Shaping the Future of Academic Libraries: Authentic Learning for the Next Generation

Jurgen Schulte, Belinda Tiffen, Jackie Edwards, Scott Abbott, and Edward Luca

In the context of future of academic librarianship terms such as "blended" and "embedded" librarian have been used to describe emerging greater levels of involvement within the universities enterprise. Simultaneously new pedagogical approaches are being developed towards more authentic and engaging learning experiences. This case study documents the redevelopment of an undergraduate course supported by librarian leadership to deliver more engaging and authentic assessment tasks culminating in a library published peer-reviewed eJournal. It provides exemplars of 'new' librarian roles including co-teacher, publisher and communications expert, while also demonstrating the effective integration of professional graduate attributes into academic curriculum.

Introduction

Academic librarianship is changing in response to new pedagogies and educational approaches emerging in the tertiary (in other words, post-secondary, college, or university) education sector.[1] As teaching shifts to more engaged and authentic student experiences, with a focus on preparing undergraduates with the necessary attributes to succeed in the future workplace, librarians have the opportunity to employ their skills in information management, digital literacy, scholarly communication, and technology to partner with academic staff in effecting this change.

As outlined in the recent Joint Information Systems Committee (JISC) *Guide to Developing Digital Literacies*,[2] emerging librarian skills and knowledge in digital and data literacy—building on long-standing expertise in information literacy—can assist teaching staff and students to develop the capabilities for success in a digital and data-driven society. Similarly, the revitalization of library publishing programs provides new opportunities for libraries to assist in augmenting student learning with experiences

Dr. Jurgen Schulte is a faculty in the School of Mathematics and Applied Sciences, e-mail: Jurgen.Schulte@ uts.edu.au; Dr. Belinda Tiffen is Director, Library Resources Unit, UTS Library, e-mail: Belinda.Tiffen@ uts.edu.au; Jackie Edwards is Information Services Librarian II, UTS Library, e-mail: Jackie.Edwards@ uts.edu.au; Scott Abbott is Manager in Scholarly Communications & UTS ePRESS, UTS Library, email: Scott.Abbott@uts.edu.au; all at the University of Technology Sydney. Edward Luca is Manager Academic Services in Academic Services, University of Sydney Library, e-mail: Edward.Luca@sydney.edu.au. ©2018 *Jurgen Schulte, Belinda Tiffen, Jackie Edwards, Scott Abbott, and Edward Luca, Attribution-NonCommercial (http://creativecommons.org/licenses/by-nc/4.0/) CC BY-NC.*

simulating authentic research and professional environments. In addition to developing discipline-specific knowledge, these authentic research experiences grounded in scholarly publishing can contribute to the attainment of so-called "soft skills," such as communication and collaboration skills, vital in today's employment market.[3] Librarians are also increasingly taking on roles related to marketing and communication to promote the library's own services and collections, as well as supporting library clients in communicating and disseminating their own work to appropriate audiences. This diverse range of skills and experience means librarians can, and should, be more closely embedded in the academic curriculum, expanding the range of services and knowledge they offer to support staff and students in their teaching and learning programs. This paper presents a case study of a successful collaboration between library and academic staff within an undergraduate science course to provide a rich and authentic learning experience for students, where the traditional role of the librarian has been challenged to take on new responsibilities as partners in curriculum development and enabling new learning outcomes.

Literature Review

An examination of the literature supports our central thesis that the role of the librarian is evolving to meet the requirements of pedagogical changes. The role of the academic librarian has traditionally revolved around managing and developing collections to support teaching, learning, and research, in addition to providing programs that support the development of information literacy skills in graduates. In a digitally connected world where the library is no longer the de facto information resource, academic librarians have grappled with a growing ambiguity and uncertainty around the future of the profession and their role in higher education. Changes to the curriculum and to the wider environment of work and society mean these traditional roles may no longer be sufficient to support academic staff and students. Librarians therefore need to reposition the profession, with a greater focus on partnering with academic staff, becoming embedded in the curriculum, and taking on new roles and capabilities in allied areas such as publishing and marketing. The term "blended librarian" was first used in 2004 to describe an academic librarian combining traditional information skills with a new blend of IT skills and a capacity to use technology in a purposive way to enhance learning.[4] Librarians have an opportunity to develop their roles as educators, building skills in areas such as educational design, development, and innovation, as "facilitators of active, critically reflective learning."[5]

