td>
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<td>Articulate storyline Software:</td>
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<td>“How Articulate storyline is using”; “Articulate storyline and lecturer”</td>
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Table 1: Summary of distinguishing elements of learning objects

Learning Objects, Learning Object Repositories and limitations

What is a Reusable Learning Object?

Wayne Hodgins in 1994 coined the term Learning Object when he was involved in working out a solution for learning architectures (Pithamber, 2003). According to the University of Nottingham (2016), reusable learning objects are small multimedia web-based objects which contain a single learning objective which support to add content to predetermined templates without any specialised technical expertise. Kay and Knaack (2007, p. 6) define learning objects as “interactive web- based tools that support the learning of specific concepts by enhancing, amplifying, and guiding the cognitive processes of learners” while Wiley (as cited in Lehman, 2000) mentioned that with the purpose of creating the manipulate lessons for online learning, the eLearning objects are designed by an interactive mediated presentation. In addition, there are other suggests that the eLearning objects are designed by an interactive mediated presentation. Similarly, Lazar et al. (2010) found that eLearning objects are curriculum units made smaller and shared in many ways for customization and use by individual learners: they are any digital resource that can be inherited and reused to support learning and used in multiple contexts. In addition, Churchill, (2005) suggests that eLearning objects can be conceptual models, information objects, presentation objects, practice objects; simulation
objects. Alanazi and Abood (2014) describe some different types of learning object examples: electronic text, graphics and pictures, video, templates, sound files, flash files, dynamic maps, quizzes, open source material, past exam papers. Learning objects allow students to learn independently; to experiment with various decisions, make mistakes and repeat what they have learned (Devine et al, 2015). The table below summarises the opinions, ideas, and major contexts of learning objects from the previous researches (see Table 2).

The important factors of an interactive eLearning object were described above which was very useful in developing. The learning objects would create should be reusable, easy to modify, not limited in any specific unit, it could be a small multimedia web-based contain smooth transition. The conceptual information (text, label, heading front size, and colour) in learning object should be well structured and they should be modularised into small units of instruction.

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<td>Reusable</td>
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<td>customised</td>
<td>Information objects</td>
<td>pictures, video</td>
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<td>Chunks</td>
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<td>Curriculum units</td>
<td>Practical objects</td>
<td>templates, send files,</td>
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<td>made smaller</td>
<td>Simulation objects</td>
<td>Flash files, dynamic</td>
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<td>Interactive web</td>
<td>Inter active web-</td>
<td>Conceptual models</td>
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<td>maps, quizzes</td>
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<td>Low level</td>
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<td>Information objects</td>
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<tr>
<td>Develop discipline</td>
<td>Learn concepts</td>
<td>Practical objects</td>
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Table 2: Learning object publishing models

Learning Object Repositories

According to the Lone Star College (2016), a Learning Object Repository is a library used for storing, managing, and sharing the learning material, including quizzes, presentations, images, and video, or any other kind of document for online learning. Cervone (2012) argues that “learning objects require an intuitive organization of materials using various discovery approaches such as keywords,
topic/subject, educational level, type of resource (online tutorial, assignment, animation, quiz, etc.) as well as format (PDF, PowerPoint, jpg, Flash animation, etc)” (p.15). Cervone (2012) claims that a learning object is essentially a measure of potential reusability and the three most commonly used learning object repository software includes Digital Open Object Repository (DOOR), Ariadne and Rhaptos. DOOR software uses a hierarchical object model which can be integrated with the Moodle learning management system; Ariadne is a system for learning objects by providing interface for both Moodle and Blackboard; while Rhaptos is one of the largest learning object libraries which helps to create, use, modify and review learning object. Specially, in the USA, there are two popular learning repositories: Multimedia Education Resource for Learning and Online Teaching (MERLOT) and National Science Digital Library (NSDL) (Chen et al., 2015). In terms of implementing learning object repositories, Cervone (2012, p.16) identifies a range of issues including: long-term storage, use of learning objects, development and implementation of learning object repositories suggesting that when “learning object repositories are integrated into learning management systems but often that integration comes at the expense of long-term flexibility”.

The research reviewed above indicates that in order to share, manage and use a learning object, it was necessary to focus on how learning objects would be stored and maintained (Cervone, 2012). In this project, after the learning objects are created they could be managed and shared in the learning content management system. To do this, the learning objects would be published as HTML-5 files and embedded in CDU Learnline. Other options include giving external links for students through the learning management system, or storing the learning objects in DOOR, MERLOT or Ariadne tools.

**Learning Object implementation considerations**

Cervone (2012) argues that learning objects should be developed using popularly accepted information technologies and standard formats that make object reuse simpler. In particular, this will help user’s access to content across a wide variety of hardware platforms (iOS, Android). However, there is a limited technology support when using learning object repositories on some devices. Raspopovic et al., (2016) explain that “not every Learning Management System supports implementation and presentation of learning materials through a series of Learning Objects” (p.2). For example, most current learning objects need a flash player to run (Instancy, 2016). Consequently, Flash learning object content is unusable to the population of users because of hardware platform. In addition, Flash technology is no longer supported by many browsers (Woollaston, 2015).

Another method for building interactive objects is using HTML-5 Mark-up language which includes a set of technologies which allow more diverse and effective web sites as well as application with
new elements, attributes and behaviours; therefore, HTML 5 could be an effective solution to perform learning objects widely (Mozilla Developer Network, 2015). Furthermore, the other disadvantage is that “not every LMS supports implementation and presentation of learning materials through a series of LOs” (Raspopovic et al., 2016). In this project, learning objects were built by Articulated Storyline software, so there were four methods to delivery learning objects to students. The Table 3 summarises four effective methods to publish the learning objects.

