

# **Accelerating student learning in CARS: A case study on the adoption of adaptive learning technologies for scenario-based modules**

## **Abstract**

This case study will describe the adoption of adaptive learning technologies to redesign and enhance the compulsory, introductory online Communication and Research Skills (CARS) unit completed by all undergraduate students at the University of Western Australia (UWA). The use of open-source tools and e-learning authoring software has enabled a significant change to the delivery of CARS moving from linear, content-focused modules to interactive, scenario-based modules. This new approach personalises learning and increases engagement, allowing students to make decisions and apply skills in interactive real-life scenarios that they are likely to encounter in their studies.

The redesigned unit was launched in February 2019 and this case study will reflect on the impact and the lessons learnt throughout the design and implementation process. It will also provide recommendations based on this example for other libraries considering using adaptive learning methods and technologies.

Keywords: adaptive learning technologies, information literacy, learning design, scenario-based learning, interactive storytelling, communication and research skills, rapid prototyping, usability testing, student feedback

## **Introduction**

Communication and Research Skills (CARS) is a compulsory, introductory online unit for all undergraduate students at the University of Western Australia (UWA). It assists students to develop basic communication and research skills such as working in teams, delivering an oral presentation, finding evidence, and writing their assignment in an academic context. The unit was originally created by the University Library and the University's Academic Skills Centre, *STUDY Smarter* in 2010. Apart from updates to the content and a platform change in 2015, there had not been any major reviews or updates until an institutional-wide review of the unit was conducted in 2017.

## **Aims and objectives**

The institutional-wide review identified that the varying levels of students' prior knowledge and educational experiences highlight 'the difficulty of providing uncontextualised, introductory information, as students with more advanced skills may find the content too basic and thus less valuable'. The review's three main recommendations focused on this challenge and emphasised the need to contextualise and customise the content, delivery and use of the unit. As a result, the objectives of the redesign project were to update CARS content to focus on practical skill development in a variety of academic and professional contexts, and deliver it on a platform that

would allow for the customised delivery of this content. The project commenced in August 2018 with the aim of launching to commencing students in late February 2019.

## **Methodology**

The UWA Library's project management approach is based on Prince 2 methodology and the project was established with a project manager, project board and project team. The project team included representatives from the Library and *STUDY Smarter*, who were later joined by a Learning Designer and Educational Technologist from the University's Educational Enhancement Unit. Each team member, provided a different perspective to support the Library's development of CARS:

- Librarians managed the project, designed the branching scenarios and developed the modules in Articulate Storyline 360.
- Learning Skills Advisors also designed branching scenarios and wrote content for the modules relating to effective study techniques, writing, communication, and research skills.
- Learning Designers provided advice and support around learning principles and strategies, including design for branching scenarios.
- Educational Technologists established the technology requirements such as the virtual learning environment, software and templates.

The project was mapped out in stages, which included:

- assessment and selection of available learning platforms;
- storyboarding of content and activities;
- development of a communication plan;
- design of assessments;
- development of modules;
- testing, and;
- development of an ongoing management plan.

These stages were not as linear and stand-alone as initially expected, due to the way the team dipped in and out of stages by storyboarding and developing prototypes, testing ideas, and re-developing modules based on feedback.

### *Review of available learning platforms*

The original CARS unit was built in Adobe Captivate 8 and deployed via two platforms: as a package within the virtual learning environment (Blackboard Learn) for students currently enrolled in the unit, and openly available as HTML5 content on the CARS webpage. The CARS review identified 12 functional requirements that would need to be met by a replacement platform to address student experience, sustainability and technology needs. Being able to create a 'choose your own adventure' personalised delivery style and incorporate gamification principles were two of these requirements that focused the platform review on adaptive learning technologies.

The team's investigation of adaptive learning technologies led to a meeting with an Educational Technologist from the University's Educational Enhancement Unit who recommended attending a Unit Design Workshop. Unit Design Workshops are based on Carpe Diem, a process of learning design through teamwork and collaboration (Salmon, 2016). These workshops consist of a team of professionals (namely, Learning Designers, Educational Technologists, and Librarians), who specialise in different areas of education support coming together for a day to assist a unit coordinator to reconsider the design of their unit with a particular focus on effective and innovative learning and assessment strategies. Although CARS is not a traditional credit unit, the same principles applied in mapping out the unit to get to the core of its teaching goals. In hindsight, the decision to start the project with a focus on the technology was premature as it was important to understand firstly the purpose of the unit, the pain points for students, and what their CARS experience should look like.

### *Storyboarding and rapid prototyping*

Through taking part in the Unit Design Workshop, the team realised that the ultimate goal of CARS should be to foster behavioural change and the development of skills rather than simply the retention of information in order to pass a final quiz. Students should feel more prepared for University and confident in applying the skills in real-life as a result of completing the unit. Early in the development phase it was determined that a traditional approach to learning design would not be suitable for CARS. The modules had to be self-paced, interactive, and provide feedback, without intervention from an instructor. Another aim of CARS was to provide a resource that was not simply recreating content that was readily available online. As such, an action mapping approach to learning design was used (Moore, 2017). Action mapping focuses on first developing goals that solve real world problems, and then the subsequent actions required to do so. This approach switches the emphasis from memorising de-contextualised knowledge related to a topic, to what the learner actually needs to do in order to solve a problem. The final steps of action mapping include practising behaviours and decisions, while accessing information resources and 'task aids' at the point of need.