Clearly, there is a need for "deeper integration of [the library] profession into the mainstream functions of higher education,"[6] though this poses significant challenges. Collaboration between faculty members and librarians may be most obvious in the realm of information and digital literacies, though librarians are not universally recognized for their contributions to course planning and teaching.[7]

More recent research has attempted to address the issue of faculty and student perspectives of librarian efficacy and has sought to develop more effective methods for demonstrating the positive effects of the librarian's contributions to student learning outcomes. Findings by Booth, Lowe, Tagg, and Stone suggest that greater collaboration between faculty and librarians cultivates a greater focus on learning outcomes and a common understanding of information literacy as a priority for the university.[8] Following them, Reed and Thompson argue that research methods courses provide a natural place for faculty and librarian collaboration.[9] Students can develop their understanding of information literacy skills, but, additionally, such material offers a perfect opportunity to engage students in discussions around today's complicated and ever-evolving scholarly communication environment.

As part of the changing role of librarians, academic and research libraries have become steadily more active as publishers or publishing partners on campus over the past decade. In a 2007 survey of American research libraries, Hahn found an "emerging research library role as publishing service provider" with only 36 percent of libraries not active in the publishing arena.[10] A more recent 2016 report notes that around 30 percent of the members of the Association of American University Presses reported to libraries,[11] a figure that had doubled in the five years up to 2016, suggesting an ongoing growth in library-based presses and publishing activity. Australia has not lagged in this area, with a 2015 survey undertaken by the Council of Australian University Libraries finding a quarter of university libraries in Australia are publishing original scholarly work, with a wide readership of more than 3.4 million downloads per annum.[12] These efforts, however, have largely been directed at supporting the research mission of the press's home institution. Library-based presses have been most active in providing pathways for the dissemination of their institution's research outputs.[13]

Projects using the library-based press to enhance teaching efforts and contribute to the development of valuable skills building students' persistence, success, and employability are a more recent and not yet well-embedded development. A leader in this field has been Purdue University, where the formation of the *Journal of Purdue Undergraduate Research* (*JPUR*) has "provide[d] students with an opportunity to disseminate their work while learning about the scholarly publishing process."[14] Backed by funding to undertake a structured assessment of the success of the journal in contributing to student learning outcomes, the Purdue University program has demonstrated that students "developed important information literacy competencies."[15] Furthermore, 20 percent of students who had published in *JPUR* indicated a desire to pursue a career in research in their respective fields of study; they also were positive about considering publishing in the future—both important indicators in preparing students for future careers within their chosen professions. These findings echo the experience of other student journals—most published under the auspices of library publishing programs— that "the nexus of scholarly communication and information literacy"[16] offers fruitful ground for developing key competencies in undergraduate students that will develop critical information and digital literacy skills and knowledge.[17]

While the shift to developing programs that will transmit critical digital literacy skills affects all disciplinary areas, recent literature on science education suggests there is a particular need within the sciences for a focus on the broader digital fluency and scholarly communication skills that align to the expanded role and professional skills of librarians as described in the information and knowledge management literature. In a study conducted in 2007, Rodrigues et al. found that science degrees need to be reconsidered to deliver effective foundations for employment.[18] Additionally, they recommended that relevant skills must be developed as part of the educational experience, with opportunities in the program "for students to practice and receive feedback on these skills."[19] This recommendation is reflected in the push to integrate graduate attributes—a defined set of skills, characteristics, and qualities that a graduate is expected to attain and that are transferable beyond disciplinary boundaries—into Australian university policy[20] nationwide, generally referred to as graduate attribute framework. Each university then formulates its own graduate attributes framework in consultation with their respective industry. This process was started with a graduate attribute mapping of degree courses and, at our university, is now reaching the stage of graduate attribute alignment of courses and assessment tasks; in other words, curricula are being refined to include or identify assessment tasks that address these attributes.