<table>
<thead>
<tr>
<th>Publish Models</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td><strong>Web (HTML5 and/or Mobile Publishing)</strong></td>
<td>Articulate storyline software supports publishing the learning object via Internet or an intranet for students</td>
<td>Articulate storyline software does not support methods to track student’s completion or process.</td>
</tr>
<tr>
<td><strong>LMS</strong></td>
<td>LMS is a good method to publish the learning object because CDU has been using a learning management system (LMS). Also, it supports tracking capabilities and embedding learning objects on the LMS.</td>
<td>However, it is necessary to contact LMS administrators for any approval or help with the specifics of uploading, launching, or tracking the learning objects.</td>
</tr>
<tr>
<td><strong>Articulate Storyline</strong></td>
<td>It is a user-friendly hosted service. It allows academics to track how students interact with learning objects.</td>
<td>It is important to note that if academic republish and re-upload learning objects that they previously published to Articulate Online, the newly published would replace the old one.</td>
</tr>
<tr>
<td><strong>Offline</strong></td>
<td>It is easy way to publish the learning object for a standalone computer. Academics need to deploy the learning object from a CD, DVD, or standalone computer.</td>
<td>However, the inconvenience is that it needs to check the player properties and quality settings.</td>
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(Adapted from Articulate Global, 2016)

Table 3: Summarises four effective methods to publish the learning objects

In fact, there are many interactive learning objects and learning object repositories which help teaching and learning. However, academic users have been challenged to decide which learning objects are effective for students and how to create it. Therefore, engaging users with learning objects was very necessary. To do this, the session below will discuss about the user centred research and its benefits.

What is a User Centred Research and why is it important in this project?

User Centred Research

To maximize the quality of the user experience in this software development of eLearning objects, it was necessary to involve both lecturers and students from the beginning. Early enlistment results in less repair work that needs to be done at the final stages, such as usability testing (Baxter et al., 2015).
Thus, there is a need to understand what user centred design processes are. Pratt and Nunes (2012) state that “In UCD, a designer strives for a detailed understanding of the needs, wants, and limitations of the people who will use the end product and then makes design choices that incorporate this understanding” (p. 12). In addition, according to International Organization for Standardization (ISO), standard ISO 13407:1999 describes four essential activities in a user-centered design project which include requirements gathering, requirements specification, design and evaluation. The activities of the user centred design are presented in the figure below (See Figure 2).

Based on the Figure 2, user centred research methods include: focus groups, studying small samples, participant observation, user trials, product in use, interviews, customer diaries, scenarios-of-use, consumer idealized designs, webs of association, contextual inquiry, prototype testing, and usability testing (Lofthouse & Lilley, 2006).

**Why is User Centred Research important in this project?**

Lofthouse and Lilley (2006) suggest that advantages of using user centred research includes: reducing unfriendly design, meeting user requirements by focusing on user tasks and goals, getting a chance to know more about the complicated association among people and their products, and becoming a convincing way for transferring the requirements. Hermawati and Lawson (2014) state that user centred research focuses on impacts of end-users in the design process. The level of users’ participation in user centred research can range from a simple observation to user representatives on the design team (*op cit*). According to ISO, the important principles of user centred research includes: understanding of users, tasks and environments; user involvement throughout design and development; driving and refining design through user-centred evaluation; iterative design process; addressing the whole user experience; inclusion of multidisciplinary skills and perspectives (*ISO 9241-210:2010*).
Modified Usability Testing

To establish a deep understanding of users’ (academic and students) needs and requirements in this project, it was necessary to modify a usability test to get to know, listen to and observe users. “Usability tests are conducted to gauge users’ experience with a system, preferably before it is released for real use, and thereby find any problems that prevent users from completing their tasks, slow them down, or otherwise degrade their user experience” (Hertzum, 2016). According to ISO, there are various standards for usability. *ISO IEC9126* describes usability as: “The capability of the software product to be understood, learned, used and attractive to users, when user under specified conditions” (2000). More recently the definition has been updated as the “extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (ISO 9241-11, 1998). Furthermore, El-Halless (2014) states that software usability testing supports developers to evaluate software from a users’ perspective, and in the usability testing process the data is collected for analysing and interpreting the final results. By involving users in the usability tests, academics and students gained more insight into the instruction of learning objects design and how they applied in the online courses.
There are two types of usability testing: formative testing and summative testing. Firstly, formative usability testing focuses on quality of the feedback, representative opinions, and problems detection. Secondly, summative usability testing has a tendency to emphasize more on measuring the level, metrics and the qualities of the tasks (Lazar et al., 2010). Pratt and Nunes (2012) argue that the purpose of usability includes: evaluating a product, understanding the users’ feeling when they test the samples, and providing users a chance to examine the level of product. In this project, usability testing will observe users’ (academics and students) behaviour when they use the eLearning Objects repository examples. For this project, it was planned to recruit at least 5 users because according to Nielsen (1990) “a team of four to five experts can be expected to identify ~70% of usability problems”.

According to Lazar et al. (2010), users should be invited to do a list of tasks on a site. The feedback from those tasks would be collected to evaluate and moderate the reusable eLearning object issues and identify the users’ frustrations. The users may be requested to express their thoughts as soon as they occur about what and why they are doing making certain decisions. The time can be counted when the users are completing tasks to measure how long it takes and this is also is a good way to evaluate the effectiveness. Lazar et al. further argue that to get the best results, the test should concentrate on collecting the non-statistic responses from “speak aloud” or statistical data. However, there are some drawbacks of usability testing that need to be noted. Travis (2011) argues that “many usability tests are worthless. Researchers recruit the wrong kind of participants, test the wrong kind of tasks, put too much weight on people’s opinions, and expect participants to generate design solutions”.