Inspired by best practice examples such as Connect with Haji Kamal (World Warfighter, 2010) and Arcade Intern (Dalmady, 2015), the team began exploring a scenario-based approach to the future delivery of CARS. This involved replacing previously static content with scenarios that would encourage students to make decisions and apply skills as they navigate through the unit, mimicking realistic and interactive situations that they are likely to encounter in their studies (Moore, 2017). For example, in the module on teamwork, a team of student characters are shown discussing their group assignment and the user is asked to make decisions to guide the team's experience. The success of the team depends on the decisions made and the user is given feedback at the end of the module. In another module, the user makes decisions about search strategies, referencing and the most reliable sources to use in their character's assignment.

[SCREENSHOT CARS 1]

Figure 1 Screenshot from *Module 2: Writing your assessment* showing character dialogue from a reflective essay scenario.

[SCREENSHOT CARS 2]

Figure 2 Screenshot from *Module 2: Writing your assessment* showing the realistic decisions that the students have to make to proceed through the scenario.

[SCREENSHOT CARS 3]

Figure 3 Screenshot from *Module 2: Writing your assessment* showing the adaptive feedback presented to the student at the end of the module based on their decisions throughout.

Several software solutions were considered for the development of CARS, including Twine and Articulate Storyline 360. Twine, an open-source, text-based interactive storytelling tool, was used to create prototypes in order to introduce the project team to the concepts behind adaptive learning and branching scenarios. Twine was developed for online 'choose your own adventure' stories, and can incorporate conditional logic, variables and images, which are published in HTML. Twine is easy to use, with simple text-based commands and markup that allows for rapid prototype testing and scenario mapping. Developing the modules in Twine enabled early testing of the pathways for each of the CARS modules, along with the creation of a visual map for each scenario.

[SCREENSHOT CARS 4]

Figure 4 Screenshot showing a branching scenario prototype developed in Twine for *Module 1 Starting your assessment and finding evidence*.

While Twine proved to be an efficient way to test ideas and prototype learning scenarios, it was ultimately decided that the final product needed to have the capability for greater customisation of the graphical interface and user experience. To investigate another option, two project team members built a working prototype of one of the modules in the trial version of Articulate Storyline 360, despite having had no previous experience in the software or adaptive learning technologies. The prototype module was tested by 18 current students who were asked to compare it to the equivalent existing module. Overall, students felt they could relate better to the content within the prototype as it presented realistic scenarios they face as students and demonstrated how to apply skills and put them into practice. They commented that they preferred this learning approach to rote learning. The students also felt the prototype was more user-friendly and visually appealing, and the interactivity made them feel more engaged with the content. As a result of the positive feedback from students and the successful assessment against functional requirements, the decision was made to proceed with a scenario based learning approach using Storyline 360.

*Development, stakeholder feedback and usability testing*

Starting the learning design process with action mapping naturally led to the scenario development for the modules. Each scenario had major decision points that provided students with the option to go down different pathways, where they had to make realistic decisions with consequences and adaptive feedback built in. This required programming variables and triggers into Storyline 360 so that the software would take learners down their chosen pathway, and also remember their choices. Triggers allowed the user to take particular actions depending on what they clicked on, such as taking them to another slide, opening a layer, or revealing feedback. Variables were used to store choices the learners made in Storyline 360, such as the buttons they clicked on, or the slides they went to on a particular pathway. By storing variable information, triggers were then used to provide adaptive feedback to learners. Creating multiple pathways required a significant time investment, not only in the slide development and programming, but also in making sure that learners had equal opportunity to understand the CARS concepts required, no matter which pathway they took.

#### *Usability tests, written feedback, and crowd-annotated feedback*

Stakeholder feedback and usability testing was conducted during the development using a variety of methods. One method used Articulate Review 360, an online platform which allows users to preview and share Storyline 360 projects, to gather feedback on the CARS modules. Using this online platform meant that subject matter experts and stakeholders could annotate changes and feedback against particular slides or scenes without needing any prior experience with the Storyline 360 software or a separate spreadsheet or database to capture responses. Due to the number of pathways and different combinations in a scenario-based module, this approach ensured rigorous crowdsourced testing to ensure all pathways worked and dead-ends were avoided.

#### [SCREENSHOT CARS 5]

Figure 5 Screenshot from Articulate Review showing contextual stakeholder feedback from the usability testing phase.

The usability testing involved project team members observing students and staff as they worked through the modules. The users were encouraged to ‘think out loud’ and share their thoughts and expectations about the experience. This proved to be a useful way to test assumptions about the technology, especially around topics such as navigation, functionality, and design.

Navigation had been discussed by the project team a great deal during the development, before the decision was made to provide minimal instructions and aim to design the experience in a way that was intuitive enough that they were not needed. Despite this, usability testing showed that the vast majority of users overlooked the Tips and Guides icons that linked them to the contextual task aids at the top right of the screen. As a result, the team added an introduction slide detailing how to navigate the module.