Foremost among these graduate skills is the development of digital literacies, a relatively new concept referring generally to a range of "capabilities which fit someone for

living, learning and working in a digital society."[21] Library and Information Science (LIS) literature strongly argues for libraries to expand their services to provide educational programs that assist both academic staff and students develop these digital literacy skills. The literature on science education echoes the necessity of developing digital literacy skills to enable more effective learning. While definitions of digital literacy abound, the focus may be specifically on technical literacies, the development of technical capabilities, and proficiency with common online platforms such as blogs and wikis or productivity software (such as word processing or spreadsheets). It has been argued these ICT-enabled affordances may be particularly valuable in science education, enabling, for example, better understanding of science concepts through the use of multimodal representations that "in science learning are important due to the abstract nature of many concepts."[22] Digital literacies, however, are usually also considered to develop the underlying skills to find, evaluate, reuse, create, share, and manage rights necessary to adequately use technology as an information and communication tool in an educational or workplace setting.

The JISC report provides a succinct overview of the emergent area of digital literacy, offering an attempt to understand and codify the new skills necessary to succeed in a digitally rich society. Many of the activities embedded in the course described in the following case study aim to develop digital literacy skills in the students and represent a practical application of the new approaches to librarianship espoused in the JISC report.[23]

Institutional Context and Background

To illustrate how librarians can use their diverse range of professional skills to expand their role and more effectively partner in academic teaching and learning design, this paper presents a specific case study of how library and academic staff collaborated to rejuvenate the curriculum in one particular course in the sciences. *Energy Science and Technology* is a theory-heavy, third-semester physics course in the Faculty of Science at the University of Technology Sydney (UTS) that introduces theoretical thermodynamics to physics students in the context of electric energy production. Recently, the curriculum of this course was reviewed with the twin aims of: 1) providing a more challenging and engaging learning experience than current textbook-based approaches, in line with a universitywide initiative to rejuvenate learning; and (2) incorporating university-stipulated graduate attributes (see table 1).

Each degree course at UTS has a graduate profile associated with it that describes industry-informed capabilities that graduates are expected to achieve, along with discipline-specific knowledge. The graduate attributes are developed throughout a degree course gradually through careful scaffolding and monitoring of course-intended learning outcomes. Course graduate attributes and learning-intended outcomes are mapped against assessment criteria. Through this process, assessment tasks and assessment results are then inherently linked to degree course–intended graduate attributes; thus, all graduates can be expected to meet the required graduate attributes.

On introduction of the administrative requirement to comply with the graduate attribute framework[24] at UTS, the *Energy Science and Technology* course was reviewed and found to formally address only one of the requisite graduate attributes ("Disciplinary Knowledge"). This was not surprising considering the course's traditional textbook focus and primary role as a foundational, theory-focused course. To support the larger scaffolding of graduate attributes throughout the degree, it became evident that a broader range of important graduate attributes needed to be developed within the *Energy Science and Technology* course addressing skills and knowledge crucial to success within the classroom and graduate employability.

Several challenges were identified in attempting to address multiple graduate attributes, including the following:

- difficulty in designing learning activities and assessment tasks to specifically address particular graduate attributes;
- teaching a range of different graduate attributes without compromising on subject content, especially in STEM where discipline-specific knowledge is the foremost attribute in all courses;
- identifying and deploying the requisite skills, given that lecturers rarely hold learned knowledge of how to formally teach and assess specific graduate attributes.