Hertzum (2016) states that “there is no single accepted procedure for usability specialists to follow when conducting usability tests: these tests normally involve users who think out loud while using a system and an evaluator who observes the users’ behaviour and listens in on their thoughts”. Although users’ recommendations in the usability tests are very important, after all, Krug (2000, p.5) argues “usability really just means that making sure that something works well: that a person of average (or even below average) ability and experience can use the thing - whether it's a Web site, a fighter jet, or a revolving door - for its intended purpose without getting hopelessly frustrated”. In addition, Hertzum (2016) considers usability test is not an interview and he presents the core of usability tests in the figure 3.
How can Articulate Storyline help to create interactive lesson

Articulate Storyline is an eLearning software package that allows people to create an interactive online content including quizzing, screen recording, and software simulation (Articulate Storyline, 2016). Gibben et al, (2015) explain that Articulate Storyline is a software package used for building interactive learning objects and presentations. Bouki et al (2014) notes that the set of slides in Articulate Storyline software are used to create a complex interaction lesson while Ballantyne (2008) writes that Articulate Storyline has benefits such as audio-visual recordings and this multi-media approach may help many students learn more easily and it helps academic to creation lessons from a learning theory perspective. Users can increase the interactive lesson in a single scene by adding and modifying several layers in that slide. Bouki et al. (2014) state that the resources (interactive objects) in Articulate Storyline software support users to create learning objects effectively, because these objects have flexible states for designing. After the learning objects are created they can be published to various formats such as HTML 5, Flash, or Articulate Mobile Player. Therefore, users can interact with learning objects on iPads, desktops, laptops and more. CDU has applied Articulate Storyline software for teaching and learning purposes (see Figure 4). Figure 4 shows a learning object that academics created using Articulate Storyline for CDU students to learn how to do a reference correctly.
Methodology

In this section, the overview of research methods and proposed data analysis are provided. According to the ISO (2000) there are four essential activities in a user-centered design project which include requirements gathering, requirements specification (concept definition), design and evaluation (See Figure 5). Requirements gathering and specification in this project used a modified usability testing approach, while the software development approach follows an iterative agile approach. In the research stage, modified usability tests with academics and students using existing articulate storyline objects were developed to fully understand user requirements. Analysis of the feedback from these tests provided specifications for new learning objects to be developed. In the next stage, learning objects were designed based on feedback academics and students. Finally, the learning objects were built for academic and students. Firstly the methodology for requirements gathering and analysis will be described and then the software development methodology outlined.

User research in the first phase of user centred development process was conducted with two user groups: academics and students. To enable this to occur, formal University ethics approval was required (See Appendix 1 and 2 for the proposal and approval). This process also required the development of a series of resources that included plain language statements (see Appendix 3 and 4) and consent forms (See Appendix 5); recruitment documents (see Appendix 6 for Advertising flyer and recruitment emails); Usability Test Scripts (see appendix 8) and usability test website (see...
Appendix 9). Next, participants were recruited for the usability test which was to be conducted in the academics’ offices. A second stage of investigation was recruiting students from units the academics are teaching to understand their requirements for learning interactions. Student usability testing was to occur in the CDU library. The development of the usability resources will be discussed in more detail following.

![User Centred Design Process](image)

**Figure 5: User Centred Design Process**

**Usability tests**

A modified form of usability tests was developed using a range of available online interactive eLearning Object which have been created by Articulate Storyline (e.g. drag and drop, multiple choices, text input and multiple responses etc.) (Articulate Global, 2016). A web based prototype consisting of a five interactive learning object examples (drag and drop, tabs interaction, process interaction, quiz and branching scenario) was developed in Weebly a fast website drag-and-drop building site. This web test URL was sent by email to users just before the usability test began. These interactive eLearning Object samples were shown to participants and they were asked a short set of questions and asked to complete as series of structured tasks. The usability tests took between 30 – 45 minutes. Similar interviews were undertaken with students using the same software examples. Qualitative data analysis was used as data was collected through participant observation; and included problems and solutions experienced; comments and recommendations; answers to open-ended questions.

**Learning Objects**

The learning objects chosen were selected from a wide range of online resources to try to provide users a broad experience of what is possible to develop with the Articulate Storyline software. The
sample learning objects included drag and drop activities, tabs interaction, process interaction, quiz, and branching scenario. The major reasons for choosing these examples were that the sample learning object should be interesting, effective and they may engage students’ attention. Furthermore, it was very important to consider how students achieve the understanding of key concepts or terms; and how student can gain insight in the knowledge level (drag-and-drop). In addition, there other reasons: learning resources can be presented to support higher level thinking skills (tabs interaction and process interaction) and students need a learning object to review and explore (quiz). The Branching Scenario offers students a change to access a knowledge base but it reduces the stressful real-world benefits without real world risks (Articulate Global, 2015).

**Recruiting participants**

Recruitment of users had two phases. Initially, academics were recruited through the use of flyers distributed by the University Faculty Learning Technologists. Three academics (two from Nursing and one from Education) volunteered to be part of the user research. The original plan of using students from their units however did not occur because most of their students are external to the university and there was not enough time in the project for remote usability testing. Instead students were recruited from the IT classes (PRT 455 – Software Engineering Practice). The two students who volunteered included one who is studying a Bachelor of Software Engineering while the second student is studying a Master of Software Engineering. The usability testing with academics did take place in their offices using Morae (see Figure 6).

