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ARTICLE

Assigning students to publish on the web: Examples, hurdles, and needs†

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ABSTRACT

Assign students to create a website, video, or podcast, and they can become more engaged with content and more capable in communication, teamwork, critical thinking, and ethics. That is the promise. Still needed are documentation and dissemination of effective teaching approaches and suitable platforms to handle inevitable copyright issues. We characterise these needs here through a case study of one web publishing assignment in science that has run since [2003], brief descriptions of other new media assignments being undertaken by science academics in Australia, and the attractions and concerns that their colleagues voice. The discussion points to a critical question, the level of commitment of university academics to preparing their graduates to handle the complexity of relationships with stakeholders that the web can readily present. Are lecturers ready to take on the preparation of students to employ digital media to relate to audiences outside the university?

INTRODUCTION

The web represents a medium of learning and publication that students find engaging, academic staff increasingly see as practical, and employers value as relevant. The web also offers opportunities for cross-university and international collaboration. Within this context, university instructors face increasing demands to put material online for students. Materials may be housed in the ubiquitous "learning management system" that students log into or made more public in the tradition of MIT's "Open Courseware" ([2011]). One can stand back and ask, is the web affecting the ways in which students learn beyond making access to resources more convenient and more comprehensive? Is it making teaching easier or more challenging as opportunities for plagiarism become more convenient and more tantalising?

A definitive answer to these questions requires extensive research covering a range of contexts. We contribute to this effort by outlining a modest but growing trend in how the web can facilitate learning of content and development of professional skills and insights. The approach that we describe holds promise for teaching students abilities in composition by imbuing them with a pride of ownership in what they compose and submit. Peer review and public scrutiny become more readily facilitated, and that can reduce the drive to plagiarise.

This approach involves student publication on the web. That is, students assemble a wiki to share information gleaned about a laboratory technique, for example. Alternatively, they compose a podcast on a key concept in chemistry to be learned for the final exam. A range of theory supports the educational value in the process of assembling information, composing, refining, and producing something in text, audio, or visual elements, and publishing it for an audience of peers, or more widely (e.g., literature cited by Ainsworth, Prain & Tytler, 2011, and Orion, Dubowski & Dodick, 2000).

This promise has been seen by the authors through a decade of their own classroom experiences in assigning students to create "new media". This development led to a major grant from the government-funded Australian Learning and Teaching Council to identify, characterise, and share best practices in use of new media assignments to develop the "graduate attributes" (professional skills and insights) of university science students. Examples of assignments and lessons revealed during this project are described in this article.

We recount below a case history of one early assignment to illustrate opportunities and hurdles. Then we describe a series of examples found in our current New Media for Science project. The project has led us to conclude that key challenges lie ahead in areas like science, where there are demands to learn content as well as to develop professional abilities. Despite such challenges, we conclude that "new media" assignments are becoming increasingly necessary as professionals need to represent themselves, their organisation, or their cause on the web for an audience that can reach far beyond those in their own discipline.

This article is meant to provide inspiration for academics to experiment with new media assignments but also guidance on pitfalls to avoid and open questions that need to be resolved with careful evaluation. We offer a case for training in new media as being educationally useful beyond having students gain, for example, the ability to edit a video. How necessary this training is remains an open question. Our statistics suggest that approximately 1% of science academics in Australia assign students to create new media, which means that 99% still do little or nothing in this domain.

HISTORICAL CASE STUDY ILLUSTRATES POSSIBILITIES AND HURDLES

A case study of the *World-Wide Day in Science* project (WWDS) in the period 2003-2010 reveals how the web has the ability to enable involvement of a range of stakeholders in a university assignment. Here, we recount the hurdles faced and opportunities realised in having university students in science assigned to build an online career guide for high school students (Rifkin, 2007). The WWDS project has afforded a form of "authentic" assessment (Herrington & Herrington, 1998) as students have created a real product for a real audience addressing a real need – declining science enrolments (Rennie & Goodrum, 2007). WWDS has required students to engage in teamwork, the critical thinking involved in peer review, and the ethics of asking for permission to publish an interview. Such graduate attributes

are an area in science that surveys of employers and graduates indicate requires attention (McInnis, Hartley & Anderson, 2000). The educational value of WWDS has been assessed favourably from a range of disciplinary perspectives. The Day in Science website receives over 1 million "hits" per year. Yet, the approach has failed to spread widely as a learning activity at either universities or high schools. A look at the history of the WWDS project can reveal implications for other new media assignments being undertaken today.[1]