TABLE 1 University of Technology Sydney Graduate Attributes			
	Intellectual	**Professional**	**Personal**
Practice-Oriented	○ Critical and independent thinking	○ Disciplinary, professional, and technical knowledge	○ Spoken and written communication ○ Managing own work
Situated in Global Workplace	• Information technology literacy	○ Application of expertise appropriate to the practice context ○ Understanding the contexts of professional work	○ Working with others • Cross-cultural understanding
Research-Inspired and Integrated	○ Information literacy	• Ethical understanding	○ Capacity for initiative and innovation • Capacity for community engagement
Open circles indicate those graduate attributes targeted in the redesign of the Energy Science and Technology course. An additional graduate attribute adopted by the UTS Faculty of Science ("Lifelong Learning") is not included in the table.			

It was at this point, once the course curriculum had been reviewed and the challenges of curriculum identified by the course coordinator (who is also faculty in Energy Science and Technology), that faculty staff approached the library to adopt a team-based approach with library and teaching faculty to redesign the curriculum. The intended aims were to make learning more engaging, enable more authentic assessments, and develop graduate capabilities beyond specific and theoretical disciplinary knowledge. The team recognized that librarians have long-standing experience and knowledge in developing skills in finding and evaluation information, which could be employed to enhance the learning experience of students. For the course coordinator, the real value of involving librarians was in harnessing newer skills that could enrich the course. Faculty librarians could bring a diverse range of skills within the broad fields of digital and scholarly communication literacies, which could be employed to inform the course redesign to embed digital literacy capabilities. Professional staff within the library working in marketing and communications who had extensive experience in written communication, event planning, and graphic design could enable activities assisting students to build professional presentations. Students would use some of these skills in their professional research papers to express their findings; others would enable them to present at a professionally organized public presentation at a miniconference. The library also manages one of Australia's oldest and most successful open access scholarly presses, UTS ePRESS, with expertise in all aspects of scholarly communication and academic publishing, which provided an opportunity for students to build an understanding of the production and dissemination of scholarly outputs.

These diverse skills and experience were recognized to align closely with many of the graduate attributes to be embedded within the *Energy Science and Technology* course. Drawing upon the expertise of both academic and library staff provided the basis for developing the new curriculum, with authentic learning experiences based around the development of critical communication, research, and technology skills. In the following section we present a case study describing how a partnership between academic and library staff was formed to deliver an authentic and multifaceted learning experience to students.

Case Study

The Learning Design team consisting of course coordinator and library staff faced the challenge of introducing workplace skills into the curriculum of a theory-heavy science course, doing so in a way that was engaging and encouraged self-motivated learning in students.

Before describing the solution they developed, it is worth noting briefly the methodological approach adopted by the team. As the work is based in practice, the approach has largely been one of evidence-based research, with solutions applied iteratively over a period of two teaching cycles as staff have reflected on the experience and sought to improve student outcomes. However, in this paper, rather than describe action research methodology and its appropriateness for practice-based research in educational settings, which has been adequately discussed elsewhere,[25] we will describe the process of curriculum review and collaboration undertaken in this specific case study of the course *Energy Science and Technology*.

Learning Design Process

The course review had established that *Energy Science and Technology* adequately developed disciplinary knowledge in students but did not address the attainment of other capabilities they would need for success within their chosen discipline as identified by the UTS industry–informed graduate attributes. Therefore, it was thought that a suitable course of action would be to embed an authentic learning experience that simulates a real workplace scenario and is subject to real workplace conditions. Such authentic learning experiences can be either a workplace-integrated or a workplace-simulating experience.[26] The latter, in which the learner undertakes tasks mimicking real work conditions, is often used at an early stage in the degree while the former, in which learning is undertaken in a workplace outside the higher education setting, generally requires a more mature competency and skills base. In this context, for second-year students, a workplace-simulating experience was felt to be more appropriate.