The Morae was installed on a Windows tablet (CDU equipment) and used for recording all academic and student interaction with the learning objects including: voice, video, keystrokes, mouse movement, screen action, etc. The Manager Morea module was used to analyse, edit and package the resulting usability test. This usability test was repeated with students in CDU library. The usability testing opened an opportunity for academics and students to show their needs about learning objects. The following section will discuss results and findings.
Software Methodology

As the software was to be built with Articulate Storyline, it was necessary to spend time to understand what methods are providing by Articulate Storyline to create interaction learning objects. It was take time to understand how slide layers support to design and it needed to know how slide layer in articulate storyline allows users to modify objects. In the subsequent stage, interactive learning objects were created and they were sent to users for the further feedback and testing. The learning object drag and drop, for example, were created with objects (button, text, images, and hotspot) and some methods provided by Articulate Storyline software like adding triggers, states and notes. Similar, in the tabs interaction, the slides, variables, timeline etc. were used to catch actions when users click on button. The tabs interaction template was created quickly and easily, and the active layer would be occurred when users perform certain operations.

There were three important issues needed to be considered carefully before started to design any learning object include user expectations, how Articulate storyline work, how to create learning
object meet users’ expectations. First, list of user requirements was analysed to ensure created right product. Next, there were some researches about current learning object were built by Articulate Storyline to understand the software methods. Finally, the learning objects were created by combined the users’ needs and Articulate Storyline functionality. After learning object created, there were some teaching content was added for testing how the functionalities work (Articulate Global, 2016).

**Results and discussion**

As mentioned, usability tests were used to better understand participant (academic and student) requirements and this section presents principal findings after completing the usability tests (see Tables 4 and 5). How users interacted with the learning objects examples helped inform the requirements of future learning objects to be developed. Data collections from users were used to outline the design and development for the learning objects. The usability testing data is grouped into five sections: asking users, user choices, learning object choices, analysis of user choices, and design. Data about the roles of users and their background were also collected. Next, the participants were asked their first impression of the learning objects and they completed a series of tasks related to exploring the learning objects.

<table>
<thead>
<tr>
<th>Participants/Roles</th>
<th>Roles at CDU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic 1</td>
<td>Lecturer Bachelor Nursing, Bachelor of Science (FNL)</td>
</tr>
<tr>
<td>Academic 2</td>
<td>Lecturer Post-graduate Nursing (MNL)</td>
</tr>
<tr>
<td>Academic 3</td>
<td>Lecturer in School of Education (MLL)</td>
</tr>
</tbody>
</table>

Table 4: Group user 1 – Academics

<table>
<thead>
<tr>
<th>Participants/Major</th>
<th>Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td>Bachelor of software engineering (WC)</td>
</tr>
<tr>
<td>Student 2</td>
<td>Master of software engineering (SH)</td>
</tr>
</tbody>
</table>

Table 5: Group user 2 –Students

**Asking Users**

To determine which reusable learning objects to build, there are some great ideas from academics (see Table 6). The three lecturers interviewed indicated that they had all used Learnline to teach their students who are mostly postgraduate online or undergraduate students or a mixture of both. While one lecturer uses YouTube and games as online incentives, another lecturer believes the online discussion to be very important. Two academics believed that there could be improvements made eLearning options provided by Charles Darwin University. On the other hand, the third academic who is new to distance teaching, thought what is currently available is quite reasonable. All
academics indicated that they knew what an Interactive Learning Object was and that they were aware of the benefits of using interactive learning objects. Benefits identified included engaging students more; helping students conceptualise important concepts they are learning and making the study more interesting. Additionally, one lecturer noted that Interactive learning objects are also good for external students because they could enrich the distance learning, while another lecturer was interested in using interactive learning objects because doing so provided access to latest technologies and innovations which can assist in improved teaching and studying.

<table>
<thead>
<tr>
<th>Questions/Participants</th>
<th>FNL</th>
<th>MNL</th>
<th>MLL</th>
</tr>
</thead>
</table>
| **Using online or Blended learning for?** | • Use it a lot in the units  
• **Example:** YouTube on incentives to get students motivated website, game, crossword puzzle | • Very much interesting on Learn-line because of inter-states students. | • Take both face-to-face classes and advance sessions on  
• Online discussion is very important  
• Use the computer in the face to face session, and explore stuff together. |
| **Improve CDU eLearning** | Yes | No | Yes |
| **Know what an interactive learning object is?** | • Yes, I have done a course about it | Yes | • Yes.  
• It is standalone service.  
• It is a clickable standalone executable.  
• It is an app |
| **Benefits of interactive learning objects** | • Interactive learning engages a student more Put the students in a position where they don't even realise that their learning  
• Able to get the student to do something either in edition instead of reading  
• Has better outcomes for students | • Engagement from the students’ part  
• Help to engage students with the learning content. | • Every day, there are new interactive opportunities  
• Using technology is a smart way.  
• **Problem:** Not looking at the edge of innovation enough. |

Table 6: Demographics of volunteer participants (Group 1)

The second testing group were two current students enrolled at Charles Darwin University (see table 7). These students both had experience in using Interactive Learning Objects in the past. The students stated that they thought learning objects were a website or application with images, text, and sound that made learning more interesting for students. The benefits of learning objects were discussed and
the students believed that learning objects were created to help students study independently; enabling them to use the object again and again until they understand the theory.