The *World-Wide Day in Science* project was conceived as a problem-based learning assignment for a second-year subject in a university degree programme for high achieving science students. The subject was part of a degree programme involving three years of coursework plus an honours year at a research intensive, urban university in Australia.

The strategy to involve a whole class in one project was inspired by student-designed conferences, particularly one developed by Gruba and Søndergaard (2001) for engineering students at the University of Melbourne. The "day in the life of …" aspect drew on the coffee table books conceived by Rick Smolen, a photographer for *LIFE* magazine. That approach is exemplified in books like *A Day in the Life of Africa* (Cohen & Liberman, 2002). Smolen had assigned professional photographers to spread across a particular country or continent to capture a day in the lives of inhabitants on a target date. The Day in Science approach employed amateurs, university students, who were meant to learn from the process as well as the outcomes. They recorded a day in the lives of various science-based professionals. The students shadowed a range of professionals, from laboratory scientists to park rangers, recording interviews and taking photographs.

Participants in the 2003 class of 80 students were organised into functional roles – a top management team, leaders of reporting teams, reporters and producers, editors and web development staff. These roles were complementary and designed to incorporate organisational relationships that students would encounter in the professional world. For example, the output from one team, reporters, was the input for another team, editors (Advanced Life Sciences class, 2003, Epilogue).

Students were told that they must organise to shadow a scientist or science-based professional on a target date in April, mid-way through their semester. By the end of the semester, the class needed to deliver a website presenting their stories online. Their target audience would be students in Years 9 and 10 of high school with the aim of making science careers more appealing in the hope to address declining enrolments in science. Years 9 and 10 are when students in Australia decide what to study for their high school leaving exam. Their score on that exam determines which universities and what majors they are eligible to enter.

Students in the Day in Science class were assessed on the quality of the website as

1 This case study is excerpted from the chapter, "World-Wide What? Assigning students to publish on the web," from the forthcoming volume, *Effectively implementing Information Communication Technology in Higher Education in the Asia-Pacific Region*, M. Piscioneri, M. Islam, and O. Lee (Eds.), NOVA Science Publishers, Inc.

a whole. That mark was modified for each student by credit added or subtracted via peer assessment. The quality of their essays describing and analysing peers' contributions also formed a part of their mark. The final part of their mark was a prospective essay explaining how they would apply insights gained from the exercise in a future science career, basing their analysis on stories of scientists' careers that classmates had gathered for the website.

The WWDS assignment ran in this form from 2003 until 2007. It constituted half of the required subject to develop students' "graduate attributes." This subject stretched across two semesters, due to idiosyncrasies in the degree programme. The lecturer both taught and conceived the Day in Science assignment.

The nature of the degree programme changed in 2007, and the subject in which WWDS was incorporated also changed. The Day in Science assignment was altered to eliminate the need to create a website. Students were still required to develop content, albeit for a website where submission had been automated. All students became both reporters and editors. Each student interviewed a professional of interest, addressing certain key topics designated in the assignment, with some topics emerging from tutorial discussions. They then each drafted a story, and the story was subjected to online peer review. Peer review was done through the *Calibrated Peer Review*® (CPR) system. CPR is a widely used, web-based application developed in the US over a decade ago under a grant from the National Science Foundation. Students employed feedback from the CPR review process to edit their stories. They also had to reduce their story to 250 words and upload it to the new WWDS website (e.g., http://wwdis2007.didymodesigns.com.au). This shift in approach, from a class-wide project to individual interviews and individual submissions, was accompanied by a reduction in credit for the assignment from essentially 50% to 20% of their mark for the subject.