Initially, for a course that covers theoretical thermodynamics, for the faculty to find an appropriate industry and a related workplace scenario that can be integrated into the existing course appeared quite difficult. Like quantum mechanics, theoretical thermodynamics is not a topic commonly worked on in industry; rather, it is something that one would find in a pure research environment or specialized engineering setting. Such an environment is very common, however, at a higher education teaching and research institution, where the full range of tasks undertaken by academic staff is generally not visible to students whose encounters are often limited to teaching activities. In their daily work academics, they may undertake a variety of tasks, ranging from formulating an original research objective for a research study, to finding and analyzing peer-reviewed scientific literature, to writing and submitting a research paper within journal-prescribed formats and timelines, to communicating findings to colleagues and presenting at conferences, to managing a public profile and promoting their research in appropriate disciplinary and broad-based outlets (including social

media), to acting as a peer-reviewer of other research papers. Much of this work takes place in the context of a research team and contributes to competing priorities and workloads that include teaching and administration tasks.

For this reason, the course coordinator chose the writing of a student peer-reviewed scientific paper within a small research team as a new assessment task to provide a more engaging and practice-oriented learning experience. Through the process of preparing a scientific paper for publication, students would undertake tasks mimicking a real-world workplace setting—in this case, an academic laboratory in a research environment. This activity could develop the students' understanding of "scholarly publishing literacy,"[27] thus preparing them, as graduates in physics, for one possible career in active research, while also developing a range of professional skills, such as communication and teamwork, which are transferrable to most workplaces. This new team-based, student peer-reviewed assignment replaced more traditional examinations in the course. Unlike exams, this type of assessment embedded in the course enables, rather than simply measures, learning.[28] The task was designed to allow this predominantly theoretical course to become a practical, student self-managed learning experience that is stimulating and challenging to students and helps to facilitate the institutionally desired graduate outcomes.

The *Energy Science and Technology* students are in their second year (third semester) of the four-year program, still in the process of building fundamental disciplinary knowledge, and they have not yet encountered authentic professional research tasks.

To provide an attainable pathway into research conducted in a professional environment, students were instructed to go beyond a literature review of their topic and to adopt a meta-study research approach. In this approach, results from different data in the team's research texts are synthesized in a systematic way to identify data patterns that are not apparent in any of those sources to create new knowledge,[29] which they then document in a professionally written, peer-reviewed paper.[30] Students were allowed to form their own teams and select research topics from a range of proposed topics. The teamwork itself exposes students to the practice of working in a team and managing a preset goal, team dynamics, and team tasks. These are skills that go beyond disciplinary knowledge, requiring students to engage in ways that are socially and emotionally demanding and are skills that are expected to be acquired in an authentic learning environment. Further, the writing of an academic research paper for publication in a research journal requires students to meet specific style guidelines and a submission deadline and participate in a rigorous peer-review process. At the end of the peer-review process (and still within the course term), the research papers are then collated for professional printing and published in an open access peer-reviewed student research journal. Students were provided with an assessment rubric that showed the alignment with respective targeted graduate attributes.

Throughout the session, students undertook a range of tasks, from literature searching to statistics workshops, building to the publication of a peer-reviewed journal article and miniconference presentation. Scaffolded support was embedded within learning tasks, to build both theoretical knowledge and practical digital and scholarly communication literacies, preparing students for future studies, research careers, or employment beyond academia.

Library Partnership in Learning Design
Library staff were involved from the formative stages of course planning as part of the learning design team developing educational resources and learning activities, which embedded a range of graduate attributes into the curriculum.

Librarians worked with the course coordinator and other teaching staff to design the course curriculum, scaffolding the material and developing supplementary online material. Some of the content developed and delivered by librarians represented essential library learning skills that have long been included in library training programs, such as constructing search queries, searching indexing and full text databases, evaluating scholarly and scientific literature, and correctly citing sources.

While this content may represent established information literacy practices, for the class on *Energy, Science and Technology,* the delivery was embedded in the curriculum, as part of regular librarian-led face-to-face teaching modules, rather than as an invited single session or voluntary workshops. The teaching format also focused on flipped and blended approaches, using online content and practical in-class exercises to reinforce learning, resulting in a more effective approach to traditional information literacy and library instruction.