<table>
<thead>
<tr>
<th>Questions/Participants</th>
<th>WC</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using online or Blended learning for?</td>
<td>Yes, I have. It was BIS243-Organisational Security Unit. It was not much communicated between external students</td>
<td>Yes, I had two online units.</td>
</tr>
<tr>
<td>eLearning is an effective method for Study</td>
<td>ELearning is a useful ways to study.</td>
<td>• I used Learn-line to complete 2 online units. &lt;br&gt;• Communicate with lecturers via discussion board and online class &lt;br&gt;• Get instant feedbacks from lecturers</td>
</tr>
<tr>
<td>Know what an interactive learning object is?</td>
<td>Website or tools and students can use it to study independently</td>
<td>A small application with images, sounds</td>
</tr>
<tr>
<td>Benefits of interactive learning objects</td>
<td>• Study independently  &lt;br&gt;• Using it again and again until they understand the theory  &lt;br&gt;• Students want to study more.</td>
<td>• Making more interesting for students. &lt;br&gt;• Helps students understand the theory and practice more</td>
</tr>
</tbody>
</table>

Table 7: Demographics of volunteer participants (Group 2)

**User Choices**

After ascertaining this initial information, the participants were then shown the page of interactive learning object samples. Firstly, they were asked to review the samples provided and indicate which they would like to explore first. Then they were asked to choose the three objects of most interest to them in order of preference and discuss why they thought each would be useful. Following is a summary of the outcomes of these conversations.

Before interacting with any samples, users were given an opportunity to review all samples provided and were then asked which interactive learning object they would like to use first and why they made this choice. Table 8 below illustrates the first actions of users when, reviewed all the examples and discussed what they were seeing.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Academics</th>
<th>Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>What would you explore first?</td>
<td>FNL: Probably branching scenario.  &lt;br&gt; MNL: I am actually interesting in tab interaction.  &lt;br&gt; MLL: Branching scenario</td>
<td>WC: Writing tool activities Charles Darwin University Example.  &lt;br&gt; SH: I want to explore the Quiz example.</td>
</tr>
</tbody>
</table>
Why?

It's got the words here now "what will you do" which is asking me personally to do something and so that makes me want to have a look

Because my previous students not using the different tabs to explore the information they need it for the assignment so, I will be keen to use tabs interaction. My understanding is that this tabs interactions is about how to engage students in using the available tabs inside the Learn-line

Some of my research is how digital technology can scaffold questioning and I am interested in kind of questioning the natural way we think in the way of questions as a child grows up it is asking why-when-how.

It is Charles Darwin University Example and I have not seen it on Learnline before ; I want to know what is that

I don’t know. I don’t want to see a lot of information. it is familiar with me, it is look very essay.

Table 8: Summarises the responses of users before the exploration of the materials began

In the first testing group, two academics chose the Branching Scenario: one responded to the question – “what will you do” that made this academic wanted to explore. The other was interested in branching Scenario because this academic’s research interests are about how digital technology can scaffold questioning. The third academic chose the tabs interaction because of issues students had previously with this form of interaction - he was looking to solve a problem.

In the second testing group that consisted of students, the first student chose the drag and drop activities because the learning object sample is Charles Darwin University example which he had not seen on Learnline before so the student wanted to know what it is. The other student chose the quiz to explore first stating that the quiz was familiar to them and looked very easy.

Learning object choices

During the usability testing, users provided their thoughts and feedback about three specific Interactive Learning Objects of their choice. Initially, all five participants showed different preferences for the sequence of user activities chosen. Table 9 summarises the preferences. The highest preferences are Drag and Drop and Tabs Interaction which were chosen by four users, while, Quiz and Branching Scenario were chosen by two users for each of the learning objects.

<table>
<thead>
<tr>
<th>Learning Objects</th>
<th>Academics</th>
<th>Student</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FNL</td>
<td>MNL</td>
<td>MLL</td>
</tr>
<tr>
<td>Drag and drop</td>
<td>1st Choice</td>
<td>2nd Choice</td>
<td>1st Choice</td>
</tr>
<tr>
<td>Tabs Interaction</td>
<td>3rd Choice</td>
<td>1st Choice</td>
<td>3rd Choice</td>
</tr>
<tr>
<td>Quiz</td>
<td>3rd Choice</td>
<td>2nd Choice</td>
<td>2nd Choice</td>
</tr>
<tr>
<td>Process interaction</td>
<td>2nd Choice</td>
<td>2nd Choice</td>
<td>1st Choice</td>
</tr>
</tbody>
</table>
Drag-and-drop

The drag-and-drop interaction (see Figure 10) asked a user to match the correct icons with the appropriate explanations. Table 10 summarises the responses of users while exploring the drag and drop samples. The first finding is that most of the users found drag-and-drop to be interesting because it captures the students’ attention straight away.

<table>
<thead>
<tr>
<th>Participants/Questions</th>
<th>What do you think about that interactive?</th>
<th>Could you see how this may be useful in your learning materials? How?</th>
</tr>
</thead>
</table>
| **FNL**                | • Students like it  
  • I like using it  
  • Provides a number of different learning outcomes.                                                      | • Easy for me, as a lecturer it is easy to put something like this together.  
  • Asking students series of questions where they can link the concepts together.  
  • It is important to have a point “click back” where they can click to come back |
| **MNL**                | • Good to see the icon next by word. Catching the students’ interaction straight away.  
  • It is matching exercise.  
  • It is not allow putting the wrong pot.                                                                 | • There is option for student making mistake,  
  • Pop of message say in that “you need to reconsider your answer”) And then they can swap around |
| **MLL**                | • It is a formal self-assessment  
  • Lecturer focused on content in the tool rather than the interaction                                          | • Good little prep tool  
  • Have some ways in which you can track all the student response to this so you know who understand what. |
| **WC**                 | • It is similar with some games  
  • Just click and move object which match the definition.                                                    | Used for learning the definitions. also drag and drop the texts, or sounds                                                         |
| **SH**                 | *Did not choose this sample.*                                                                                                                                         |                                                                                                                                 |

Table 10: Summaries the responses of users during explore the Drag and drop

One academic stated that drag and drop would be liked by both lecturers and students because it provides various learning outcomes. Another said that it is a formal self-assessment while another academic gave more specific feedback saying that it is a matching exercise with the icons next to titles. In terms of how to apply this tool for teaching, one suggestion was that it is easy to use by asking students series of questions where they can link the concepts together. Feedback from academics about the design of the sample interactive learning objects included: building in functionality for tracking all the student responses to know who understands what; providing options
for student making mistakes and then showing the message or feedback on the screen when the wrong answer occurs and enabling “click back” where they can click to come back. All the suggestions are described in the Figure 7.