The Day in Science assignment ran in this more automated form through 2010, involving two, mandatory, first-year classes in the sciences, which grew to 180 students each. The assignment has also played a role in a class at the same university for PhD students in science, engineering, and medicine who are learning aspects of entrepreneurship.

From 2004, the WWDS team have invited university classes overseas to do these exercises in parallel. In fact, it was initially conceived with international collaboration in mind. Early adopters included a masters degree subject in the science communication programme at a university in Europe (whose students usually contributed videos), a science club and a subsequent science communication class at a large university in Latin America, and a small number of PhD students in science in a special, science communication programme at a prominent research university in the UK. Day in Science stories written by scientists themselves were also welcomed, with submissions arriving predominantly from Australia but also from every other continent, including Antarctica. For example, a half dozen submissions on the target date were collected from an international project that had early career particle physicists writing blog entries for a year.

In all versions of the Day in Science assignment for the classes at the university where it originated, students identified their own professionals and scientists to interview. They have been directed to approach someone in a career that might interest them. They were restricted mildly, being told not to interview a member of their immediate family and to avoid flocking to ask for an interview with the same favoured lecturer or tutor.

Expansion of the Day in Science assignment beyond its home subject was preceded by a feasibility study. The study assessed a range of factors, such as a suitable time of year on which to place the target date for reporting and the nature of any similar, previous efforts. The date in mid-April seemed suitable for academic years in both northern and southern hemispheres. Nonetheless, the most frequently asked question from those seeking to be involved has been whether the date can be changed to another time of year. Precedents for this "day in the life" approach range from a short-lived exercise where a small group of school students in the UK reported on a day in the life of a scientist to a national activity in the US where over one million school students annually "shadow" a professional (not necessarily a scientist) on Groundhog Day, February 2nd. The former example seemed labour intensive, and it concluded when funding support ended. The latter had tremendous reach but no reporting requirement to collect the students' accounts in one place where they could serve as a learning resource.

The Day in Science assignment overcame the funding hurdle by being an integral part of an ongoing academic subject, one required of students in multiple majors. Initial website development was done free of charge by a student team as part of the assignment. Free web space was garnered from the university. Subsequently, several internal faculty and university grants of a few thousand dollars each paid for web development to automate the uploading of stories.

WWDS added a dimension not achieved in the US shadowing day exercise by having publication of students' experiences online. That was enabled by asking the people interviewed to sign a release signalling "permission to publish". Such permission was important because technical details of a student's story might be wrong. Scientists, whose professional work benefits from their being sticklers for accuracy, were informed that such technical details were not relevant to the gist of the story. The permission form explained that stories are intended to inform the decisions of young people about careers rather than to direct senior researchers toward specific laboratory experiments to conduct. The signed permission forms also indicated that the student had indeed interviewed someone in person rather than compiling a story from an e-mail exchange or a web biography.

The WWDS website now hosts over 1,200 profiles of scientists and science-based professionals. It receives roughly one million hits per year in web searches, which result in on the order of 20,000 visits per year of thirty-seconds or longer. This level of visits is occurring even before dissemination of teaching materials on WWDS developed for high school teachers. The New South Wales Department of Education and Training has "workshopped" the Day in Science website successfully

with small groups of science teachers. Day in Science CD-ROMs were produced by students in 2003 through 2007 as a way to present their website physically, and the CD-ROMs have been allocated ISBN numbers. They have been circulated to 500 to 1,000 prospective students each year as part of the marketing effort of the faculty of science. The website has been advertised on e-mail listservers for science communication officers in Australia and internationally. Such direct publicity efforts have reached several thousand individuals, and reports on the project written by editors of various websites have doubtless reached hundreds more.