The library contribution to the course aimed to move beyond the traditional library role of assistance with finding information resources and referencing. Library staff from UTS ePRESS, the library-based institutional publisher, provided a range of professional publishing services to support the publication of the journal including editing, cover design, typesetting and layout, creation of ISSN and article-DOIs, insertion of DOIs in reference lists, and publication of the works in PDF, HTML, and Print-On-Demand formats. By ensuring that the journal was produced to the professional standards of a scholarly journal, students not only gained an authentic experience of what it means to be a professional researcher; they also had a tangible item to add to their CV, demonstrating their attainment of skills in scientific writing and publishing ethics. Library staff and students working in partnership on these activities enhanced student learning through the creation and publishing an open access journal, *PAM Review: Energy Science and Technology*,[31] and the inclusion of scholarly communication concepts and skills in the course. Through activities focused on practical learning, students were introduced over the course of the semester to the concepts of open access publishing, academic peer-review, copyright and rights management, academic writing and editing, and digital citizenship. In class workshops, students learned through practical experiences, helping to comply with the journal's editorial guidelines and peer-review processes, reviewing fellow students' work and preparing their papers for submission via the online publishing system applying consistent house styles. Each practical step—supported by library staff—reinforced learning about the process of research and academic writing, while also developing communication and teamwork skills.

Library staff also provided instruction to students on managing their own professional identity, by incorporating workshops on setting up a researcher profile using tools such as Google Scholar, ResearchGate, and ORCID. These activities provided teachable moments within the frame of digital citizenship about the benefits of building and maintaining a professional portfolio and profile, while also alerting students to the ethics and potential risks involved in the use of social media within a professional context.

To conclude the experience, library staff assisted teaching staff in organizing a miniconference hosted in the library at which student research teams presented their research findings, providing a "safe" environment for them to practice presentation and academic communication skills and gain an understanding of how skills in marketing, media, design, and event planning can contribute to the dissemination of scholarly work and the building of professional profiles.

Results

The effectiveness of the course and the success of the curriculum transformation was assessed on an ongoing and iterative basis, appropriate to the action-research method-

ology adopted, with regular analysis and evaluation from the teaching team. The key measure for success was developing an engaging experience for students that helped them gain both discipline knowledge and graduate attributes related to employability and workplace success. To measure this, focus groups were held to gather student feedback and assess students' learning experience of the new learning and assessment tasks. Students were asked to answer a set of open-ended questions and then participated in a facilitator-hosted discussion. Students commented positively about the authentic learning experience, which closely simulated a professional workplace experience, working in a research team and interacting with supporting agencies and resources (mentor, library team, and facilities).

The feedback from students in focus groups as well as video interviews taken after workshop sessions[32] indicated that they understood the purpose of the authentic learning activity they undertook throughout the semester and felt it contributed to their attainment of skills that would enhance their employability:

- Students realized the value of the nondisciplinary graduate attributes, commenting that it made "the subject more applicable to future careers."
- They identified the value of learning to work in professionally organized teams with responses including: "I have also learned a lot about being a leader and making sure everyone is on the right track, but in a positive and encouraging manner" and "[W]orking in a team was rewarding, it helped to improve my skills of collaboration and collaborative time management."
- Students also realized the limited benefit that rote learning presents; as one student pointed out, "there are ways to pass tests without understanding but this way we have to understand."
- The power of placing learning into an authentic environment taught by learned experts was highlighted by one student commenting that "[I] enjoyed the self-managed learning the most, as I feel information I've collected during this project will have greater 'staying power' than it may otherwise."
- Students also gained more insight into aspects of professional work they were not aware of previously: "I wasn't actually aware that scientific papers were reviewed in this way before publishing."
- Students were also able to identify the transferability of the skills: "The self-managed learning was a good way to see what I would have done differently for another project in terms of time management and working within a team."

Additional positive outcomes were also indicated by the professional growth and satisfaction of the staff involved in developing the curriculum. Reflexive methods to encourage self-reflection were employed throughout the design, implementation, and evaluation of the course. Library staff reported that the experience had enhanced their relative skill set in various ways, such as in designing and delivering in-class workshop learning activities. Academic staff who were involved reported professional development in terms of curriculum design, scaffolding of graduate attributes, and teaching communication skills, as well as a broadening and deepening of their own professional insight into the field of knowledge they presented to the class.