In the student testing group, there was only one student who explored drag and drop. Interestingly, the student stated that this learning object is similar to some games that he had played. The student claimed that it is interesting and the structure is simple because it is just clicks and move objects to match the definitions. However, it is an effective method to learn the definitions. The design suggestion was to include sound in the drag and drop activities.

Because three academic and one student found drag-and-drop interesting and provided a range of suggestions for the interface and functionality so this interaction type were developed as a reusable learning object.

Figure 7: Findings and recommendation for drag and drop activities

**Tabs Interaction**

The Tabs interaction chosen by four users (two academics and two students) will now be outlined in more detail. Basically, the tabs interaction allowed users (academics and students) view the contents after clicked on the tabs buttons. Table 11 summarises the responses of users during exploring the Tabs interactions samples.
<table>
<thead>
<tr>
<th>Participants/Questions</th>
<th>What do you think about that interactive?</th>
<th>Could you see how this may be useful in your learning materials? How?</th>
</tr>
</thead>
</table>
| FNL                   | • You should get something in English (concept of example is no meaning)  
• Pre-design because it takes time to click on the tabs to come back the previous page. | • I would use it  
• It is a nice way to present series of points for students  
• More friendly, smooth.  
• All the tabs listed down rather than click and come back |
| MNL                   | • The picture would make more sense,  
• I feel that you are trying to make me guess about the content by just having a look at the pictures. | • It is possible. It is a good way of catching students’ attention, because it is an entrusting picture because.  
• It is catchy so it can grab the attention of the students. |
| MLL                   | Did not chose this sample | Add some more functionality there like sounds, or questions or discussion.  
• Perhaps, a small game or quiz could be embed in this tab interactions |
| WC                    | • Just only pictures and alphabet text.  
• The description in the bottom is useful  
• It is necessary to show a background about learning purpose in this tab interaction. Example topic on the top or the meaning heading.  
• The size should be full screen There is one more other activities (example Quiz, feedback or discussion) to review about this theory | Use to describe the theory. For example, software engineering; the tab 1 could be “Software Engineering Development Life Cycle”. Then when I click on there, on top it shows the picture of processes and the bottom could be the content to explain about that, it is just example. |
| SH                    | • It is boring one.  
• Because there are only some pictures and “testing text”.  
• It takes time to click on the tabs to come back  
• Giving a topic label instead of using the name tab 1, tab 2, and tab3. | |

Table 11: Summaries the responses of users during explore the Tabs Interaction

Firstly, in the academics testing group, there was a suggestion that the samples content should contain something in English: the academic did not understand the use of the “lorem ipsum” text. Similarly, the other academic critique was the use of the image indicating that it would be more meaningful if the image related to the teaching or learning purpose. Despite these difficulties with the lack of content in the example, some benefits were identified: it could be used to present series of points for students; it is a good way of catching students’ attention because an interesting image. However, the tabs interaction should focus on the design and performance with one academic indicating that it was not necessary to click on the tabs many times; it could be better that the tabs should be listed on the page rather than click on tab to come back the previous page.
In the student testing group, both students chose this example and found the tabs interaction boring because of the lack of meaning in the content. One student found the instructions “Click the tab to go back” useful, because it helped to know about the learning object performance. In terms of design and performance, both students gave some very useful recommendations. The first student mentioned the meaning of heading and suggested adding some more review functionality for Tabs Interaction such as quiz, feedback or discussion. Also, this student expected the Tab Interaction would be full screen rather than just a small window application. The second student suggested that clicking on tabs many times to come back to the previous page which is not necessary; this comment was similar with the academic’s recommendation above. This student stated that it would be better if there were some adding functionalities like lecturers’ sounds, or questions or discussion. Finally one student could really visualise how this would help in his own learning and suggested a specific example: it would be very helpful for describing the theory, about software engineering; the Tab 1 could be “Software Engineering Development life Cycle”. Then when a student clicks on tab 1, the picture of processes and its content would appear. All the suggestions have been summarised in the figure 8:

![Figure 8: Findings and recommendation for Tabs Interaction](image)

While the tabs interaction, received mixed feedback from the two user groups, it was obvious that students saw the potential of the learning object so this will also be developed using the suggestions from both user groups to extend the interaction’s usability.
Process Interaction

The process interaction learning object allowed users (academics and students) is to present the learning material by effectively way. In this learning object there are some numbers on the bottom of the screen, when the user clicks on those numbers, the descriptions of the stages appear on the screen. This learning object was chosen by 3 participants (one academic and two students). Table 12 summarises the responses of users exploring the Process Interaction.