Lesson plans for activities for high school science classes have been developed, such as worksheets and homework assignments that have students using the Day in Science website. They were drafted by two high school science teachers hired with AUD$15,000 in grant funds from the university. These teaching materials, which have been evaluated by other science teachers, have been poised for release and distribution for over a year now. A delay in release resulted from the impending, and ultimate, closure of the academic unit that hosted WWDS. The unit was deemed not to fit the new strategic aims of the faculty. Despite the closure, the Day in Science assignment remains in modified form as an element in two, first-year subjects in the faculty and in the entrepreneurship subject for PhD students, involving over 400 students at the university.

Experience gained has contributed to a range of other online publications created by university science students. These efforts supported an application for a grant from the Australian Learning and Teaching Council, referred to earlier, to develop and disseminate new media assignments for university science subjects. Through production of blogs, wikis, podcasts, and videos, students are to deepen their knowledge of scientific content (Ainsworth et al., 2011) and enhance their insights and abilities in communication, teamwork, critical thinking and ethics (Rifkin, Longnecker, Leach, Davis & Orthia, 2010).

Feedback indicates that the Day in Science assignment was well received by the students involved. Their learning was evident in their product, their discussions, their peer reviews and their reflective essays (Rifkin, *In Press*). Rigour might demand "before" and "after" tests or treatment and control groups to accurately gauge learning gained by students. Such tests for development of graduate attributes of science students remain wanting. It can be hard to discern whether the insights that one sees students revealing in a final essay or peer evaluation are really new to the student or if they are merely reiterating an observation of something they noticed in high school. Hope is on the horizon for a "before" measurement, though, as the widely-cited, Organisation for Economic Co-operation and Development (OECD) Programme for International Student Assessment (PISA) tests of school students will be assessing insights on things like teamwork and abilities for critical thinking and synthesis (Helen Wyatt, School Education Director, New South Wales Department of Education and Communities, personal communication, 4 March 2012).

Development of widely-agreed measures of achievement of graduate attributes proved to be beyond the scope of our funded initiative, and exploration of this

broader issue is beyond the scope of this article. Yet, consistent with criterion-referenced assessment, we could claim that students generally evinced insights seen as desirable by the end of their first semester at university, such as awareness of the positives and negatives associated with careers in science, a sense of the nature and attractions of career paths in biomedical science beyond being a general practitioner, appreciation of other students' perspectives and abilities in writing and teamwork, as well as an ability to articulate the value of peer review. These outcomes are consistent with the theories of adult learning employed in the Day in Science class, which had strong experiential elements, large amounts of reflective and analytical class discussion, students learning from one another as well as from outside experts whom they interviewed, and students linking in-class activities to outside experiences and applications.

As a result, we suggest that the exercise illustrated the potential for development of graduate attributes through an authentic web publication assignment. The dream of a global, collaborative effort was not fully realised, though it was piloted. A lesson here may be that a web assignment's reach, i.e., in involving a range of stakeholders, can exceed its grasp. What might be seen as less ambitious attempts at student creation of new media have followed.

EXAMPLES OF NEW MEDIA ASSIGNMENTS TODAY

We have identified over two dozen types of new media assignments or extensions of existing assignments that can be completed in new media formats for science subjects. They are nearly all simpler or more conventional than the Day in Science assignment, with few involving publication for a target audience outside the university. They tend to be an extension or adaptation of a more traditional assignment, a video augmenting a research report, for example.

We originally categorised these assignments according to which new media technology the lecturer was asking the students to employ. That is, were students assigned to make a podcast or assigned to create a wiki? Surveys of lecturers at our conference workshops helped to invert that categorisation. The technological medium seemed to be a secondary consideration in identifying the types of assignments that lecturers would be interested in employing. So, we re-categorised assignments into more conventional types, such as explaining a concept in a student's own terms. Within these types, the medium of submission could be paper or new media, though we have argued that the new media option offers pedagogical advantages (Rifkin et al., 2010). Here are the categories of assignments that we arrived at along with examples that we identified as being used by science lecturers in Australia.[2]

2 This section of this article is excerpted from our paper, "Worried about Engagement? Have students create 'new media'," from the proceedings of the 2011 Australian Conference on Science and Mathematics Education, Sydney.