[Navigation slide]

Figure 6 Screenshot showing the redeveloped introduction slide based on usability feedback.

The modules were originally designed with feedback only presented upon completion of the pathways. Feedback from some of the students during the usability testing indicated that they had forgotten their choices by the time they reached the end of the module and that they would prefer to receive the feedback in context. This became a delicate balancing act to try and present a realistic story and pathways, whilst ensuring feedback was timely and relevant. This impacted on the design of some modules, with longer modules being split so that feedback could be presented at the halfway point, as well as immediate feedback being added for any interactive activities such as drag-and-drop and other matching activities. Another observation from the usability testing was that students felt they might have missed important information due to the pathway they went down. The ability to jump backwards in a module and re-set any previous choices and completed activities required further experimentation with the software and an extension of the triggers and variables.

### *Accessibility*

It was important that CARS be fully accessible so all students receive the same learning experience. The software chosen needed to meet web accessibility standards and requirements and this was one of the core functional requirements during the review of learning platforms. At the time, it was noted that Storyline 360 supported Web Content Accessibility Guidelines (WCAG), including screen reader support. However, after testing the modules with a student with a visual impairment and using the JAWS screen reader program, the project team discovered the importance of tab order within the screens and adding alternative text to all images, activities and links. This really emphasised the importance of testing the tools and resources with a screen reader rather than assuming the software is accessible straight out of the box.

### **Outcomes and Impact**

The redeveloped CARS unit was launched to commencing students at the beginning of Semester 1 in February 2019. Enrolled students were given access to the unit via a link to the HTML5 version from the University's Blackboard virtual learning environment (VLE). In addition, the HTML5 version was linked from a web page to provide open access to the unit for unit coordinators and the wider community. As of June 2019, 3,519 students had completed CARS.

Student feedback was gathered throughout the semester via a survey embedded into the CARS LMS unit, and additional interviews were conducted with a selection of students who had completed CARS. The students were asked to share their experiences on the content, activities, dialogue, format and usability of CARS.

Generally, students enjoyed the scenario-based format and felt it offered a better learning experience than simply reading information and memorising. They also reported that the unit was user friendly and easy to navigate across modules, although a small group of students did encounter issues when viewing CARS on mobile devices as it did not display well on smaller screens.

Several students shared that they found CARS useful for gaining an understanding of the expectations at university and that they could relate to the information in CARS as it reflected their own early experiences at university. Students found the content relatable, mimicking the way they would think and react if they were actually doing the assignment.

Students liked the activities embedded into the modules as it was an opportunity for them to test their knowledge. However, a number of students stated that they would have liked to have the choice to skip an activity, yet they were unable to do so. Additionally, when they got an activity incorrect they did not receive detailed feedback, so they did not always know how to improve. Despite the addition of an introductory navigation slide as a result of the usability testing, none of the students interviewed noticed the Tips and Guides icons embedded into slides.

As a result of student feedback and testing, a number of updates and changes have been made to the CARS modules for Semester 2, 2019. These changes included reviewing all activities embedded into the modules to ensure they provide targeted constructive feedback, adding the functionality to enable users to skip an activity if desired, carrying out further cross-device testing to improve user experience on mobile devices, and creating an additional creative assessment type pathway. The Tips and Guides icons were also made more prominent throughout the modules so that students have the opportunity to learn in more detail about the content they are working through on the slide.

An ongoing development and management plan was the last product to be delivered as part of the project. A team was established to provide operational support and management for the administration, development, maintenance and promotion of CARS. This operational team will carry out a bi-annual review of CARS to ensure the content remains up-to-date and any technology changes are addressed.

## **Conclusions and recommendations**

UWA Library is already exploring how adaptive learning technologies could be used beyond CARS. Librarians were recently trained in Articulate Storyline and worked in pairs to develop short, standalone learning objects to be made available in the University's LMS for re-use by unit coordinators. Other parts of the University have also been exploring adaptive learning including the development of a 'Health and Well-being at UWA' pilot program.

Based on the CARS experience, seven recommendations for other libraries considering incorporating adaptive learning methods and technologies into their information literacy instructional design are listed below:

- Start with the content and learning experience, not the technology. Do not let the technology dictate the learning design.
- Partner with colleagues from other areas of the university to bring together expertise and different ways of thinking.
- Carry out rapid prototyping and testing. Do not wait for the content or design to be 'perfect' before asking for stakeholder feedback
- Be careful not to overcomplicate your design. Branching scenarios can expand very quickly as each scenario-based activity you add requires additional pathways and multiple learning paths. These can be time-consuming to build and add.
- Start with a design template to ensure your modules have a consistent look and feel.
- Take the time to make the content accessible. Do not assume the software is fully accessible simply because it states it supports assistive technologies.
- Do not underestimate the time commitment in planning, storyboarding, building, consulting with stakeholders, and testing.

This project demonstrated that adaptive learning technologies can provide new opportunities for libraries to enhance their online information literacy instruction by contextualising learning using real-world scenarios with adaptive feedback.

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