<table>
<thead>
<tr>
<th>Participants/Questions</th>
<th>What do you think about that interactive?</th>
<th>Could you see how this may be useful in your learning materials? How?</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNL</td>
<td>Did not chose this sample</td>
<td></td>
</tr>
<tr>
<td>MNL</td>
<td>Did not chose this sample</td>
<td></td>
</tr>
<tr>
<td>MLL</td>
<td>• This is the process template.</td>
<td>• The world of digital technology which is more than the web now. This is the challenge that how we integrate digital technology together.</td>
</tr>
<tr>
<td></td>
<td>• It would be useful because this structure works flow.</td>
<td>• Recommendations: Should have a little map, work flow map</td>
</tr>
<tr>
<td></td>
<td>• This is a template for academics summary the progress</td>
<td>• It could be some icon shows the work process flow -just heading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A little bit consistence navigation is very important</td>
</tr>
<tr>
<td>WC</td>
<td>• It is a process.</td>
<td>• I refer something as simple. My feeling is that this example is about the process and normally process is quite popular in the units.</td>
</tr>
<tr>
<td></td>
<td>• Should have some meaning contents or picture about general idea about the project or topic title on top just help to understand more.</td>
<td></td>
</tr>
<tr>
<td>SH</td>
<td>• It is interesting.</td>
<td>• There are 12 weeks per semester in this process then each week we have tasks need to be done some things like that</td>
</tr>
<tr>
<td></td>
<td>• There are texts, picture in each step.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The size and front is quite easily readable.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Well, it is good one.</td>
<td></td>
</tr>
</tbody>
</table>

Table 12: Summaries the responses of users during explore the Process Interaction

Firstly, the only academic who explored the process interaction suggested that this template would be useful for an academic who wanted to summarise their materials and put them in a process. The academic believed that this process template would be useful since its structure works in a logical way. However, the academics expressed that integrating the process template within Learnline as well as integrating the digital technology together is challenging. Regarding the design and performance, the academic suggested that it could include a little map, such as work flow map or
some icons to present the work process flow; and giving more the meaning to the heading. Also, the academic believed that consistent navigation was very important.

In the student testing group, the first student expected more detail in the initial page so that they could understand more about the purpose of the process. Both students said that the process interaction was very interesting. The first student suggested that this workflow process was quite popular in the information technology units and could be usefully applied here. The second student indicated that font size on the screen was readable and suggested that this type of interaction could be used by students to construct their own study processes. For example, there are twelve weeks each semester and then each week is a stage; when student click on stage one it means week one and they would receive study material for week one and tasks needing to be done. All the suggestions are described in the Figure 9

![Figure 9: Findings and recommendation for Process Template](image)

**Quiz**

The Quiz interaction was chosen by one academic and one student. Table 13 summarises the responses of users when exploring the Quiz interactive.
Table 13: Summarises the responses of users during exploring the Quiz

The academic was confused because some questions had only one correct answer while some questions had two correct answers. Therefore, the recommendation from the academic was that the Quiz it should have a description to explain the activities and each question should indicate the total correct answers. The student thought this Quiz learning object was very useful because its results immediately occurred before the next question was showed. However, similar to the academic experience, the student was also confused about the number of correct responses required in each question and the student suggest that the answers options should be mentioned somewhere. The student found it was useful to review the study materials. Regarding the design, the student suggested that a list of questions should be located at the bottom of the screen to enable users to move to other questions easily especially, if there were some hard questions in the list. The results presented here may facilitate improvement in the design and all the suggestions are described in the Figure 10.
The Quiz was not of great interest to users; therefore, this interactive learning object would not be built.

**Branching Scenario**

The Branching Scenario was chosen two academics. The branching scenario, there were some cases with details and pictures; and each case the questions and answers were given. The user would choose the answer and clicked on the answer button for feedback. The major purpose of this interactive learning object is that it gave users the opportunity to learn from the mistakes. Table 14 summarises the responses of users who explored this object.

<table>
<thead>
<tr>
<th>Participants /Questions</th>
<th>What do you think about that interactive?</th>
<th>Could you see how this may be useful in your learning materials? How?</th>
</tr>
</thead>
</table>
| FNL                     | • I like that little scenario where it puts you in changes of the information as a learner.  
                           • It is quick for me to follow it through  
                           • I like the whole set up of this scenario  
                           • You should have to a user control | • Student having to play the role of the health practitioner.  
                           • They are trying to do thus in actually work through a scenario that they might encounter in being to do it in safe place, but till using a personable information about physical instruction on directing it to the student so they take responsibility for the decision on what they are responding. |
| MNL                     | • It is confusing because some questions have one correct answer and some questions have two correct answers. It should have description to explain about the activities. | • In the questions you should indicate that there is more than one correct answer, and then students must click on 2 tabs for the answers. |
Table 14: Summarises the responses of users during exploring the Branching Scenario

Overall, both academics liked this learning object. The first academic claimed that it would be good if it provided more user control to enable users to control the speed of the information presentation. This academic could see how this interactive could be used in their discipline area of nursing experiencing an opportunity to play the role of the health practitioner in a safe place by working through a scenario. With the same learning object, the second academic suggested branching scenario conducted numerical experiments; lot of teaching scopes would be presented by a scenario; In addition, it was an effective method to deal with a lot of ethical questions in school. Based on the results, all the suggestions are described in the figure 11: Findings and recommendations for Branching Scenario.

Figure 11: Findings and recommendations for Branching Scenario

The Branching scenario was chosen by two academics. This was because academics thought that the Branching scenarios would encourage students’ access, improve their knowledge as well as memorize major ideas and concepts. Therefore, branching scenario would be built for academics.
Analysis of user choice

Before a final decision was made about what learning objects to develop, a further analysis of the interaction types was provided. Essentially the five sample interaction types fall into two categories when user experience is considered. The five learning objects examples Learning Objects have chosen were categorised by the type of interaction (see Table 15). Among five users, three required a user to click read and think and then do (i.e. make a decision based on prior knowledge). Table 16 compares these interaction types with user choices during testing (see table 16).

Many interesting results as well as recommendations above indicating the requirements for interactive learning objects have been reported. Both academic and student users found interactive learning objects that require a click and think approach more useful than a click and read approach. Therefore, the learning objects built included two variations of click-and-think interactions: a drag-and-drop interaction and a branching scenario interaction. Because students also expressed an interest in click-and-read interactions, three variations of the tabs interactions were built for academics to use.