1. Explaining science concepts in a student's own words. Three hundred students in a service subject in chemistry in first year at the University of Western Australia (UWA) worked in small teams to create podcasts on key concepts – acids and bases or oxidation and reduction (E. Bartle & N. Longnecker, UWA, personal communication; Bartle, Longnecker & Pegrum, 2011). Chemistry students at Curtin University created wikis on elements in the periodic table (D. Southam, Curtin University, personal communication). Eleven hundred first-year students in biology at Monash University are reporting on their research in the form of a *PowerPoint* slide (G. Rayner, Monash University, personal communication). One hundred and fifty second-year students in biochemistry created short *You Tube* videos to illustrate difficult biochemical concepts in a second-year subject at Griffith University (J. Vanderlelie, Griffith University, personal communication). Vanderlelie identified significant improvement over the previous year in students' answers to complex essay questions on the exam.
2. Documenting a process, such as a laboratory or fieldwork exercise or a site visit. First-year biology students at the University of Western Sydney (UWS) have been creating animations of fieldwork techniques (P. Ross, UWS, personal communication). Thirty students studying molecular and cell biology at the University of New South Wales (UNSW) have been working in teams to create a website on a laboratory technique (L. Lutze-Mann, UNSW, personal communication).
3. Commenting/reflecting on topics relevant to class for classmates or a broader audience. Students at UWS who are studying environmental issues have been making podcasts about site visits (J. Arvanitakis, UWS, personal communication). Six hundred first-year biology students at the University of Queensland (UQ) have been working in teams to film videos on environmental topics (L. Kuchel, UQ, personal communication). Science communication postgraduates at UQ are tracking and commenting on science issues in print and online media via their own blogs (author, Leach).
4. Peer assessment of teamwork/self-assessment. Two hundred first-year chemistry students at UQ are writing blogs to reflect on their learning processes (Gwen Lawrie, UQ, personal communication). Chemistry students at UWA are employing a wiki or online quiz to assess project teammates (E. Bartle & N. Longnecker, UWA, personal communication).
5. Report on research or for consultancy. An ALTC project has students at universities in Australia and overseas using online laboratory notebooks available across the partner universities for sharing data and analysis (R. Quinnell & M. Todd, University of Sydney, personal communication). Analysis in forensic science is presented by student teams in a blended learning subject (mixed local and distance-learning students) at Charles Sturt University (A. Crampton, CSU, personal communication).
6. Report for public consumption. Food chemistry students at the University of South Australia (UniSA) created videos of themselves explaining a basic chemistry concept to a lay person (K. Pearce, UniSA, personal communication; Pearce, 2010). Science communication undergraduates at the UNSW have created websites for school students on topics such as the solar system (author, Rifkin).

> Thirty doctoral students at UNSW have created a website representing their research for potential sponsors from the business community (author, Rifkin).

When attempting to conceive of – or adopt – such options, what do lecturers see as challenges in assigning students to work in new media? We asked focus groups of lecturers from biology, chemistry and physics. The groups ranged from a half dozen across a range of disciplines to a collection of 30 physicists and a group of 30 biologists and chemists. The lecturers were asked to discuss in groups and then brainstorm together as a larger group what they saw as hurdles.

All 3 audiences identified as challenges the time and effort needed to learn how to use the technology as well as the time needed to create and mark assignments. Two of the three groups expressed concerns about how to assess the assignments, about equity in access to technology, about whether a one-off new media assignment scaffolds learning appropriately, and about the traditional trade-offs of group work versus individual work. The following topics were raised by just one focus group each: originality and copyright; showing work publicly versus keeping it private; assuring that the assignment is appropriate to the discipline; and addressing graduate attributes. These results are being echoed in preliminary analysis of in-depth interviews of 20 science academics and in a recent workshop of lecturers who pioneered in employing these new media assignments.