Library staff also reported an expansion of capabilities and satisfaction in being able to more fully use the range of professional skills and knowledge they possess. One library staff member reflected that the research and development of a teaching session focused on open access publishing, and open scholarly communication generally, was especially rewarding as it raised their awareness of important current trends related to the library and university sector as a whole. A broadening of the concept of what it meant to be a modern academic librarian was also reported by two of the library teaching staff, and this was seen as a positive outcome of the shared teaching

and curriculum development. In the future, quantitative metrics may also be applied; for example, they could be used to measure the success of the journal employing statistics such as article downloads and citations to demonstrate the professionalism of the students' work, as well as relevance and quality of their documented research.

The success of *PAM Review* as learning supporting medium has led to further curriculum development and student publishing projects that aim to provide authentic research experiences for students. A second student journal entitled *NEW: Emerging Voices in Australian Indigenous Studies* has launched and is publishing works by undergraduate students from two institutions in what the editors term "Critical Indigenous Studies."[33] The launch of a third journal is being planned for 2017 from postgraduate students.

In part due to the success of *PAM Review*, the library has also pursued other partnerships with academic staff to develop learning and research programs, which in many cases stretch the traditional role of the library and meet emerging initiatives in academic librarianship. For example, students enrolled in the School of Design have curated an exhibition of their work and presented tutorial sessions in the library talking about their learning experiences. The library hosted the exhibition and made curatorial staff available to students to assist them in preparing the exhibition. In doing so, students were supported to develop key skills around reflecting on their own practices and knowledge, exhibiting and communicating about their work, and building their professional persona. These are the same skills developed by students within *Energy Science and Technology*, where authentic and engaging experiences have been created by drawing on the joint expertise of academic staff employing their disciplinary and pedagogical knowledge, and library staff using an expanded array of professional skills around information and knowledge management, publishing, and communication.

These outcomes strongly suggest that the process of embedding librarians within the teaching and research enterprise in the university enables better learning experiences and lifelong outcomes for students and supports the research mission of the university. As a corollary of expanding the role of academic librarians, better outcomes for the library can also be achieved in terms of a higher profile and greater value to the institution.

The sustainability of a peer-reviewed student journal such as *PAM Review* will rely upon maintaining academic rigor, high-quality production, and active promotion. The team produced a documentary-style video[34] during the 2017 teaching session, which captures the student experience over a semester of producing *PAM Review*. The video is intended to help future students better understand the process they will follow in developing their skills through the experience of researching, writing, peer-reviewing, and editing a journal. It also provides a guide for library and academic staff who may wish to adopt a similar approach in their own work. This video project, undertaken with the assistance of the university's Institute for Interactive Media & Learning (IML), will further enhance the professional reach of the *PAM Review* experience and, for the curriculum team involved, enable a continuation of the process of review, evaluation, and iterative improvement as part of the practice-based, action research methodology adopted for this project.

Conclusions

The librarian's role as a learned expert partnering in teaching and publishing as part of the science curriculum demonstrates the move from librarians as traditional custodians of educational materials to new roles as mentors, teachers, publishers, and content creators. By shifting the role of the academic librarian away from the physical library and engaging with staff and students in their classroom and through the library website, the library has become a much more valuable and effective contributor to improving the student experience, playing a key role in curriculum design and course delivery.

The embedded librarian becomes just as engaged in the work of the team as any other team member. As the engagement grows, the embedded librarian develops highly customized, sophisticated, and value-added contributions to the team.[35]

The achievement of a professionally produced open access scholarly journal by a group of undergraduate students, such as *PAM Review*, is evidence of the success of this approach in imparting to students critical theoretical and discipline-specific knowledge and helping them obtain digital and communication skills they will need to succeed in the workplace of the future.

Acknowledgement

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