<table>
<thead>
<tr>
<th>Interaction type</th>
<th>Drag and drop</th>
<th>Tabs interaction</th>
<th>Quiz Temples</th>
<th>Process Interaction</th>
<th>Branching scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Click read and think</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Click and show</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 15: Interaction type

<table>
<thead>
<tr>
<th>Group user</th>
<th>User</th>
<th>Using information (Click and think)</th>
<th>Presenting Information (Click and read)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academics</td>
<td>FML</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>MNL</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>MLL</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Students</td>
<td>WC</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>SH</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 16: Types with users’ choices during testing

Design

The above results decided three types of learning object should be built include Drag and drop, Tabs interaction and branching scenario. In this section, a raw of learning objects were designed were before theses learning object should be built by Articulate Storyline software.
Figure 12: Prototype user interface of Drag and Drop Interactive for Academic and student Users
Figure 13: Prototype user interface of Tabs Interaction for Academic and student Users

Figure 14: Prototype user interface of Tabs Interaction for Academic and student Users
Learning object built

After completing the prototypes, the learning objects were created using *Articulate Storyline*. Various learning objects were created including drag and drop (see Figure 15); tabs interaction template 1 (see Figure 16) and tabs interaction template 2 (see Figure 17). Those learning objects were built based on the users (academics and students) analysis above. After the learning objects created, the learning contents were added to functionality testing (see Figure 18).

![Figure 15: A screen shot from the Articulate Storyline software](image_url)
Figure 16: A screen shot of Tabs Interaction template 1 from the Articulate Storyline
Figure 17: A screen shot of Tabs Interaction Template 2 from the Articulate Storyline

Figure 18: Teaching contents was added for functionality testing
Conclusions

In recent years there have been many programs which support for creating interactive eLearning objects; and in the future, the distance learning will be developed quickly. It means that eLearning objects are built based on the experiences of educator with a well design and series of tests before being updated into the learning management system. This is intended to help teachers' knowledge be communicated extensively throughout the world. It is encouraging students to explore their studies.

E-Learning is essential, because it is the need of students to acquire the knowledge anytime and anywhere. It is helps students develop knowledge in a sustainable way. In my opinion, in the future there will be a digital library of interactive eLearning objects. The eLearning objects will be very high standard. It means, educator can use, maintain, and update them easily. This kind of library will be built with a corporation of experts in education, designing, and programming. Those people will create a library to help students around the world can study with a good learning materials. These experts will ensure that students will gain knowledge but not lose their own creativity of the students. That is a mission. I believe that to create a good interactive eLearning objects there are four key factors: content, creativity, technology and passion.

The primary objective of this project was to develop interactive learning objects for academics. Those interactive learning objects were built based on requirements as well as recommendations of both academics and students. To achieve this, it was first necessary to understand the foundation concepts by conducting a literature review. The main contribution of the literature review was to provide the theoretical background for eLearning objects, eLearning object repositories, a user centered research, a modified usability test, and Articulate Storyline software. It was also very important to identify relevant research methods in this project. Therefore, the definitions, methods, benefits of User Centered research were discussed in the literature review. Furthermore, there are many useful methods in the user centered research, among them, usability tests have many advantages for this project. With the help of user centered design methodology, three academics and two students participated in the usability tests providing suggestions for the design of a range of learning objects.

The key finding to emerge from this study is that both academics and students found interactive learning objects are very useful. The academics and students shared their own thoughts about the improvements for user interface as well as functionalities of learning objects. These suggestions were analysed for designing the learning objects Through user centred designed recommendations given, the learning objects addressed educational issues, such as offering an effective designing of learning objects, and pointing to appropriate interactive learning objects from the testing examples one. These
findings point out that both academic and student users found interactive learning objects that require a click-and-think approach more useful than a click-and-read approach. Specifically, click-and-think interactions include a drag-and-drop interaction; Quiz and a branching scenario interaction while click-and-read interactions were tabs interaction, process interaction. The learning objects built included a drag-and-drop interaction, several with tabs interaction, and branching scenario.

The participations of academics and students helped to build relevant learning objects. It was the found that the interactive learning objects was an effective method to catch students’ attention. This research applied Articulate Storyline to provide better options for teaching and studying. However, using Articulate Storyline to develop learning objects without any templates was a task that academics found to be very difficult. In response, five learning objects were created for academics to modify and publish for student use. The significant benefit of the learning objects is that external students could use learning objects to study from home. In addition, the library of interactive eLearning objects was developed by Articulate Storyline which can be reused. Also of significant benefit is these interactive learning objects could be embedded within the university learning management system, potentially reducing the time academics need for designing and building their own learning objects.

The scope of this research was limited in terms of the number learning object created and in terms of the number of participants. Clearly, the findings can only be indicative. Only five learning objects with instruction were created. Moreover, Articulate storyline is complex software, and it takes time to deeply understand its functionalities. Consequentially, the interactive learning objects used for usability tests did not cover whole user needs.

The results of this research can drive development and deployment of building interactive learning objects; however, a further study could assess the long-term effects of appropriated self-assessment activities for students. As future work, integrating and testing the interactive learning objects with learning management system will be needed more researches.

**Declarations**

**List of abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>CDU</td>
<td>Charles Darwin University</td>
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<tr>
<td>LMS</td>
<td>Learning Management Systems</td>
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<tr>
<td>RLOR</td>
<td>Reusable Learning Object Repository</td>
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Authors' information

Denis Doan is a Software Engineer who works in the field of technology enhanced learning. He has a Master’s degree in Software Engineering completed at Charles Darwin University and a Bachelor from Deakin University (Melbourne).
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