Audiences of science academics who are shown examples of student-created science videos have added a concern about mistakes in the scientific content of what is created. They voice a concern that misconceptions that are artfully presented will be adopted by fellow students. Some would argue that misconceptions that persist or propagate through a class are not the sole domain of new media. A typical final mark for a science subject is about 65%, which suggests that one in every three of the important concepts with which an average student leaves a class is wrong. Put another way, of the concepts that are sufficiently important to be on a quiz or examination, one in three is not correctly understood by students with an average mark. Furthermore, students who leave a final examination with one-third of their content knowledge being mistaken may not know which third it is. They typically do not receive feedback question-by-question, and post-exam reviews are almost unheard of.

It would be useful to have a debate about whether it makes sense to leave such misconceptions to the individual student to retain or propagate. Alternatively, should students make their understandings more public within a class so that misconceptions can be addressed? Bartle et al. (2011) found that students who made podcasts about acids and bases or oxidation and reduction made no mistakes in identifying these concepts in subsequent assessment. One could conclude that new media assignments ought to be peer reviewed in class for quality and accuracy of expression before being made more public. Such an assessment should ascertain whether the information is sufficiently accurate for use by the intended audience.

Despite reservations voiced by some science academics, others forge ahead. Our interviews and correspondence, as part of our ALTC project, suggest interest in

development of new media assignments among approximately 200 science lecturers in Australia. We have identified 30 lecturers who are already employing such assignments. The solitary practices of individual lecturers are now being shared more publicly, as we have gathered two dozen pioneers to share insights and effective practices. This move traces the lines of what Palmer (1992) suggests, where a range of individuals' inventions can lead to growth of a "movement." If a movement toward more use of new media assignments is growing, one wonders what challenges and opportunities the future holds.

FUTURE – EVALUATION, PLATFORMS, PARADIGM SHIFT

The educational impact of new media assignments needs to be assessed more carefully. Platforms for publishing student assignments for peer review within and across classes are needed. Also needed are means for making worthy student videos and wikis more visible publicly. As well, we are sensing a step-like barrier between having a lecturer create online materials for students, such as a podcast of a lecture, and having students create content for sharing within the class. There is a further step up to sharing that material beyond the realms of the class, something that science academics have shown a great reluctance to do. We will close this article by addressing each of these challenges briefly.

Measuring learning impact has not seemed to be the highest priority for the lecturers who have been pioneering use of new media assignments, we have found. They express a faith in the pedagogical soundness of what they are implementing. They report being buoyed by (1) the enthused engagement of even potentially marginal students, (2) the technical accuracy of students' content, (3) the general lack of condemnation of the new media exercises in student evaluations, (4) anecdotally positive impacts on learning (with definitive data still being gathered), and (5) occasional accolades from previously skeptical colleagues. One might call these factors elements in a "situated evaluation". A lecturer is assessing whether an approach works for their specific context, that it sufficiently addresses the multiple constraints that this one academic faces.

These lecturers seem to be assessing the new media approach against what might be called a "tin standard" (as opposed to a gold standard): content-heavy subjects; didactic lectures; cookbook laboratory exercises; and multiple-choice exams that count for a large proportion of the final mark. Pioneering new media lecturers, whom we have interviewed, have argued that such traditional approaches cause a proportion of students to disengage and resort to surface learning. One can also sense that such traditional approaches are not engaging these lecturers intellectually, whereas developing a new media approach does engage them.

Evaluation of educational impact that is supported by theory is being pursued by Hoban, Loughran and Nielsen (2011) in a search for more convincing measures of whether comprehension of scientific content is indeed improved. Hoban et al. (2011) argue that students learn in these new media production processes because they

need to revisit science content from several different perspectives. Students see these perspectives, respectively, through scripting, production, and evaluation of the impact of what they create (which, in Hoban's case, is a simple animation made through the Slowmation process). Production processes, such as scripting, require repeated reading of scientific material and a sufficiently thorough understanding to reproduce that conceptual understanding in simpler terms for a viewing audience. These various mechanisms for stimulating learning are also noted by an analysis of learning by school science students who have been assigned to represent concepts by drawing, with an overview recently published in the prestigious journal, *Science*, by Ainsworth et al. (2011).

The measurement of improvements in the mastery of oral and written communication, teamwork, critical thinking, and ethics is more problematic. There has been so little attention to these areas in the university science curriculum (McInnis, Hartley & Anderson, 2000; The Higher Education Academy UK Physical Sciences Centre, 2011) that baseline measurements are hard to define. That is, one is left comparing a concerted attempt to build the teamwork ability of science students to a conventional approach where students are allocated to groups for a project, provided with little or no instruction in how to manage them, and then not assessed specifically on their teamwork capability but only on the quality of their scientific report. This gap can be attributed to a lack of confidence and expertise among lecturers, who report that addressing graduate attributes tends to lie outside what they feel is their domain of expertise (Radloff et al., 2009).

Even if one accepts the "situated evaluation" of our pioneering lecturers – the conclusion that new media assignments have educational value – hurdles remain. Where does one publish student work? If students are asked to create a wiki, they can use a free provider, such as Wikispaces, as a platform. They can then share the URL of their submission with the lecturer, with other students, or more widely. If they create a video, students can upload it to You Tube, Vimeo, or a similar free site that translates their camera's (and editing program's) output into a common, readily viewed format. One can set the URL for a video as semi-private, meaning that it is not revealed by keyword searches on the web. Students can provide the URL to the lecturer for assessment or to peers for their viewing. Mechanisms for "publishing" podcasts and blogs are similar.

A challenge arises when one wants to share student work beyond a single class, as was done with WWDS. Lecturers may not want material that could contain mistakes in content shared widely (our argument to counter this concern notwithstanding). Furthermore, students are sometimes inclined to use images or music that falls under copyright strictures, and they can be seen to have too little experience, drive, or time management capacity to gain permission to share that publicly.

Experience in Rifkin's science communication classes has shown that students who create websites that simplify science for non-science audiences have tended to borrow images and video without obtaining copyright permission (though they often cite the source). Some student teams have suffered from having one or two students cut-and-paste slabs of text from existing websites (in one case, the

team wrote in their project report – apparently without irony – that their website served a need because no websites with such simple information existed). These transgressions were suspected after pasting a suspicious sentence into Google. A period of plagiarism amnesty followed, being instituted just before the final exam. If a team admitted that they had used material without copyright permission, their penalty would be reduced or eliminated. Interestingly, all [8] project teams in the class admitted to a real or possible infraction.

Plagiarism in terms of one student copying the work of another student has not been detected in the [180]-student Day in Science class, and the lecturer has read all student stories for several years. Such plagiarism could have included copying a story from a previous year. The apparent lack of compulsion to copy from other students can be attributed to giving students some creative leeway as well as the opportunity to personalise their work. That said, the prevalence of plagiarism among students should be monitored. The digital nature of students' submission could make such monitoring relatively easy, as in evaluating essays via submission to the *Turnitin* database.

For such practical and legal reasons, we have sought to create a special platform to contain student web publications. The platform would require password protection in order to attend to current copyright restrictions. The platform would also enable selecting which audiences can view student works. Password protection and mechanisms for permitting one specific audience or another to see what is on a web site require management. They would present time-poor lecturers with an additional load in administration. There is also the need for lecturers to learn how to use such a new technology.

The issues here involve a number of dimensions – evolving technology, changing copyright regulations, shifts in copyright practices, such as movements to Creative Commons approaches, and uneven adoption of copyright agreements among universities (e.g., some agreements cover nearly all universities in the US and the UK but only a small fraction in a country like Australia). There are also changing practices of students in their use of borrowed images and audio and evolving teaching practices at the school level that impact on what entering university students are expecting to do and to be accountable for. Despite these matters being in flux, one can conclude that it could be worthwhile for students to have greater awareness of copyright issues; for greater acceptance by artists, writers, and publishers of the value in creative commons approaches; and for the possible development of an education-only area of the web with looser copyright restrictions. Such a platform would also need to have a particularly easy mechanism for an academic to employ in drawing and re-drawing boundaries to specify the nature and breadth of viewing audiences. Simultaneously, it would be beneficial to provide a mechanism for applying "fair use" guidelines to student-created publications that serve an educational purpose.

At this point, one can see two central challenges – ([1]) a need for evaluation of the impact on learning of content and professional insights and ([2]) establishment of a suitable, online publication platform. An additional challenge involves convincing lecturers that having students create content for viewing by other students, and

potentially wider audiences, is a worthwhile endeavour for both student and audience. This notion of publishing the work of amateurs as an educational strategy has been accepted and used to great effect in the development of literacy among children and illiterate peasants. Having assignments that focus on concerns shared by the learner and community were championed by Paulo Freire (2007). Freire is known for developing programmes to teach peasants how to read by having them create newsletters on community issues. His programmes have proven highly effective in Brazil and Cuba, with the literacy rate in Cuba now at 90%, among the highest for countries with its modest level of economic development. Freire's approach is echoed in the *World-Wide Day in Science* and student-organised conferences. Have students collect, collate, compose, and present information for a real audience.

Yet, our focus groups and current interviews of potential adopters of new media assignments suggest an emphasis on lecturer-generated content – *PowerPoint* slides, recordings, videos, etc. This emphasis on what the lecturer creates differentiates potential early adopters whom we have identified from the pioneers. Even for the pioneers, student-created work tends not to count for a large proportion of a class's mark, with more traditional assessment tasks, final exams and laboratory reports predominating. The nature of this balance involves a range of factors – such as whether a subject is meant to embed knowledge of specific content for an ensuing subject or merely to provide an introduction and guidance to a field that a student might pursue in honours research. There are also questions about the extent to which the academic seeks to develop students' professional abilities in writing, teamwork, or ethics, for example. Even given such depth and complexity in considerations about the nature of assessment, it is easy to see that new media assignments offer a potential to shift the balance between student and lecturer as generators of information that can be shared within and beyond the class, and that presents a series of questions worth debating. These questions will not shrink in significance as the ease of publishing on the web increases, either for students or for the graduate professionals whom they will become.

One can conclude that the educational value of these types of assignments and their potential societal value need to be documented. The evidence that has been provided has not been sufficient to convince many lecturers to adopt web publication assignments. The few lecturers who are assigning students to publish online, anecdotal evidence suggests, tend to come from media studies, digital media design, marketing, and related fields. In science, we have identified only 30 pioneers among the 5,000 to 10,000 lecturers in science-based areas in Australia. Some would argue that the university sector should take a "wait and see" approach, delaying development of students' web publication capabilities until definitive studies have been completed. Others could argue just as strongly that today's students will soon become professionals who, as we noted early in this piece, are increasingly called on to represent themselves, their organisation, or their cause on the web. Those behind this latter argument could point to the fact that nearly every member of academic staff is currently represented professionally on the web. Many would acknowledge that most students are now visible on Facebook or similar platforms.

The web indeed has attractions, as it offers an extensive array of connections, much

like a spider's web. The academic has the opportunity to engage students with one another as well as with a range of stakeholders in the world outside the university. The web has stickiness, as well, when one considers addressing the concerns that each stakeholder has, as arose in the case where the *World-Wide Day in Science* involved school teachers, their students, and science-based professionals. Concerns are also expressed by lecturers with whom we have engaged, urging them to experiment with student web publication. Such caution may be the strongest argument for moving forward with new media assignments. That is, the potential complexities of such assignments are the very ones that we need to prepare our students to handle as professionals, areas that more traditional approaches to science teaching fail to address. Some could argue that web publishing capability should take its place among the more traditionally accepted "graduate attributes."[3]

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3 This conclusion is excerpted and adapted from the chapter cited earlier, "World-Wide What?"

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